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FEASIBILITY STUDY REPORT FOR OPERABLE UNIT 2, DRAFT AUGUST 1994 - VOLUME 4 OF 6

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FEASIBILITY STUDY REPORT FOR OPERABLE UNIT 2

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERNALD, OHIO

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

VOLUME 4 OF 6
APPENDICES B, C, AND D

AUGUST 1994

U.S. DEPARTMENT OF ENERGY
FERNALD FIELD OFFICE

000001 **DRAFT**

APPENDIX B

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs) AND TO BE CONSIDERED CRITERIA (TBCs)

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TABLE B-1
CHEMICAL-SPECIFIC REQUIREMENTS

Citation	Chemical	Requirement	Determination	Remarks
DRINKING WATER MAXIMUM CONTAMINANT LEVEL GOALS (MCLGs) AND MAXIMUM CONTAMINANT LEVELS (MCLs)				
EPA National Primary Drinking Water Regulations 40 CFR §141.15 and §141.16	MCLs for Radiological Contaminants	The following are maximum contaminant levels for radiological contaminants: Combined radium-226 and -228 . . . . . 5 pCi/L Gross alpha particle activity . . . . . 15 pCi/L (including radium-226 but excluding radon and uranium) Beta and photon radioactivity . . . . . 4 mrem/year from man-made radionuclides	Relevant and Appropriate	OEPA MCLs from OAC 3745-81-15 and -16 are the same as the Federal MCLs.
56 Federal Register 33050 (July 18, 1991)	Proposed MCLs for Radiological Contaminants	The following are the proposed maximum contaminant levels for radiological contaminants: Radium-226 . . . . . 20 pCi/L Radium-228 . . . . . 20 pCi/L Radon-222 . . . . . 300 pCi/L Uranium . . . . . 20 μg/L (30 pCi/L) Beta and photon emitters . . . . . 4 mrem ede/year (excluding radium-228) Adjusted gross alpha emitters . . . . . 15 pCi/L (excluding radium-226, uranium, and radon-222)	TBC	
EPA National Primary Drinking Water Regulations 40 CFR §141.61	MCLs for Organic Contaminants	The following are the maximum contaminant levels for organic contaminants: Benzo(a)pyrene . . . . . 0.0002 mg/L Polychlorinated biphenyls (PCBs) . . . . . 0.0005 mg/L	Relevant and Appropriate	Final MCLs are not presented for contaminants for which the non-zero MCLG is less than or equal to the MCL.
EPA National Primary Drinking Water Regulations 40 CFR §141.51	MCLGs for Inorganic Contaminants	The following are the non-zero maximum contaminant level goals for inorganic contaminants: Antimony . . . . . 0.006 mg/L Beryllium . . . . . 0.004 mg/L	Relevant and Appropriate	

TABLE B-1
(Continued)

Citation	Chemical	Requirement	Determination	Remarks
DRINKING WATER MAXIMUM CONTAMINANT LEVEL GOALS (MCLGs) AND MAXIMUM CONTAMINANT LEVELS (MCLs) (continued)				
50 Federal Register 46936 (November 13, 1985)	Proposed MCLGs for Inorganic Contaminants	The following are proposed, non-zero, maximum contaminant level goals for inorganic contaminants: Arsenic . . . . . 0.05 mg/L	TBC	
Ohio Drinking Water Regulations OAC 3745-81-11	MCLs for Inorganic Contaminants	The following are the maximum contaminant levels for inorganic contaminants: Arsenic . . . . . 0.05 mg/L	Relevant and Appropriate	Final MCLs are not presented for contaminants for which the non-zero MCLG is less than or equal to the MCL. This MCL is a stricter state standard.
OHIO WATER QUALITY STANDARDS				
Ohio Water Quality Standards OAC 3745-1-21	Use Designation	Paddys Run and the Great Miami River are designated as: • warmwater aquatic life habitat • agricultural and industrial water supply • primary contact recreational use	Applicable	In addition to these overall designations: • Ross Rd. (River Mile (RM) 95.7) to Taylorsville Dam (RM 92.6) is a state resource water • RM 130 and RM 118 are public water supplies The FEMP effluent discharge pipe is located at RM 24.73, downstream of the state resource waters and public water supplies.
Ohio Water Quality Standards OAC 3745-1-07	Warmwater Habitat Water Quality Criteria	Parameter (µg/L) — outside mixing zone Max. / Avg. — inside mixing zone Max. Antimony (total) 650 190 1,300 Arsenic 360 190 720 Beryllium (total) 520 23 1,000	Applicable	Beryllium is based on a water hardness of 100 mg/L calcium carbonate ($CaCO_3$).

TABLE B-1
(Continued)

Citation	Chemical	Requirement	Determination	Remarks
OHIO WATER QUALITY STANDARDS (continued)				
Ohio Water Quality Standards OAC 3745-1-07 (continued)	Warmwater Habitat Water Quality Criteria	Parameter (µg/L) — outside mixing zone Max. / outside mixing zone Avg. / inside mixing zone Max. Dieldrin - 0.005 - Polychlorinated Biphenyls (PCBs) - 0.001 -	Applicable	
Ohio Water Quality Standards OAC 3745-1-07	Human Health and Agricultural Water Supply Criteria	Parameter (µg/L) — Human Health (outside mixing zone) / Agri-cultural Antimony (total) 780 - Arsenic - 100 Beryllium (total) 1.17 100 Dieldrin 0.00076 - Polychlorinated Biphenyls (PCBs). 0.00079 - Polynuclear Aromatic Hyrdrocarbons (PAHs) 0.31 -	Applicable	
RADIATION DOSE LIMITS				
Radioactive Waste Management DOE Order 5820.2A Chapter III (3)(a)(2)	Protection of the General Population from Releases of Radioactivity	Concentrations of radioactive material which may be released to the general environment in surface water, ground water, soil, plants or animals must not result in an effective dose equivalent that exceeds 25 mrems per year to any member of the public. Reasonable effort should be made to maintain releases of radioactivity in effluents to the general environment as low as is reasonably achievable.	TBC	

TABLE B-1
(Continued)

Citation	Chemical	Requirement	Determination	Remarks
		RADIATION DOSE LIMITS (continued)		
Radiation Protection of the Public and the Environment DOE Order 5400.5 Chapter II (1)(a)	Public Dose Limits	The exposure of members of the public to radiation sources as a consequence of all routine DOE activities shall not cause, in a year, an effective dose equivalent greater than 100 mrem. Dose evaluations should reflect realistic exposure conditions. Specific authorization may be received for a temporary increase of the dose limit up to 500 mrem in a year.	TBC	
Radiation Protection of the Public and the Environment DOE Order 5400.5 Chapter II (1)	Public Dose Limits	The public dose limits include consideration of all exposure modes from all DOE activities (including remedial activities). Effective dose equivalent is the sum of the effective dose equivalent (weighted summation of doses to various organs of the body) from exposures to radiation sources external to the body during the year plus the committed effective dose equivalent from radionuclides taken into the body during the year. Medical sources, consumer products, residual fallout from past nuclear accidents and weapons tests and naturally occurring radiation sources are not included in this summation.	TBC	
National Emission Standards for Hazardous Air Pollutants 40 CFR §61.92, 61.93 Subpart H [Radiation Protection of the Public and the Environment DOE Order 5400.5 Chapter II (1)(b)]	National Emissions Standards for Emissions of Radionuclides Other than Radon from DOE Facilities	Emissions of radionuclides (except radon-220 and radon-222) to the ambient air from Department of Energy facilities shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 mrem/yr. To determine compliance with the standard, radionuclide emissions shall be determined and effective dose equivalent values to members of the public calculated using EPA approved sampling procedures, computer models CAP-88 or AIRDOS-PC, or other procedures for which EPA has granted prior approval.	Applicable	
Radiation Protection of the Public and the Environment DOE Order 5400.5 Chapter II (3)(a)(5)	Interim Dose Limit for Native Aquatic Animal Organisms	The absorbed dose to native aquatic animal organisms shall not exceed 1 rad per day from exposure to the radioactive material in liquid wastes discharged to natural waterways.	TBC	

TABLE B-1
(Continued)

Citation	Chemical	Requirement	Determination	Remarks
		RADIATION DOSE LIMITS (continued)		
Radiation Protection of the Public and the Environment DOE Order 5400.5 Chapter IV (4)(c)	External Gamma Radiation	External gamma radiation levels on open lands shall comply with the basic public dose limit of 100 mrem effective dose equivalent in a year and the ALARA process, considering appropriate-use scenarios for the area.	TBC	
		EFFLUENT AND AIR EMISSION STANDARDS		
Radiation Protection of the Public and the Environment DOE Order 5400.5 Chapter II (1)(d)	Drinking Water System Standards	It is DOE policy to provide a level of protection for persons consuming water from a public drinking water supply operated by the DOE, either directly or through a DOE contractor, that is equivalent to that provided to the public by the public community drinking water standards of 40 CFR Part 141 (listed above). These systems shall not cause persons consuming the water to receive an effective dose equivalent greater than 4 mrem in a year. Combined Ra-226 and Ra-228 shall not exceed $5x10^{-9}$ μCi/mL and gross alpha activity (excluding radon and uranium) shall not exceed $1.5x10^{-8}$ μCi/mL. The liquid effluents from DOE activities shall not cause private or public drinking water systems downstream of the facility discharge to exceed the drinking water radiological limits in 40 CFR Part 141 (listed above).	TBC	
Radiation Protection of the Public and the Environment DOE Order 5400.5 Chapter III	Derived Concentration Guides for Air and Water	The derived concentration guides (DCGs) are provided as reference values for conducting radiological environmental protection programs at operational DOE facilities and sites. DCG values are presented in Figures III-1 and III-3 of DOE Order 5400.5 for the following exposure modes: • ingestion of water • inhalation of air • immersion in a gaseous cloud	TBC	

TABLE B-1
(Continued)

Citation	Chemical	Requirement	Determination	Remarks
		EFFLUENT AND AIR EMISSION STANDARDS (continued)		
Radiation Protection of the Public and the Environment DOE Order 5400.5 Chapter III (continued)	Derived Concentration Guides for Air and Water	The DCG values for internal exposure are based on a committed effective dose equivalent of 100 mrem for the radionuclide taken into the body by ingestion or inhalation during one year. The DCG values account for only three exposure pathways (ingested water or inhaled air or air immersion) and do not include other potentially significant pathways. When more complex environmental pathways are involved, a more complete pathway analysis is required for calculating public radiation doses resulting from the operation of DOE facilities.	TBC	
Radiation Protection of the Public and the Environment DOE Order 5400.5 Chapter II (3)(a)	Discharges of Liquid Waste to Surface Waters	The best available technology is the prescribed level of treatment for liquid radioactive discharges to surface waters that would otherwise contain radioactive concentrations greater than the DCG values. Implementation of the best available technology process is not required for waste streams that contain radionuclide concentrations of not more than the DCG values at the point of discharge to a surface waterway. The DCG for waste streams containing more than one type of radionuclide shall be the sum of the fractional DCG values.	TBC	
Radiation Protection of the Public and the Environment DOE Order 5400.5 Chapter II (3)(a)(4)	Prevention of Radionuclide Buildup in Sediments	Liquid process waste streams containing radioactive material in the solid present in the waste stream must not exceed 5 pCi/g above background level of settleable solids for alpha-emitting radionuclides or 50 pCi/g above background of settleable solids for beta-gamma-emitting radionuclides.	TBC	

TABLE B-1
(Continued)

Citation	Chemical	Requirement	Determination	Remarks
		EFFLUENT AND AIR EMISSION STANDARDS (continued)		
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings 40 CFR §192.02 (b) Subpart A 40 CFR §192.32 (b)(1)(ii) Subpart D Radiation Protection of the Public and the Environment DOE Order 5400.5 Chapter IV (6)(d)	Control of Radon Emissions	The following standards apply to the: • control of residual radioactive materials from inactive uranium processing sites. • management of uranium byproduct materials after closure of a disposal area. • long-term management of uranium, thorium, and their decay products. Controls shall be designed to provide reasonable assurance that releases of radon-222 from the above materials to the atmosphere will not: • exceed an average annual release rate of 20 pCi/m^{2}s • increase the annual average concentration of radon-222 in air or above any location outside the disposal site by more than 0.5 pCi/L.	Relevant and Appropriate	
Radiation Protection of the Public and the Environment DOE Order 5400.5 Chapter IV (6)(b)	Interim Storage of Residual Radioactive Material	Control and stabilization features of an interim storage facility for residual radioactive material shall be designed such that radon-222 concentrations in the atmosphere above the facility, in addition to background levels, will not exceed: • 100 pCi/L at any given point • an annual average concentration of 30 pCi/L over the facility area • an annual average concentration of 3 pCi/L at or above any location outside the facility area • flux rates from the storage of radon producing wastes shall not exceed 20 pCi/m^{2}s	TBC	

TABLE B-1
(Continued)

Citation	Chemical	Requirement	Determination	Remarks
EFFLUENT AND AIR EMISSION STANDARDS (continued)				
National Primary and Secondary Ambient Air Quality Standards 40 CFR §50	National Ambient Air Quality Standards	The following are the primary National Ambient Air Quality Standards (NAAQS): Criteria Pollutant / Primary Standard / Averaging Time Carbon Monoxide: 9 ppm, 8-hour; 35 ppm, 1-hour Lead: 1.5 $\mu g/m^3$, Quarterly average Nitrogen Dioxide: 0.053 ppm, Annual Particulate Matter: 50 $\mu g/m^3$, Annual; 150 $\mu g/m^3$, 24-hour Ozone: 0.12 ppm, 1-hour Sulfur oxides: 0.03 ppm, Annual; 0.14 ppm, 24-hour	Relevant and Appropriate	
Review of New Sources of Air Toxic Emissions OEPA Proposed Policy January 1994	De Minimis Emission Levels for Carcinogens	The following are the Ohio de minimis emission levels for classes A, B1, and B2 carcinogens: Carcinogen / EPA Class / Emission Level Chromium VI: A, 0.1 ton/year All Others: A, B1, B2, 1.0 ton/year	TBC	
Ohio Particulate Matter Standards OAC 3745-17-11	Restrictions on Particulate Emissions	The following are restrictions for particulates from any operation, process, or activity which releases or may release particulate emissions into the ambient air. These limits are based on the weight of material being processed.	Applicable	

TABLE B-1
(Continued)

Citation	Chemical	Requirement	Determination	Remarks
EFFLUENT AND AIR EMISSION STANDARDS (continued)				
Ohio Particulate Matter Standards OAC 3745-17-11 (continued)	Restrictions on Particulate Emissions	Process Weight at Maximum Capacity lb/hr. / Allowable Rate of Particulate Emission lb/hr. 100 / 0.551 200 / 0.877 400 / 1.40 600 / 1.83 800 / 2.22 1000 / 2.58	Applicable	
RADIONUCLIDE CONCENTRATIONS IN SOILS				
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings 40 CFR §192.12(a) Subpart B 40 CFR §192.20 Subpart C	Cleanup of Soils Contaminated with Residual Radioactive Materials	Remedial actions shall be conducted so as to provide reasonable assurance that, as a result of residual radioactive materials, the concentration of radium-226 in land averaged over any area of 100 m^2 shall not exceed the background level by more than: • 5 pCi/g, averaged over the first 15 cm of soil below the surface • 15 pCi/g, averaged over 15 cm thick layers of soil more than 15 cm below the surface Compliance with this requirement should be shown through measurements performed within the accuracy of currently available types of field and laboratory instruments in conjunction with reasonable survey and sampling procedures.	Relevant and Appropriate	
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings 40 CFR §192.21 (f) and §192.22 (b) Subpart C	Supplemental Standards	Where radionuclides other than radium-226 and its decay product are present in sufficient quantity and concentration to constitute a significant radiation hazard from residual radioactive materials, remedial actions shall, in addition to satisfying the standards of 40 CFR §§ 192.02, Subpart A and 192.12, Subpart B (both listed above), reduce other residual radioactivity to levels that are as low as is reasonably achievable.	Relevant and Appropriate	

TABLE B-1
(Continued)

Citation	Chemical	Requirement	Determination	Remarks
		RADIONUCLIDE CONCENTRATIONS IN SOILS (continued)		
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings 40 CFR §192.32 (b)(2) Subpart D	Management of Uranium Byproduct Material	The requirements for the management of uranium byproduct materials after closure of a disposal area (40 CFR §192.32 (b)(1)) shall not apply to any portion of a disposal site which contains a concentration of radium-226 in land, averaged over areas of $100m^2$, which, as a result of uranium byproduct material, does not exceed the background level by more than the limits specified in 40 CFR §192.12 (a).	Relevant and Appropriate	
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings 40 CFR §§ 192.40-192.42 Subpart E	Management of Thorium Byproduct Material	The following are requirements for the management of thorium byproduct materials: • the provisions for the management of uranium byproduct material (40 CFR §192.32) shall apply to thorium byproduct material and: - provisions applicable to the element uranium shall also apply to the element thorium - provisions applicable to radon-222 shall also apply to radon-220 - provisions applicable to radium-226 shall also apply to radium-228 With the concurrence of EPA, alternative provisions may be substituted for any of the above requirements provided the alternative provisions will provide at least an equivalent level of protection for human health and environment.	Relevant and Appropriate	
Radiation Protection of the Public and the Environment DOE Order 5400.5 Chapter IV (4)(a)	Guidelines for Residual Radioactive Material	Guidelines for residual concentrations of radionuclides other than thorium and radium shall be derived from the basic dose limits by means of an environmental pathway analysis using specific property data where available. Procedures for these derivations are given in DOE/CH-8901. Residual concentrations of radioactive material in soil are defined as those in excess of background concentrations averaged over an area of $100\ m^2$.	TBC	

TABLE B-1
(Continued)

Citation	Chemical	Requirement	Determination	Remarks
		RADIONUCLIDE CONCENTRATIONS IN SOILS (continued)		
Radiation Protection of the Public and the Environment DOE Order 5400.5 Chapter IV (4)(a)(2),(3)	Generic Guidelines for Residual Concentrations	The generic guidelines for residual concentrations (in excess of background) of radium-226, radium-228, thorium-230, and thorium-232 are: • 5 pCi/g, averaged over the first 15 cm of soil below the surface; and • 15 pCi/g, averaged over 15-cm-thick layers of soil more than 15 cm below the surface. These guidelines take into account ingrowth of radium-226 from thorium-230 and of radium-228 from thorium-232, and assume secular equilibrium. If both thorium-230 and radium-226, or both thorium-232 and radium-228, are present and not in secular equilibrium, the appropriate guideline is applied as a limit for the radionuclide with the higher concentration. If other mixtures of radionuclides occur, the concentrations of individual radionuclides shall be reduced so that either the dose for the mixture will not exceed the basic dose limit or the sum of the ratios of the soil concentration of each radionuclide to the allowable limit for that radionuclide will not exceed 1. Explicit formulas for calculating residual concentrations guidelines for mixtures are given in DOE/CH-8901.	TBC	
Radiation Protection of the Public and the Environment DOE Order 5400.5 Chapter IV (4)(a)(1)	Hot Spots	If the average concentration in any surface or below surface area less than or equal to 25 m^2, exceeds the limit or guideline by a factor of $(100/A)^{0.5}$ [where A is the area (in square meters) of the region in which the concentrations are elevated], limits for "hot spots" shall also be developed and applied. Procedures for calculating these hot spots limits, which depend on the extent of the elevated local concentrations, are given in DOE/CH-8901. In addition, reasonable efforts shall be made to remove any source of radionuclide that exceeds 30 times the appropriate limit in the soil, irrespective of the average concentration in the soil.	TBC	

TABLE B-1
(Continued)

Citation	Chemical	Requirement	Determination	Remarks
RADIONUCLIDE CONCENTRATIONS IN SOILS (continued)				
EPA Guidance Methods for Evaluating the Attainment of Cleanup Standards, Vol. 1	Attainment of Soil Cleanup Standards	This document describes methods for testing whether soil chemical concentrations at a site are statistically below a cleanup standard or ARAR. If it can be reasonably concluded that the remaining soil or treated soil at a site has concentrations that are statistically less than relevant cleanup standards then the site can be judged protective of human health and the environment.	TBC	
LEAD SOIL CLEANUP STANDARDS				
Resource Conservation and Recovery Act 40 CFR §268.41	Requirements for Lead Cleanup	The maximum concentration of lead in the extract of any sample of treated soil is 5 mg/L.	Relevant and Appropriate	
PCB SOIL CLEANUP STANDARDS				
PCB Manufacturing, Processing, Distribution, and Use Prohibitions 40 CFR §761.125 (c)(4)(v)	Requirements for PCB Cleanup	Soil contaminated by a PCB spill in non-restricted access areas will be decontaminated to 10 ppm PCBs by weight, provided that the soil is excavated to a minimum depth of 10 inches. The excavated soil will be replaced with clean soil, i.e. containing less than 1 ppm PCBs, and the spill site will be restored (e.g. replacement of turf).	Relevant and Appropriate	The source of PCBs in Operable Unit 2 is unknown.

TABLE B-2
SOLID WASTE ACTION-SPECIFIC REQUIREMENTS

Citation	Action	Requirement	Determination	Remarks
		DEFINITIONS		
Resource, Conservation, and Recovery Act 42 U.S.C. §6903 (27)	Definition	Solid waste means any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations and from community activities, but does not include source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-01 (UU)	Definition	Solid wastes means such unwanted residual solid or semisolid material as results from industrial, commercial, agricultural, and community operations, excluding earth or material from construction, mining, or demolition operations, or other waste materials of the type that would normally be included in demolition debris, nontoxic flyash, spent nontoxic foundry sand, and slag and other substances that are not harmful or inimical to public health, and includes, but is not limited to, garbage, tires, combustible and noncombustible material, street dirt, and debris. Solid waste does not include any material that is an infectious waste or a hazardous waste. For the purpose of this definition, "semisolid material" does not contain liquids which can be readily released under normal climatic conditions, as determined by method 9095 (paint filter liquids test) in SW-846: "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods".	Applicable	
Resource, Conservation, and Recovery Act 40 CFR §261.3(a)	Definition	A solid waste is a hazardous waste, if: • it is not excluded from regulation as a hazardous waste under 40 CFR §261.4(b). • it exhibits any of the characteristics of hazardous waste. • it is listed in 40 CFR §§ 261.30 - 261.35. • it is a mixture of solid and hazardous wastes.	Applicable	

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TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
		DEFINITIONS (continued)		
Ohio Solid Waste Disposal Regulations OAC 3745-27-03 (H)(2)	Definition	Chapters 3745-27 (Ohio Solid Waste Disposal Regulations) and 3745-37 (Ohio Hazardous Waste Management Regulations) do not apply to lime sludge disposal or storage. Lime sludge is defined as a material resulting from the treatment of a water supply for drinking or industrial purposes.	Applicable	
Ohio Infectious Waste Regulations OAC 3745-27-01 (V) OAC 3745-27-30 (A),(E),(H) ORC 3734.021 (A)(1)(c),(d)	Definition	Infectious waste is defined by 9 categories of waste including human blood specimens and blood products, sharp wastes used in the treatment or inoculation of human beings, and any other waste materials generated in the diagnosis, treatment, or immunization of human beings. A generator who places all sharp infectious wastes and all unused hypodermic needles, syringes, and scalpel blades into a "SHARPS" container before they are transported and who generates less than 50 lbs. of infectious wastes each month and does not hold a certificate of registration as a generator of infectious wastes may transport and dispose of infectious wastes in the same manner as solid wastes. Treated infectious wastes can be transported and disposed in the same manner as noninfectious waste. Infectious waste that is also radioactive shall be managed in accordance with applicable Ohio Department of Health and U.S. Nuclear Regulatory Commission regulations.	Applicable	
Resource, Conservation, and Recovery Act 40 CFR §261.4(b)(4)	Definition	Flyash waste, bottom ash waste, slag waste, and fly gas emission control waste, generated primarily from the combustion of coal or other fossil fuels, are excluded from the definition of hazardous waste.	Applicable	

TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
		DEFINITIONS (continued)		
55 Federal Register 30797, Section by Section Analysis, B.3. (July 27, 1990)	Definition	EPA has decided that firing range areas should not be considered solid waste management units. Unexploded ordinance fired during target practice is not discarded material which falls within the regulatory definition of "solid waste". Ordnance that does not explode, as well as fragments of exploded ordnance, would be expected to land on the ground. Hence, the "ordinary use" of ordinance includes placement on land.	TBC	According to this rule, the lead bullets in the soil embankment of the South Field Firing Range are not considered solid waste. EPA stated this position earlier in a September 6, 1988 memo from S. K. Lowrance which explained that discarded bullets are not considered solid waste. Because hazardous waste is a subset of solid waste, according to the Federal definition in RCRA, the discarded bullets also cannot be considered hazardous waste.
Ohio Petroleum Contaminated Soil Policy OEPA Policy PP 01 03 200	Definition	The basis of the "contained in" policy is that environmental media, such as soil or groundwater, are not considered to be waste material. Because they are not a solid waste, the mixture rule, as set forth in OAC 3745-51-03, does not apply when they become contaminated with a listed hazardous waste but only contains the waste. The result of this policy is that if the waste constituents can be removed, the soil is no longer considered to contain a hazardous waste. Therefore, since soil is not a waste material it does not have to be de-listed in order for it to be used for its intended purpose. However, as long as the soil contains the waste material, it must be managed as a hazardous waste. If we apply this concept to petroleum-contaminated soil, the soils containing a petroleum hydrocarbon would not need to be managed as a solid waste if the contaminants were removed.	TBC	

TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
		DEFINITIONS (continued)		
Proposed Ohio Construction Debris Regulations OAC 3745-29-01 OAC 3745-29-08 (B)(1), (2),(4)	Definition	Construction and demolition debris means those materials resulting from the alteration, construction, destruction, rehabilitation, or repair of any manmade physical structure, including, without limitation, houses, buildings, industrial or commercial facilities, or roadways. Construction or demolition debris does not include reinforced or non reinforced concrete, asphalt, building or paving brick, or building or paving stone that is stored for a period of less than two years for recycling into a usable construction material. Construction debris disposal facilities that existed prior to the issuance of this rule are not required to install a recompacted soil liner or a leachate management system. Disposal facilities that have reached final elevations and no additional disposal will occur after the issuance date of this rule are not required to construct a cap system.	TBC	
CERCLA Compliance with Other Laws Manual Section 2.7	Definition	Placement/disposal of waste does not occur under the following circumstances: • waste is consolidated within a unit (including an area of contamination that can be viewed as a single unit); • waste is capped in place, including grading prior to capping; • waste is treated in situ; and • waste is processed within the unit in order to improve its structural stability for closure or for movement of equipment over the area.	TBC	

TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
		DEFINITIONS (continued)		
Resource, Conservation, and Recovery Act 40 CFR §260.10	Definition	Remediation waste means all solid and hazardous waste, and all media (including groundwater, surface water, soils, and sediments) and debris, which contain listed hazardous wastes or which themselves exhibit a hazardous waste characteristic, that are managed for the purpose of implementing corrective action requirements under 40 CFR §264.101 and RCRA section 3008(h). For a given facility, remediation wastes may originate only from within the facility boundary, but may include waste managed in implementing RCRA sections 3004(v) or 3008 (h) for releases beyond the facility boundary.	Relevant and Appropriate	
Resource, Conservation, and Recovery Act 40 CFR §264.552 (a),(c)	Definition	For the purpose of implementing corrective action for solid waste management units, the Regional Administrator may designate an area at the facility as a corrective action management unit (CAMU). One or more CAMU's may be designated at a facility. • Placement of remediation wastes into or within a CAMU does not constitute land disposal of hazardous wastes. • Consolidation or placement of remediation wastes into or within a CAMU does not constitute creation of a unit subject to minimum technology requirements. • The CAMU shall facilitate the implementation of reliable, effective, protective, and cost-effective remedies. • Waste management activities associated with the CAMU shall not create unacceptable risks to humans or to the environment resulting from exposure to wastes. • The CAMU shall include uncontaminated areas of the facility only if including such areas for the purpose of managing remediation waste is more protective than management of such wastes at contaminated areas of the facility.	Relevant and Appropriate	Under all of the remedial alternatives, any hazardous waste from the firing range is being sent off-site for disposal. This CAMU rule would only be used if Operable Unit 5 plans to dispose hazardous waste in a centralized disposal cell; the cell would then have to be designed to meet RCRA standards and it would not be cost-effective to send the firing range material off-site for disposal. Because this is dependent on Operable Unit 5, the RCRA disposal requirements will be addressed in Operable Unit 5 ARARs.

TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
		DEFINITIONS (continued)		
Resource, Conservation, and Recovery Act 40 CFR §264.552 (a),(c) (continued)	Definition	• Areas within the CAMU, where wastes remain in place after closure of the CAMU, shall be managed and contained so as to minimize future releases, to the extent practicable. • The CAMU shall expedite the timing of remedial activity implementation, when appropriate and applicable. • The CAMU shall enable the use, when appropriate, of treatment technologies (including innovative technologies) to enhance the long-term effectiveness of remedial actions by reducing the toxicity, mobility, or volume of wastes that will remain in place after closure of the CAMU. • The CAMU shall, to the extent practicable, minimize the land area of the facility upon which wastes will remain in place after closure of the CAMU.	Relevant and Appropriate	
Resource, Conservation, and Recovery Act 40 CFR §264.553 (a),(b)	Definition	For temporary tanks and container storage areas used for treatment or storage of remediation wastes during remedial activities, the Regional Administrator may determine that a design, operating, or closure standard applicable to such units may be replaced by alternative requirements which are protective of human health and the environment. Any temporary unit to which alternative requirements are applied shall be: • located within the facility boundary; and • used solely for treatment or storage of remediation wastes.	Relevant and Appropriate	
		SOLID WASTE DISPOSAL		
Ohio Solid Waste Disposal Regulations OAC 3745-27-05 (A)	Solid Waste Disposal Methods	Solid waste shall be disposed of only by the following methods: • sanitary landfill	Applicable	

TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
		SOLID WASTE DISPOSAL (continued)		
Ohio Solid Waste Disposal Regulations OAC 3745-27-05 (A) (continued)	Solid Waste Disposal Methods	• incineration • composting Methods not mentioned above and not prohibited by this chapter, OAC 3745-27, may be used provided that such methods are demonstrated to the satisfaction of the Director to be capable of disposing of solid waste without creating a nuisance or a health hazard, without causing water pollution, and without violating these regulations and any regulation adopted by the Director pursuant to Ohio Revised Code Chapter 3704 (Air Pollution Control).	Applicable	
US EPA Solid Waste Disposal Regulations 40 CFR §257.3-7	Open Burning Prohibited	The solid waste disposal facility or practice shall not engage in open burning of residential, commercial, institutional, or industrial solid waste. This requirement does not apply to land-clearing debris, diseased trees, debris from emergency clean-up operations, and ordnance.	Applicable	
US EPA Solid Waste Disposal Regulations 40 CFR §257.3-3	Surface Water	A solid waste disposal facility shall not cause a discharge of pollutants into waters of the United States that is in violation of the requirements of the NPDES under section 402 of the Clean Water Act, as amended. A solid waste disposal facility shall not cause a discharge of dredged material or fill material to waters of the United States that is in violation of the requirements under section 404 of the Clean Water Act, as amended. A solid waste disposal facility or practice shall not cause non-point source pollution of waters of the United States that violates applicable legal requirements implementing an area-wide or Statewide water quality management plan that has been approved by the Administrator under section 208 of the Clean Water Act, as amended.	Applicable	
US EPA Solid Waste Disposal Regulations 40 CFR §257.3-4	Groundwater Protection	A solid waste disposal facility or practice shall not contaminate an underground drinking water source beyond the solid waste boundary.	Applicable	

TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
		SOLID WASTE DISPOSAL (continued)		
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (C)(1),(2),(3),(4),(5),(6),(7),(9)	Landfill Construction	The following layers must be installed in the construction of a sanitary landfill (from bottom to top): Recompacted Soil Liner The recompacted soil liner shall be: • constructed using loose lifts 8 inches thick with a maximum permeability of 1 x 10^{-7} cm/s. • constructed of a soil with a maximum clod size of 3 inches or half the lift thickness, whichever is less. • constructed of soil with: - 100% of the particles having a maximum dimension not greater than 2 inches. - not more than 10% of the particles, by volume, having a dimension greater than 0.75 inches. - not less than 50% of the particles, by weight, passing through the 200-mesh sieve. - not less than 25% of the particles, by weight, having a maximum dimension not greater than 0.002 millimeters. • compacted to at least 95% of the maximum "Standard Proctor Density" using ASTM D-698 or at least 90% of the maximum "Modified Proctor Density" using ASTM D-1557. • compacted at a moisture content at or wet of optimum. Alternatives for the above requirements may be used if it is demonstrated to the satisfaction of the Director that the materials and techniques will result in each lift having a maximum permeability of 1 x 10^{-7} cm/s. Additionally, the recompacted soil liner shall:	Applicable	This applies to new disposal of solid waste.

TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
		SOLID WASTE DISPOSAL (continued)		
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (C)(1),(2),(3),(4),(5),(6),(7),(9) (continued)	Landfill Construction	• not comprised of solid waste. • be constructed using the same number of passes and lift thickness, and the same or similar type and weight of compaction equipment established by testing (as defined in this table). • be placed on the bottom and exterior excavated sides of the landfill and have a minimum bottom slope of 2% and a maximum slope based on: - compaction equipment limitations; - slope stability; - maximum friction angle between any soil-geosynthetic interface and between any geosynthetic-geosynthetic interface; and - resistance of geosynthetics and geosynthetic seams to tensile forces. • constructed on a prepared surface that shall: - be free of debris, foreign material, and deleterious material; - be able to bear the weight of the landfill and its construction operations without causing or allowing a failure of the liner to occur through settling; and - not have any abrupt changes in grade that may result in damage to geosynthetics. • be 5 feet thick, although the Director may approve an alternate thickness, to be no less than 3 feet, based upon the result of calculations or on a design that is no less protective of human health and the environment. • have a factor of safety for hydrostatic uplift not less than 1.4.	Applicable	

TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
		SOLID WASTE DISPOSAL (continued)		
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (C)(1),(2),(3),(4),(5),(6),(7),(9) (continued)	Landfill Construction	• be adequately protected from damage due to desiccation, freeze/thaw cycles, wet/dry cycles, and the intrusion of objects during construction and operation.	Applicable	
		Geomembrane		
		The geomembrane shall be: • placed on the recompacted soil liner. • negligibly permeable to fluid migration. • physically and chemically resistant to chemical attack by the solid waste, leachate, or other materials which may come in contact with the geomembrane. • seamed to allow no more than negligible amounts of leakage with seaming material that is physically and chemically resistant to chemical attack by the solid waste, leachate, or other materials which may come in contact with the seams. • have properties for its installation and use which are acceptable to the Director. • protected from the drainage layer by a cushion layer, as required by the Director.		
		Leachate Management System		
		The leachate management system shall: • be designed to prevent clogging and crushing of the system and to limit the level of leachate in areas other than lift stations to a maximum of 1 foot.		

TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
		SOLID WASTE DISPOSAL (continued)		
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (C)(1),(2),(3),(4),(5),(6),(7),(9) (continued)	Landfill Construction	• include a drainage layer placed on top of the geomembrane composed of granular material that must: - have a minimum permeability of 1×10^{-3} cm/s; - have a minimum thickness of 1 foot; - have a negligible amount of fines; and - not contain carbonate material. An alternate material and/or thickness may be used if it is demonstrated to the satisfaction of the Director that the material meets the requirements. • include leachate collection pipes to remove leachate from the bottom of the landfill. The pipes must: - be imbedded in the drainage layer; - have a minimum slope of 0.5%; - have lengths and configuration which shall not exceed the capabilities of clean-out devices; - be provided with access for clean-out devices which shall be protected from differential settling; - have joints sealed to prevent separation; and - be physically and chemically resistant to attack by the solid waste, leachate, or other materials that they may come in contact with. Sealing material and means of access for clean-out devices shall also be physically and chemically resistant to attack by the solid waste, leachate, or other materials that they may come in contact with. An alternate means for leachate removal may be used if it is demonstrated to the satisfaction of the Director that the means for leachate removal meets the requirements.	Applicable	

TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
		SOLID WASTE DISPOSAL (continued)		
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (C)(1),(2),(3),(4),(5),(6),(7),(9) (continued)	Landfill Construction	• include a filter layer to prevent clogging of the leachate collection system, as required by the Director. • include a protective layer to protect the recompacted soil liner, geomembrane, and leachate collection system from the intrusion of objects during construction and operation. • include lift stations which are to be protected from adverse effects from leachate and differential settling. If manholes are used as lift stations, they must be equipped with automatic high level alarms located no greater than 6 feet above the invert of the leachate inlet pipe. Lift station pipes should be of adequate capacity and shall automatically commence pumping before the leachate elevation activates the high level alarm.	Applicable	
		Leachate Collection and Storage		
		Collected leachate shall be managed in one of the following ways: • treated and disposed on site at the sanitary landfill facility; • treated on site and disposed off site of the sanitary landfill facility; or • treated and disposed off site of the sanitary landfill facility. Any leachate conveyance and storage structures located outside the limits of solid waste placement shall be no less protective of the environment than the landfill, as determined by the Director, and: • The structures must be monitored, as required by the Director. • Storage tanks must be provided with spill containment		

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TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
		SOLID WASTE DISPOSAL (continued)		
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (C)(1),(2),(3),(4),(5),(6),(7),(9) (continued)	Landfill Construction	• Leachate lines must be double-cased • Storage structures must have a minimum of 1 week of storage capacity using design assumptions simulating final closure. • If at any time leachate is evaluated to be hazardous in accordance with rule 3745-52-11 of the OAC, it shall be managed in accordance with Chapters 3745-50 to 3745-69 of the OAC, and the generator standards for storage shall apply in accordance with Chapter 3745-52 of the OAC.	Applicable	
		Surface Water Control		
		• Any permanent surface water control structures shall be designed to accommodate, by non-mechanical means, the peak flow from the 100-year/24-hour storm event. • Any temporary surface water control structures shall be designed to accommodate the peak flow from the 25-year/ 24-hour storm event. • Surface water control structures shall be designed to minimize silting and scouring. • If sedimentation ponds are used, they shall be designed and constructed according to OAC 3745-27-08 (C)(6)(d).		
		Benchmarks		
		• At least 3 permanent third order benchmarks on separate sides of the landfill shall be in easy access to the limits of solid waste placement. • The benchmarks shall have a stability class of A or B and be referenced horizontally and vertically to the National Geodetic Reference System.		

TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
		SOLID WASTE DISPOSAL (continued)		
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (C)(1),(2),(3),(4),(5),(6),(7),(9) (continued)	Landfill Construction	Groundwater Control • Any permanent groundwater control structures shall adequately control groundwater infiltration through the use of non-mechanical means such as impermeable barriers or permeable drainage structures. • No permanent groundwater control structures may be used to dewater an aquifer system.	Applicable	
EPA Criteria for Municipal Solid Waste Landfills 40 CFR §258.40	Landfill Design Criteria	The liner and leachate system shall be designed and constructed to maintain less than a 30-cm depth of leachate over the liner. The geomembrane must be at least 30-mil thick.	Relevant and Appropriate	
EPA Criteria for Municipal Solid Waste Landfills 40 CFR §258.26	Run-On/Run-Off Control Systems	The landfill shall have: • a run-on control system to prevent flow onto the active portion of the landfill during the peak discharge from a 25-year storm. • a run-off control system from the active portion of the landfill to collect and control at least the water volume resulting from a 24-hour, 25-year storm.	Relevant and Appropriate	
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (D) and (E)	Landfill Construction	Prior to being used in the construction of the recompacted soil liner and drainage layer of the sanitary landfill or the landfill cap, the following characteristics of the earthen materials must be determined to show that the material is suitable for use in construction of the landfill.	Applicable	

TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
		SOLID WASTE DISPOSAL (continued)		
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (D) and (E) (continued)	Landfill Construction		Applicable	
		Soil Material Specifications		
		The following tests shall be performed on representative samples at least once for every 1,500 yd^3 of soil except the recompacted permeability test, which shall be performed at least once for every 10,000 yd^3 of soil. • recompacted permeability at construction specifications; • moisture content and density using an approved ASTM method; • grain size distribution using ASTM D-422 for sieve and hydrometer methods; and • Atterberg limits using ASTM D-423 and D-424 methods.		
		Granular Drainage Material Specifications		
		The following tests shall be performed at least once for every 3,000 yd^3 of material. • permeability; • grain size distribution using ASTM D-422 for the sieve method; and • chemical compatibility testing may be required by the Director.		
		Geosynthetic Material Specifications		
		Geosynthetics, other synthetic materials, and joint sealing compounds used in the construction of a sanitary landfill facility or a sanitary landfill cap system shall be shown to:		

TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
		SOLID WASTE DISPOSAL (continued)		
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (D) and (E) (continued)	Landfill Construction	• be physically and chemically resistant to attack by the solid waste, leachate, or other materials that they may come in contact with using USEPA Method 9090 or other documented data. • have properties acceptable for installation and use.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (F)(1), (3),(4)	Landfill Construction	The following activities must be performed to ensure that the components of the sanitary landfill facility meet the specifications of this rule.	Applicable	
		Test Pads		
		The recompacted soil liner and the recompacted soil barrier layer in the cap system shall be modeled by the construction of test pads. The test pads shall: • be designed such that the proposed tests are appropriate and their results are valid. • be constructed to establish the construction details which are necessary to obtain sufficient compaction to satisfy the permeability requirement. The construction details include: - lift thickness; - water content necessary to achieve the desired compaction; and - type, weight, and number of passes of construction equipment. • be constructed prior to the construction of the sanitary landfill component which the test pad will model. • be constructed whenever there is a significant change in soil material properties.		

TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
		SOLID WASTE DISPOSAL (continued)		
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (F)(1), (3),(4) (continued)	Landfill Construction	• have a minimum width three times the width of the compaction equipment, and a minimum length two times the length of compaction equipment, including power equipment and any attachments. • be comprised of at least four lifts. • be tested for field permeability, following the completion of test pad construction. For each lift a minimum of 3 tests for moisture content and density shall be performed. • be reconstructed as many times as necessary to meet the permeability requirement. Any amended construction details shall be noted. An alternative to test pads may be used if it is demonstrated to the satisfaction of the Director that the alternative meets the requirements.	Applicable	
		Moisture Content and Density Testing		
		Moisture content and density testing of the recompacted soil liner and recompacted soil barrier in the cap system shall be performed at a frequency of no less than 5 tests per acre per lift. Any penetrations shall be repaired using methods acceptable to the Director.		
		Geomembrane Testing		
		• For the purpose of testing every seaming apparatus in use each day, peel and shear tests shall be performed on scrap pieces of geomembrane at the beginning of the seaming period and every four hours thereafter. • Nondestructive testing shall be performed on 100% of the geomembrane seams.		

TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
		SOLID WASTE DISPOSAL (continued)		
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (F)(1), (3),(4) (continued)	Landfill Construction	• Destructive testing for peel and shear shall be performed at least once for every 500 feet of seam length. An alternate means may be used if it is demonstrated to the satisfaction of the Director that the alternate means meets the requirements.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (G)	Landfill Construction	All tests failing to meet the specifications outlined above must be investigated and the areas reconstructed to meet specifications.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (H)	Landfill Construction	A Quality Assurance/Quality Control Plan for construction shall include: • sampling and testing procedures to be used in the field and in the laboratory; • testing frequency; • parameters and sample locations; • procedures to be followed if a test fails; • the management structure and the experience and training of the testing personnel; and • contingency plan for anticipated construction difficulties. The Quality Assurance/Quality Control Plan shall certify the design and construction of any of the following items which are incorporated into the landfill design: • in-situ foundation preparation; • liner system; • geomembrane; • leachate management system; • cap system; • permanent ground water control structures; and	Applicable	

TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
		SOLID WASTE DISPOSAL (continued)		
Ohio Solid Waste Disposal Regulations OAC 3745-27-08 (H) (continued)	Landfill Construction	• explosive gas control/extraction systems.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-09 (H)	Sanitary Landfill Operation	To demonstrate that the solid wastes to be received at the landfill facility will not compromise the integrity of any material used to construct the landfill facility, the Director may require chemical compatibility testing to be performed.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-09 (N)(1), (2)	Sanitary Landfill Operations	Surface water shall be diverted from areas where solid waste is being, or has been, deposited. The facility shall be properly graded and provided with additional drainage facilities as necessary to ensure minimal infiltration of water through the cover material and cap system, and minimal erosion of the cover material and cap system. If ponding or erosion occurs, action will be taken to correct the conditions causing the ponding or erosion.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-09 (O)	Sanitary Landfill Operations	If leachate is detected on the surface of the landfill facility, then the outbreak(s) shall be repaired and: • leachate shall be contained and properly managed at the sanitary landfill facility. • if necessary, leachate shall be collected and disposed in accordance with paragraph (C)(4) of rule 3745-27-08 of the OAC. • actions shall be taken to minimize, control, or eliminate the conditions which contribute to the production of leachate.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-09 (P)	Sanitary Landfill Operations	If the facility utilizes pumps for leachate removal, at least one lift station back-up pump shall be kept at the sanitary waste landfill facility at all times.	Applicable	

TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
		SOLID WASTE DISPOSAL (continued)		
Ohio Solid Waste Disposal Regulations OAC 3745-27-09 (Q)	Sanitary Landfill Operations	The collection pipe network of the leachate management system shall be inspected after placement of the initial lift of waste to ensure that crushing has not occurred and shall be inspected annually thereafter to determine that clogging has not occurred.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-09 (R)	Sanitary Landfill Operations	If deemed acceptable by the Director, leachate may be temporarily stored within the limits of solid waste placement until the leachate can be treated and disposed.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-10	Groundwater Monitoring Program	All new sanitary landfill facilities and all sanitary landfill facilities undergoing closure shall implement a program capable of determining the impact of the landfill facility on the quality of groundwater occurring within the uppermost aquifer system and all significant zones of saturation above the uppermost aquifer system underlying the landfill facility. The groundwater monitoring system shall collect samples that represent the quality of groundwater that has not been affected by past or present operations and the groundwater passing directly downgradient of the limits of solid waste placement.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-10 (continued)	Groundwater Monitoring Program	If contamination from the landfill is discovered, corrective action shall be taken.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-11 (B)	Final Closure of Landfill Facilities	Closure of the sanitary landfill facility must be completed in a manner that minimizes the need for further maintenance and minimizes post-closure formation and release of leachate and explosive gases to air, soil, groundwater, or surface water to the extent necessary to protect human health and the environment.	Applicable	

TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
		SOLID WASTE DISPOSAL (continued)		
Ohio Solid Waste Disposal Regulations OAC 3745-27-11 (G)(1), (2)	Construction of a Landfill Cap System	A cap system which shall minimize infiltration, must be constructed in all areas of solid waste placement: • The cap system shall have a minimum slope of 5% and a maximum slope of 25% or some alternate slope based on stability analyses. • The cap system shall have a maximum projected erosion rate of 5 tons/acre/year. • Any penetrations into the cap system shall be sealed so that the integrity of the soil barrier layer is maintained. The cap system shall, at a minimum, consist of the following (from bottom to top):	Applicable	
		Recompacted Soil Barrier Layer		
		The recompacted soil barrier layer of the cap shall be: • a minimum of 2 feet thick. • constructed in accordance with the specifications outlined above for construction of the recompacted soil liner for a landfill facility ((C)(1)(a) to (C)(1)(e) of OAC 3745-27-08) and modeled by the construction of a test pad.		
		Granular Drainage Layer		
		The granular drainage layer shall be: • a minimum of 1 foot thick.		

TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
		SOLID WASTE DISPOSAL (continued)		
Ohio Solid Waste Disposal Regulations OAC 3745-27-11 (G)(1), (2) (continued)	Construction of a Landfill Cap System	• constructed on top of the recompacted soil barrier layer in accordance with the specifications outlined above for the drainage layer included in the leachate management system of a sanitary landfill facility ((C)(3)(a) of 3745-27-08 of the OAC).	Applicable	
		Soil Vegetative Layer		
		The soil vegetative layer shall: • consist of soil and vegetation placed on top of the granular drainage layer. • have soil of sufficient thickness and fertility to support its vegetation and to protect the underlying layer from damage due to root penetration and frost. • healthy grasses or other vegetation shall form a complete and dense vegetative cover.		
		Surface Water Control		
		• Land surfaces shall be graded to prevent ponding of water where solid waste has been placed. • Drainage facilities shall be provided to direct surface water from the sanitary waste landfill facility.		
Ohio Solid Waste Disposal Regulations OAC 3745-27-11 (G)(5)(b)	Final Closure of Landfill Facilities	A notation must be recorded on the deed to the sanitary landfill facility property, or on some other instrument which is normally examined during title search, that will in perpetuity notify any potential purchaser of the property that the land has been used as a sanitary landfill facility. The notation shall include information describing acreage, exact location, depth, volume, and nature of the solid waste deposited in the sanitary landfill facility.	Applicable	

TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
		SOLID WASTE DISPOSAL (continued)		
Ohio Solid Waste Disposal Regulations OAC 3745-27-14 (A)(1), (2)	Sanitary Landfill Post-Closure Care	Following completion of final closure activities in accordance with rule 3745-27-11 of the OAC, post-closure care activities shall be conducted at the sanitary landfill facility for a minimum of 30 years. Post-closure care activities for all sanitary landfill facilities shall include, but are not limited to: • continuing operation and maintenance of the leachate management system, the surface water management system, any explosive gas extraction and/or control system, any explosive gas monitoring system, and the groundwater monitoring system • maintaining the integrity and effectiveness of the cap system, including making repairs to the cap system as necessary to correct the effects of settling, dead vegetation, subsidence, erosion, or other events, and preventing run-on and run-off from eroding or otherwise damaging the cap system	Applicable	
EPA Criteria for Municipal Solid Waste Landfills 40 CFR §258.61	Post-Closure Care	The Director of Ohio EPA may allow the owner or operator to stop managing leachate if the owner or operator demonstrates that leachate no longer poses a threat to human health and the environment.	Relevant and Appropriate	
		INFECTIOUS WASTE MANAGEMENT		
Ohio Solid and Hazardous Waste Regulations ORC 3734.03	Open Burning or Dumping	No person shall dispose of treated or untreated infectious wastes by open burning or open dumping.	Applicable	
Ohio Infectious Waste Regulations OAC 3745-27-34 (B) and (C)	Packaging of Infectious Wastes	Sharps shall be packaged in a "SHARPS" container that is rigid, puncture resistant, leak resistant, and closed tightly. The container shall be labeled "SHARPS" and, if the waste has not been treated, with the international biohazard symbol.	Applicable	

TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
INFECTIOUS WASTE MANAGEMENT (continued)				
Ohio Infectious Waste Regulations OAC 3745-27-34 (B) and (C) (continued)	Packaging of Infectious Wastes	Containers holding infectious wastes shall not be dropped, managed, or transferred in such a manner as to cause damage to the bag or container. Infectious wastes shall not be transferred through the use of chutes.	Applicable	
Ohio Infectious Waste Regulations OAC 3745-27-31 OAC 3745-27-33 Ohio Solid and Hazardous Waste Regulations ORC 3734.021 (A)(2), (B),(D) ORC 3734.022	Transportation of Infectious Waste	Any person who transports infectious wastes off the premises where they were generated must follow the requirements outlined in these rules.	Applicable	
POLYCHLORINATED BIPHENYL (PCB) DISPOSAL				
PCB Manufacturing, Processing, Distribution, and Use Prohibitions 40 CFR §761.3	Excluded PCB Materials	PCB materials which appear at concentrations less than 50 ppm are excluded from the following PCB disposal requirements.	Relevant and Appropriate	
PCB Manufacturing, Processing, Distribution, and Use Prohibitions 40 CFR §761.60 (a)(3)	Liquid PCB Disposal Requirements	Liquids, other than mineral oil dielectric fluid, containing a PCB concentration of 50 ppm or greater, but less than 500 ppm, shall be disposed of: • in an incinerator which complies with 40 CFR §761.70 • in a chemical waste landfill which complies with 40 CFR §761.75 if information is provided to the owner or operator of the landfill that shows that the waste does not exceed 500 ppm PCB and is not an ignitable waste • in a high efficiency boiler provided that the requirements of this section are met • in a facility that is approved in accordance with 40 CFR §761.60(e)	Relevant and Appropriate	

TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
POLYCHLORINATED BIPHENYL (PCB) DISPOSAL (continued)				
PCB Manufacturing, Processing, Distribution, and Use Prohibitions 40 CFR §761.60 (a)(4)	Non-Liquid PCB Disposal Requirements	Any non-liquid PCBs at concentrations of 50 ppm or greater in the form of contaminated soil, rags, or other debris shall be disposed of: • in an incinerator which complies with §761.70, or • in a chemical waste landfill which complies with §761.75.	Relevant and Appropriate	
ASBESTOS MANAGEMENT AND DISPOSAL				
Ohio Asbestos Handling Regulations OAC 3745-20-05 (C)	Asbestos Packaging	Each owner or operator of any demolition or renovation operation to whom this rule applies shall seal all friable asbestos-containing waste material into durable leak-tight disposal containers or use an approved alternative disposal system in accordance with the following: • Asbestos containing waste materials shall be sealed in plastic bags having a thickness of at least 0.006 inches (6 mils). A second clean, leak-tight plastic bag having a thickness of at least 6 mils shall fully contain the first bag • Whenever necessary to prevent any asbestos-containing waste material from penetrating a container, the materials shall be sealed into a combination of a 6 mil plastic bag and a leak-tight steel, plastic, or fiber drum, or reinforced disposal box, leak-tight polypropylene woven fabric bag, or similar suitable and durable container. Drums shall be fitted with a matching lid and lock-rims and boxes shall be banded and sealed with reinforced tape or in accordance with manufacturers' recommendations. • Facility components coated with, covered or containing friable asbestos materials and removed in units or sections shall be sealed with at least 0.012 inched (12 mils) of leak-tight plastic or at least 0.010 inches (10 mils) of leak-tight polypropylene woven fabric.	Applicable	

TABLE B-2
(Continued)

Citation	Action	Requirement	Determination	Remarks
		ASBESTOS MANAGEMENT AND DISPOSAL (continued)		
Ohio Asbestos Handling Regulations OAC 3745-20-05 (C) (continued)	Asbestos Packaging	• Asbestos containing waste materials, facility components, and contaminated debris may be disposed of using an alternate disposal system which has received the prior written approval of the Director.	Applicable	
National Emission Standard for Asbestos 40 CFR §61.151 (a) Ohio Asbestos Handling Regulations OAC 3745-20-07 (A),(C)	Inactive Asbestos Waste Disposal Sites	Each owner or operator of an inactive asbestos waste disposal site shall do one of the following: • discharge no visible emissions from an inactive waste disposal site; • cover the asbestos-containing waste material with at least 6 inches of compacted nonasbestos-containing material and grow and maintain a cover of vegetation on the area adequate to prevent exposure of the asbestos-containing waste material; or	Federal Relevant and Appropriate, Ohio Applicable	The Federal requirement is relevant and appropriate because it specifically applies to a type of facility that is not found in Operable Unit 2. The Ohio requirement is generally applicable to any inactive asbestos waste disposal site.
National Emission Standard for Asbestos 40 CFR §61.151 (a) Ohio Asbestos Handling Regulations OAC 3745-20-07 (A),(C) (continued)	Inactive Asbestos Waste Disposal Sites	• cover the asbestos-containing waste material with at least 2 feet of compacted nonasbestos-containing material, and maintain the cover to prevent exposure of the asbestos-containing waste material. The owner or operator may use an alternative control method that has received prior approval of the Administrator.	Federal Relevant and Appropriate, Ohio Applicable	

TABLE B-3
RADIOLOGICAL ACTION-SPECIFIC REQUIREMENTS

Citation	Action	Requirement	Determination	Remarks
		DEFINITIONS		
Atomic Energy Act 42 U.S.C. §2014 (e)(2), (ee) Nuclear Waste Policy Act 42 U.S.C. §10101 (12), (16),(23)	Definition	The term low-level waste means radioactive material that is not: • high-level radioactive waste, the highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations. • spent nuclear fuel, fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing. • transuranic waste, material contaminated with elements that have an atomic number greater than 92, including neptunium, plutonium, americium, and curium, and that are in concentrations greater than 10 nanocuries per gram. • byproduct material, the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content.	Applicable	
Radiation Protection of the Public and the Environment DOE Order 5400.5 Chapter IV	Definition	Residual radioactive material is defined as: • residual concentrations of radionuclides in soil (soil is defined as unconsolidated earth material, including rubble and debris that might be present in the earth material); • concentrations of airborne radon decay products; • external gamma radiation; • surface contamination; and • radionuclide concentrations in air or water resulting from, or associated with, any of the above.	TBC	

TABLE B-3
(Continued)

Citation	Action	Requirement	Determination	Remarks
		DEFINITIONS (continued)		
Radioactive Waste Management DOE Order 5820.2A Chapter III (3)(i)(6) Attachment 2 (1)	Definition	Radioactive material that is below regulatory concern is a definable amount of low-level waste that can be deregulated with minimal risk to the public. Waste containing amounts of radionuclides below regulatory concern, as defined by Federal regulations, may be disposed without regard to radioactivity content.	TBC	
		DOE ALARA POLICY		
Radiation Protection of the Public and the Environment DOE Order 5400.5 Chapter I (4) and Chapter II (2)	As Low As Reasonably Achievable (ALARA) Process	The order adopts the ALARA process in planning and carrying out all DOE activities. ALARA requires judgement with respect to what is reasonably achievable. Factors that relate to societal, technological, economic, and other public policy considerations shall be evaluated to the extent practicable. Factors to be considered, at a minimum, shall include: • maximum dose to members of the public; • collective dose to the population; • alternative processes, such as alternative treatment of discharge streams, operating methods, or controls; • doses for each process alternative; • cost for each of the technological alternatives; • examination of the changes in cost among alternatives; and • changes in societal impact associated with process alternatives (e.g., differential doses from various pathways).	TBC	

TABLE B-3
(Continued)

Citation	Action	Requirement	Determination	Remarks
		DOE ALARA POLICY (continued)		
Radiation Protection of the Public and the Environment DOE Order 5400.5 Chapter I (4) and Chapter II (2) (continued)	As Low As Reasonably Achievable (ALARA) Process	Except for meeting requirements of NEPA, qualitative analyses are acceptable, in most instances, for ALARA judgements, especially when the potential doses are well below the dose limit. The bases for these judgements should be documented. More detailed analyses should be considered if the decision might result in doses that approach the limit.	TBC	
		GENERAL RADIOACTIVE MATERIALS DISPOSAL REQUIREMENTS		
Radiation Protection of the Public and the Environment DOE Order 5400. 5 Chapter II (3)(b)	Discharges of Liquid Waste to Aquifers and Phaseout of Soil Columns	New or increased discharges of radionuclides in liquid waste to active soil columns and virgin soil columns is prohibited.	TBC	
		MANAGEMENT OF LOW-LEVEL RADIOACTIVE WASTE		
Radioactive Waste Management DOE Order 5820.2A Chapter III (3)(a)	Performance Objectives of Low-Level Radioactive Waste Management	DOE low-level radioactive waste shall be managed to accomplish the following performance objectives: • protection of public health and safety; • protection of the public and the environment from releases of radioactivity (see chemical-specific requirements for radioactive dose limitations); and • protection of groundwater resources, consistent with Federal, State, and local requirements.	TBC	
Radioactive Waste Management DOE Order 5820.2A Chapter III (3)(c)	Low-Level Radioactive Waste Generation	Technical and administrative controls shall be directed to reducing the gross volume of waste generated and/or the amount of radioactivity requiring disposal. Waste reduction efforts shall include consideration of process modification, process optimization, materials substitution, and decontamination.	TBC	

TABLE B-3
(Continued)

Citation	Action	Requirement	Determination	Remarks
		MANAGEMENT OF LOW-LEVEL RADIOACTIVE WASTE (continued)		
Radioactive Waste Management DOE Order 5820.2A Chapter III (3)(c) (continued)	Low-Level Radioactive Waste Generation	All DOE low-level waste generators shall establish auditable programs to assure that the amount of low-level waste generated and/or shipped for disposal is minimized. Each DOE low-level waste generator shall separate uncontaminated waste from low-level waste to facilitate cost effective treatment and disposal. Each DOE low-level waste generator preparing a design for a new process or process change shall incorporate principles into the design that will minimize the generation of low-level waste.	TBC	
Radioactive Waste Management DOE Order 5820.2A Chapter III (3)(d)	Waste Characterization	Low-level waste shall be characterized with sufficient accuracy to permit proper segregation, treatment, storage, and disposal. This characterization shall ensure that, upon generation after processing, the actual physical and chemical characteristics and major radionuclide content are recorded and known during all stages of the waste management process. Waste characterization data shall be recorded on a waste manifest and shall include: • the physical and chemical characteristics of the waste; • volume of the waste (total of waste and any solidification or absorbent media); • weight of the waste (total of waste and any solidification or absorbent media); • major radionuclides and their concentrations; and • packaging date, package weight, and external volume.	TBC	

TABLE B-3
(Continued)

Citation	Action	Requirement	Determination	Remarks
MANAGEMENT OF LOW-LEVEL RADIOACTIVE WASTE (continued)				
Radioactive Waste Management DOE Order 5820.2A Chapter III (3)(f)	Waste Treatment	Waste shall be treated by appropriate methods so that the disposal site can meet the performance objectives stated above. Waste treatment techniques such as incineration, shredding, and compaction to reduce volume and provide more stable waste forms shall be implemented as necessary to meet performance requirements. Use of waste treatment techniques to increase the life of the disposal facility and improve long-term facility performance, by improved site stability and reduction of infiltrating water, is required to the extent it is cost effective. The development of large scale waste treatment facilities shall be supported by the appropriate National Environmental Policy Act documentation. Operation of waste treatment facilities shall be supported by adequate documentation.	TBC	
Radioactive Waste Management DOE Order 5820.2A Chapter III (3)(g)	Waste Shipment	The volume of waste and number of shipments of low-level wastes shall be minimized and the shipments will be conducted based on plans developed by field organizations. Generators shall provide an annual forecast in the third quarter of the fiscal year to the field organizations managing the off-site disposal facility to which the waste is to be shipped. Generators must receive advance approval from the receiving facility and shall certify prior to shipment that waste meets the receiving facility waste acceptance criteria. The certification program shall be auditable and able to withstand independent review.	TBC	
Radioactive Waste Management DOE Order 5820.2A Chapter III (3)(i)(1)-(6)	Waste Disposal	Low-level waste shall be disposed of by methods appropriate to achieve the performance objectives stated in paragraph 3a (listed above), consistent with the radiation dose limits in paragraph 3b (see chemical-specific requirements).	TBC	

TABLE B-3
(Continued)

Citation	Action	Requirement	Determination	Remarks
MANAGEMENT OF LOW-LEVEL RADIOACTIVE WASTE (continued)				
Radioactive Waste Management DOE Order 5820.2A Chapter III (3)(i)(1)-(6) (continued)	Waste Disposal	Engineered modifications (stabilization, packaging, burial depth, barriers) for specific waste types and for specific waste compositions for each disposal site shall be developed to achieve the performance objectives. Site specific waste classification limits may be developed if operationally useful in determining how specific wastes should be stabilized and packaged for disposal. Disposition of waste designated as greater than class C, as defined in 10 CFR §61.55, must be handled as a special case. Disposal systems for such waste must be justified by a specific performance assessment through the NEPA process and with the concurrence of DOE headquarters. The following are additional disposal requirements intended either to improve stability of the disposal site or to facilitate handling and provide protection of the health and safety of personnel at the disposal site: • Waste must not be packaged for disposal in cardboard or fiberboard boxes, unless such boxes meet DOT requirements and contain stabilized waste with a minimum of void space. For all types of containers, void spaces within the waste and between the waste and its packaging shall be reduced as much as practical. • Liquid wastes, or wastes containing free liquid, must be converted into a form that contains as little freestanding and noncorrosive liquid as is reasonable achievable, but, in no case, shall the liquid exceed 1 percent of the volume of the waste when the waste is in a disposal container, or 0.5 percent of the volume of the waste processed to a stable form. • Waste must not be readily capable of detonation or of explosive decomposition or reaction at normal pressures and temperatures, or of explosive reaction with water.	TBC	

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TABLE B-3
(Continued)

Citation	Action	Requirement	Determination	Remarks
MANAGEMENT OF LOW-LEVEL RADIOACTIVE WASTE (continued)				
Radioactive Waste Management DOE Order 5820.2A Chapter III (3)(i)(1)-(6) (continued)	Waste Disposal	• Waste must not contain, or be capable of generating quantities of toxic gases, vapors, or fumes harmful to persons transporting, handling, or disposing of the waste. This does not apply to radioactive gaseous waste packaged as identified in the next requirement. • Waste in a gaseous form must be packaged at a pressure that does not exceed 1.5 atmospheres at 20°C. • Waste must not be pyrophoric. Pyrophoric materials contained in waste shall be treated, prepared, and packaged to be nonflammable.	TBC	
Radioactive Waste Management DOE Order 5820.2A Chapter III (3)(i)(8)	Disposal Facility and Disposal Site Design	Design criteria shall be established prior to selection of new disposal facilities, new disposal sites, or both. These design criteria shall be based on analyses of physiographic, environmental, and hydrogeological data to assure that the policy and requirements of this Order can be met. The criteria shall be also based on assessments of projected waste volumes, waste characteristics, and facility and disposal site performance. Disposal units will be designed consistent with disposal site hydrology, geology, and waste characteristics and in accordance with NEPA.	TBC	
Radioactive Waste Management DOE Order 5820.2A Chapter III (3)(i)(9)	Disposal Facility Operations	Operating procedures for low-level waste disposal facilities shall be developed so that they: • protect the environment, health and safety of the public, and facility personnel; • ensure the security of the facility; • minimize the need for long-term control; and • meet the requirements of the closure/post-closure plan. Permanent identification markers for disposal excavations and monitoring wells shall be emplaced.	TBC	

TABLE B-3
(Continued)

Citation	Action	Requirement	Determination	Remarks
MANAGEMENT OF LOW-LEVEL RADIOACTIVE WASTE (continued)				
Radioactive Waste Management DOE Order 5820.2A Chapter III (3)(i)(9) (continued)	Disposal Facility Operations	Operating procedures shall include training for disposal facility operating personnel, emergency response plans, and a system of reporting unusual occurrences to DOE. Waste placement into disposal units should minimize voids between containers. Operations are to be conducted so that active waste disposal operations will not have an adverse effect on filled disposal units.	TBC	
Radioactive Waste Management DOE Order 5820.2A Chapter III (3)(j)	Disposal Site Closure/Post Closure	Site-specific comprehensive closure plans shall be developed for new and existing operating low-level waste disposal sites. The plan shall address closure of disposal sites within a 5-year period after each is filled and shall conform to the requirements of the NEPA process. Performance objectives for existing disposal sites shall be developed on a case-by-case basis as part of the NEPA process. During closure and post closure, residual radioactivity levels for surface soils shall comply with existing DOE decommissioning guidelines. Corrective measures shall be applied to new disposal sites or individual disposal units if conditions occur or are forecasted that could jeopardize attainment of the performance objectives of this Order. Inactive disposal facilities, disposal sites, and disposal units shall be managed in conformance with RCRA, CERCLA, and the Superfund Amendments and Reauthorization Act (SARA). Closure plans for new and existing operating low-level waste disposal facilities shall be reviewed and approved by the appropriate field organization.	TBC	

TABLE B-3
(Continued)

Citation	Action	Requirement	Determination	Remarks
MANAGEMENT OF LOW-LEVEL RADIOACTIVE WASTE (continued)				
Radioactive Waste Management DOE Order 5820.2A Chapter III (3)(j) (continued)	Disposal Site Closure/Post Closure	Termination of monitoring and maintenance activity at closed facilities or sites shall be based on an analysis of site performance at the end of the institutional control period.	TBC	
Radioactive Waste Management DOE Order 5820.2A Chapter III (3)(k)	Environmental Monitoring	Each low-level waste treatment, storage, and disposal facility shall be monitored by an environmental monitoring program that, at a minimum, meets the following requirements: • The program shall be designed to measure: - operational effluent releases; - migration of radionuclides; - disposal unit subsidence; and - change in disposal facility and disposal site parameters which may affect long-term site performance. • Based on the characteristics of the facility being monitored, the program may include, but not necessarily be limited to, monitoring surface soil, air, surface water, and, in the subsurface, soil and water, both in the saturated and the unsaturated zones. • The monitoring program shall be capable of detecting changing trends in performance sufficiently in advance to allow application of any necessary corrective action prior to exceeding performance objectives. The monitoring program shall be able to ascertain whether or not effluents from each treatment, storage, or disposal facility or disposal site meet the requirements of applicable EH Orders.	TBC	

TABLE B-3
(Continued)

Citation	Action	Requirement	Determination	Remarks
		LOW-LEVEL RADIOACTIVE WASTE CONFINEMENT		
General Design Criteria DOE Order 6430.1A 1323-5.3	Low-Level Radioactive Liquid Waste Confinement	The following shall be applicable to the low-level radioactive liquid waste confinement system: • A dike or berm around the process shall provide secondary confinement. • A tertiary confinement system is not required. • Process and waste storage vessel shall be vented through appropriate treatment systems that control the release of radioactive material in gaseous effluents. • Retention basins shall comply with DOE 5400.1 and shall be lined, fenced, and posted with appropriate radiation warning signs. A system for monitoring radionuclide migration from the basin shall be available. • An impervious berm or dike shall be capable of retaining the maximum radioactive liquid waste inventory that may be releases by a leak or failure of a primary confinement vessel. A capability shall exist to transfer waste that has leaked into the secondary confinement.	TBC	
General Design Criteria DOE Order 6430.1A 1324-5.3	Low-Level Solid Waste Confinement	Low-level solid waste that is disposed to the ground shall be confined by a site-specific system of barriers that may include, but not necessarily be limited to, waste form, waste packaging, and the geologic setting. When site permeability characteristics do not provide the required confinement capabilities, the confinement system shall be augmented by the following: • constructing low permeability walls around the low-level waste; • lining the walls and bottom of the excavated area with low permeability material; and • other suitable methods for reducing permeability.	TBC	

TABLE B-3
(Continued)

Citation	Action	Requirement	Determination	Remarks
		LOW-LEVEL RADIOACTIVE WASTE CONFINEMENT (continued)		
General Design Criteria DOE Order 6430.1A 1324-5.3 (continued)	Low-Level Solid Waste Confinement	Means shall be provided to minimize contact of emplaced low-level waste with water. Active water control measures shall not be required following permanent closure. Typical requirements for water control are as follows: • placing a layer of highly permeable material beneath the low-level waste to channel any percolating water to a sump; • mounding the soil surface to facilitate surface water runoff; • use of a suitable low-permeability cover material (e.g., clay) over the disposal area to prevent contact of the waste by infiltrating rainwater. This cover material shall be protected by a layer of overburden (e.g., sand, gravel, top soil). • a site diversion system for surface water runoff during operation of the facility; • temporary protective covers (e.g., tarpaulin) before the completion of the natural in-place soil barrier over the low-level waste; • revegetation of the overburden layer; and • other suitable and reliable means for minimizing water contact with low-level waste.	TBC	
General Design Criteria DOE Order 6430.1A 1324-6	Radioactive Solid Waste Confinement Systems	The following requirements outline the confinement system for radioactive solid waste: • Primary confinement consists of process systems equipment and its associated ventilation and off-gas system, storage containers, or other waste and site-specific engineered barriers.	TBC	

TABLE B-3
(Continued)

Citation	Action	Requirement	Determination	Remarks
LOW-LEVEL RADIOACTIVE WASTE CONFINEMENT (continued)				
General Design Criteria DOE Order 6430.1A 1324-6 (continued)	Radioactive Solid Waste Confinement Systems	• Secondary confinement consists of process cell barriers and the ventilation systems associated with the cells or building, or a large storage building or structure. In some cases, a drum, cask, or other waste and site-specific engineered barrier shall provide secondary confinement. • The natural geologic setting composes the tertiary confinement system. In addition, the tertiary confinement system shall meet the following performance objectives: • Following permanent closure, on-going site maintenance shall not be needed. • In the absence of unplanned natural processes or human contact with a low-level waste disposal facility, calculated contaminant levels in groundwater at the site boundary shall not exceed the maximum contaminant levels (MCLs) established pursuant to the Safe Drinking Water Act (see chemical-specific requirements). • In the event of human-induced activities following permanent closure, or reasonably foreseeable but unplanned natural processes, the guidelines of DOE Order 6430.1A, Section 1300-1.4.2, Accidental Releases, shall not be violated. Institutional controls may be relied on for a limited time following closure. For the purposes of calculation, these controls shall not be relied on for more than 100 years following permanent closure.	TBC	

TABLE B-3
(Continued)

Citation	Action	Requirement	Determination	Remarks
CONTROL OF URANIUM AND THORIUM BYPRODUCT MATERIAL				
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings 40 CFR §192.02 (a) Subpart A	Control of Residual Radioactive Materials	Controls of residual radioactive materials from inactive uranium processing sites shall be designed to be effective for up to 1,000 years, to the extent reasonably achievable, and in any case, for at least 200 years.	Relevant and Appropriate	
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings 40 CFR §192.20 Subpart C	Implementation	Reasonable assurance to show compliance with 40 CFR §192.02 (Subpart A) standards should be done through the use of analytical models and site-specific analyses.	Relevant and Appropriate	
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings 40 CFR §192.32 (b)(1)(i) Subpart D	Management of Uranium Byproduct Material	Disposal areas for the management of uranium byproduct materials after closure shall each comply with the closure performance standard in 40 CFR §264.111 with respect to nonradiological hazards and shall be designed to provide reasonable assurance of control of radiological hazards to be effective for 1,000 years, to the extent reasonable, and, in any case, for at least 200 years	Relevant and Appropriate	
Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings 40 CFR §§ 192.40-192.42 Subpart E	Management of Thorium Byproduct Material	The provisions for the management of uranium byproduct material (40 CFR §192.32) shall apply to thorium byproduct material and provisions applicable to the element uranium shall also apply to the element thorium	Relevant and Appropriate	
MANAGEMENT OF RESIDUAL RADIOACTIVE MATERIAL				
Radiation Protection of the Public and the Environment DOE Order 5400.5 Chapter II (5)	Release of Property	Real property (land and structures), personal property, materials, and equipment shall be released if the concentration of radioactivity is within the limits of residual radioactive contamination.	TBC	

TABLE B-3
(Continued)

Citation	Action	Requirement	Determination	Remarks
MANAGEMENT OF RESIDUAL RADIOACTIVE MATERIAL (continued)				
Radiation Protection of the Public and the Environment DOE Order 5400.5 Chapter IV (6)	Control of Residual Radioactive Material Above the Guidelines	Residual radioactive material with concentrations above the generic guidelines (see chemical-specific requirements) shall be managed in accordance with Chapter II, Requirements for Radiation Protection of the Public and the Environment, and operational and control requirements.	TBC	
Radiation Protection of the Public and the Environment DOE Order 5400.5 Chapter IV (6)(b)	Interim Storage of Residual Radioactive Material	Control and stabilization features of an interim storage facility for residual radioactive material shall be designed to provide to the extent reasonably achievable, an effective life of 50 years with a minimum life of at least 25 years. Access to a property and use of on-site material contaminated by residual radioactive material should be controlled through appropriate administrative and physical controls. These control features should be designed to provide, to the extent reasonable, an effective life of at least 25 years.	TBC	
Radiation Protection of the Public and the Environment DOE Order 5400.5 Chapter IV (6)(c)	Interim Management of Residual Radioactive Material	A property may be maintained under an interim management arrangement when residual radioactive material exceeds guideline values if the residual radioactive material is in inaccessible locations and would be unreasonably costly to remove, provided that administrative controls are established.	TBC	
Radiation Protection of the Public and the Environment DOE Order 5400.5 Chapter IV (6)(d)	Long-Term Management of Residual Radioactive Material	To properly manage uranium, thorium, and their decay products, access to a property and use of on-site materials contaminated by residual radioactive material should be controlled through appropriate administrative and physical controls such as those described in 40 CFR 192. These controls should be designed to be effective to the extent reasonable for at least 200 years.	TBC	
Radiation Protection of the Public and the Environment DOE Order 5400.5 Chapter IV (7)	Supplemental Limits and Exceptions for Residual Radioactive Material	If special specific property circumstances indicate that the concentration guidelines or authorized limits are not appropriate, supplemental limits or an exception may be requested to those guidelines or limits.	TBC	

TABLE B-4
OTHER ACTION-SPECIFIC REQUIREMENTS

Citation	Action	Requirement	Determination	Remarks
		AIR POLLUTION CONTROL		
Ohio General Provisions on Air Pollution Control OAC 3745-15-07 ORC 3704.01-.05	Prevention of Air Pollution Nuisance	Measures shall be taken to adopt and maintain a program for the prevention, control, and abatement of air pollution in order to protect and enhance the quality of the state's air resource so as to promote the public health, welfare, and economic vitality of the people of the state. The emission or escape into open air from any source whatsoever of smoke, ashes, dust, dirt, grime, acids, fumes, gases, vapors, odors, and combinations of the above in such a manner or in such amounts as to endanger the health, safety, or welfare of the public or to cause unreasonable injury or damage to property shall be declared to be a public nuisance. It is unlawful for any person to cause, permit, or maintain any such public nuisance.	Applicable	
Ohio Particulate Matter Standards OAC 3745-17-07	Control of Visible Particulate Emissions from Stationary Sources	Visible particulate emissions from any stack shall not exceed 20 percent opacity, as a six-minute average. Transient exceedance limits are included in this regulation.	Applicable	
Ohio Emissions of Particulate Matter OAC 3745-17-07(B)(5), (6)	Control of Visible Particulate Emissions	There shall be no visible particulate emissions from any unpaved roadway, parking area, or material storage piles except for a period of time not to exceed thirteen minutes during any sixty-minute observation period.	Applicable	
Ohio Emissions of Particulate Matter OAC 3745-17-08	Restriction of Emission of Fugitive Dust	No person shall cause or permit any fugitive dust source to be operated; or any materials to be handled, transported or stored; or a building or its appurtenances or a road to be used constructed, altered, repaired or demolished without taking or installing reasonably available control measures to prevent fugitive dust from becoming airborne. Such reasonably available control measure shall include, but not be limited to, one or more of the following which are appropriate to minimize or eliminate visible particulate emissions of fugitive dust:	Relevant and Appropriate	This requirement is applicable only to certain cities in Butler and Hamilton Counties.

TABLE B-4
(Continued)

Citation	Action	Requirement	Determination	Remarks
		AIR POLLUTION CONTROL (continued)		
Ohio Emissions of Particulate Matter OAC 3745-17-08 (continued)	Restriction of Emission of Fugitive Dust	• the use of water or other suitable dust suppression chemicals for the control of fugitive dust from the demolition of existing buildings or structures, construction operations, the grading or roads or the clearing of land; or • the periodic application of asphalt, oil, water, or other suitable dust suppression chemicals on dirt or gravel roads and parking lots, and any other surfaces which cause emissions of fugitive dust.	Relevant and Appropriate	
		WATER POLLUTION CONTROL		
National Pollutant Discharge Elimination System 40 CFR §122.26 (a)(1)(ii) 40 CFR §122.26 (b)(14)(v),(x)	Storm Water Discharge Associated with Industrial Activity	A discharge composed entirely of storm water associated with industrial activity is required to obtain a NPDES permit. These categories of facilities are considered to be engaging in "industrial activity": • landfills, land application sites, and open dumps that receive or have received any industrial wastes (waste that is received from any of the facilities described under this subsection) including those that are subject to regulation under subtitle D of RCRA; and • construction activity including clearing, grading, and excavation activities that disturbs 5 acres or more of total land area.	Applicable	Engineering controls will be implemented to monitor and control stormwater runoff during removal, treatment, and disposal of Operable Unit 2 material.
Clean Water Act §404 (33 U.S.C. §1344) Guidelines for Specifications of Disposal Sites for Dredged or Fill Material 40 CFR §230.10	Discharge of Dredged or Fill Material	No discharge of dredged or fill material shall be permitted: • if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as, the alternative does not have other significant adverse environmental consequences.	Applicable	

TABLE B-4
(Continued)

Citation	Action	Requirement	Determination	Remarks
		WATER POLLUTION CONTROL (continued)		
Clean Water Act §404 (33 U.S.C. §1344) Guidelines for Specifications of Disposal Sites for Dredged or Fill Material 40 CFR §230.10 (continued)	Discharge of Dredged or Fill Material	• unless appropriate and practicable steps have been taken which will minimize potential adverse impacts of the discharge on the aquatic ecosystem. No discharge of dredged or fill material shall be permitted if it: • causes or contributes, after consideration of disposal site dilution and dispersion, to violations of any applicable state water quality standard. • violates any applicable toxic effluent standard or prohibition under section 307 of the Clean Water Act. • jeopardizes the continued existence of species listed as endangered or threatened under the Endangered Species Act of 1973, as amended, or results in likelihood of the destruction or adverse modification or a habitat which is determined to be a critical habitat under the Endangered Species Act of 1973, as amended.	Applicable	
Clean Water Act Nationwide Permit Program 33 U.S.C. §1341(a)(1),(d) 33 CFR §330.1 (c)	Nationwide Permits - Terms and Conditions	An activity is authorized under an NWP only if that activity and the permittee satisfy all of the following NWPs terms and conditions. Potentially applicable NWPs include: • Nationwide Permit #26 - Headwaters and Isolated Waters Discharges - The discharge does not cause the loss of more than 10 acres of waters of the United States. - The permittee notifies the district engineer if the discharge would cause the loss of waters of the United States greater than one acre. - For discharges in special aquatic sites, including wetlands, the notification must also include a delineation of affected special aquatic sites, including wetlands.	Applicable	In a January 17, 1992 letter to the U.S. Army Corps of Engineers, OEPA conditionally certified that projects authorized by these Nationwide Permits will comply with the applicable provisions of the Federal Water Pollution Control Act.

TABLE B-4
(Continued)

Citation	Action	Requirement	Determination	Remarks
		WATER POLLUTION CONTROL (continued)		
Clean Water Act Nationwide Permit Program 33 U.S.C. §1341(a)(1),(d) 33 CFR §330.1 (c) (continued)	Nationwide Permits - Terms and Conditions	- The discharge, including all attendant features, both temporary and permanent, is part of a single and complete project. • Nationwide Permit #38 - Cleanup of Hazardous and Toxic Waste - This permit authorizes specific activities required to effect the containments, stabilization or removal of hazardous or toxic waste materials that are performed ordered, or sponsored by a government agency with established legal or regulatory authority provided the permittee notifies the district engineer. - For discharges in special aquatic sites, including wetlands, the notification must also include a delineation of affected special aquatic sites, including wetlands. - This nationwide permit does not authorize the establishment of new disposal sites or the expansion of existing sites used for the disposal of hazardous or toxic waste.	Applicable	
Clean Water Act Nationwide Permit Program 33 CFR §330.4 (c)(1) Ohio Section 401 Water Quality Certifications OAC 3745-32	Nationwide Permits - Terms and Conditions	State 401 water quality certification pursuant to section 401 of the Clean Water Act, or waiver thereof, is required prior to the issuance or reissuance of individual or nationwide permits authorizing activities which may result in a discharge into waters of the United States	Applicable	
Clean Water Act General Regulatory Policies 33 CFR §323.3	Permits for Discharges of Dredged or Fill Material	Permits will be required for the discharge of dredged or fill material into waters of the United States including wetlands. Certain discharges specified in 33 CFR Part 330 are permitted by that regulation (nationwide permits).	Applicable	

TABLE B-4
(Continued)

Citation	Action	Requirement	Determination	Remarks
		WATER POLLUTION CONTROL (continued)		
Clean Water Act General Regulatory Policies 33 CFR §323.3 (continued)	Permits for Discharges of Dredged or Fill Material	If a discharge of dredged or fill material is not permitted by 33 CFR Part 330 (Nationwide Permits), an individual section 404 permit will be required for the discharge of dredged or fill material into waters of the United States. Discharges of dredged or fill material into waters of the United States done by or on behalf of any Federal agency, other than the Corps of Engineers, are subject to the authorization procedures of these regulations.	Applicable	
Ohio Water Pollution Control Regulations ORC 6111.04	Acts of Pollution Prohibited	No person shall cause pollution or place or cause to be placed any sewage, industrial waste, or other wastes in a location where they cause pollution of any waters of the state. No person to whom a permit has been issued shall place or discharge, or cause to be placed or discharged, in any waters of the state any sewage, industrial waste, or other wastes in excess of the permissive discharges specified under such existing permit without first receiving a permit from the Director to do so.	Applicable	

TABLE B-5
LOCATION-SPECIFIC REQUIREMENTS

Citation	Location	Requirement	Determination	Remarks
		THREATENED AND ENDANGERED SPECIES PROTECTION		
Procedures for Implementing the National Environmental Policy Act 40 CFR §6.302(h) Endangered and Threatened Wildlife and Plants 50 CFR §17.21,§17.94 Interagency Cooperation-Endangered Species Act 50 CFR §402.01	Endangered Species and Critical Habitat	All Federal agencies must insure that any action authorized, funded, or carried out by them is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of the constituent elements essential to the conservation of a listed species within a defined critical habitat.	Applicable	A baseline ecological survey, conducted by Miami University, found no federally-listed endangered species at the Fernald property. However, the study did locate individuals of two state-listed endangered plants (slender fingergrass [*Digitaria filiformis*] and mountain bindweed [*Polygonum cilinode*]), and one state-listed threatened invertebrate (Sloan's crayfish [*Orconectes sloanii*]). In 1993 and 1994, surveys have verified the presence of the Sloan's crayfish in Paddys Run. Surveys were conducted in 1993 for the state-listed endangered cave salamander [*Eurycea lucifuga*]. Additional studies by ASI and consultation with the Ohio Department of Natural Resources have also identified suitable habitat for two federally-listed endangered species (Indiana bat [*Myotis sodalis*] and running buffalo clover [*Trifolium stoloniferum*]) on the Fernald property.
Interagency Cooperation-Endangered Species Act 50 CFR §402.12 (a),(b)	Biological Assessment	A biological assessment shall evaluate the potential effects of the action on listed and proposed critical habitat and determine whether any such species or habitat are likely to be adversely affected by the action and is used in determining whether formal consultation or a conference is necessary. These procedures are required for Federal actions that are "major construction activities".	Applicable	
Ohio Endangered Species Regulations ORC 1531.25	Endangered Animal Species	No person shall take or possess any native species of wild animal, or any eggs or offspring thereof, that is threatened with state-wide extinction.	Applicable	See first remark.

TABLE B-5
(Continued)

Citation	Location	Requirement	Determination	Remarks
THREATENED AND ENDANGERED SPECIES PROTECTION (continued)				
Ohio Endangered Species Regulations ORC 1518.02 OAC 1501:18-1	Endangered Plant Species	No person shall root up, injure, destroy, remove, or carry away on or from public highways, public property, or waters of the state, or on or from the property of another, without the written permission of the owner, lessee, or other person entitled to possession, any endangered or threatened plant listed in OAC 1501:18-1.	Applicable	See first remark.
Classification of Solid Waste Disposal Facilities and Practices 40 CFR §257.3-2	Any	Solid waste disposal facilities or practices shall not cause or contribute to the taking of any endangered or threatened species of plants, fish, or wildlife. Solid waste disposal facilities or practices shall not result in the destruction or adverse modification of the critical habitat of endangered or threatened species as identified in 50 CFR Part 17.	Applicable	See first remark.
HISTORIC AND CULTURAL RESOURCE PROTECTION				
Antiquities Act of 1906 16 U.S.C. §431	Antiquity Preservation	No person may appropriate, excavate, injure, or destroy any historic or prehistoric ruin or monument, or any object of antiquity situated or controlled by the Government of the United States.	Applicable	A survey of the Operable Unit 2 areas was performed in March 1993 and it was determined that the areas had already been sufficiently disturbed so that there would be no requirement to consult the State Historic Preservation Officer (SHPO). Any other proposed areas of disturbance for Operable Unit 2 remedial actions will be surveyed and the SHPO consulted as necessary.

TABLE B-5
(Continued)

Citation	Location	Requirement	Determination	Remarks
HISTORIC AND CULTURAL RESOURCE PROTECTION (continued)				
Archeological Recovery Act 16 U.S.C. §408(a) Procedures for Implementing the National Environmental Policy Act 40 CFR §6.301 (c) Protection of Archaeological Resources 43 CFR §7.4(a)	Archaeological Resource Recovery and Preservation	Whenever any Federal agency finds, or is notified, in writing, by an appropriate historical or archaeological authority, that its activities in connection with any Federal construction project or federally licensed project, activity, or program may cause irreparable loss or destruction of significant scientific prehistorical, historical, or archaeological data, such agency shall notify the Secretary of the Interior, in writing, and shall provide the Secretary with appropriate information concerning the project, program, or activity. No person may excavate, remove, damage, or otherwise alter or deface or attempt to excavate, remove, damage, or otherwise alter or deface any archaeological resource located on public lands unless such activity is pursuant to a permit. If an EPA activity may cause irreparable loss or destruction of significant scientific, prehistoric, historic, or archaeological data, the responsible official or the secretary of the Interior is authorized to undertake data recovery and preservation activities.	Applicable	See above remark.
National Historic Preservation Act 16 U.S.C. §470f 16 U.S.C. §470h-2 (a)(1) National Historic Landmarks Program 36 CFR 65.2(c)(2) Procedures for Implementing the National Environmental Policy Act 40 CFR §6.301 (a),(b)	Historic Preservation	A Federal agency must take into account the effect of any undertaking on any district, site, building, structure, or object that is included in, or eligible for, inclusion in the National Register of Historic Places. The heads of all Federal agencies shall assume responsibility for the preservation of historic properties which are owned or controlled by such agency. Prior to any Federal undertaking which may directly and adversely affect any National Historic Landmark, the head of the responsible agency shall, to the extent possible, minimize the harm to such landmark.	Applicable	See above remark.

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TABLE B-5
(Continued)

Citation	Location	Requirement	Determination	Remarks
		FLOODPLAINS/WETLANDS PROTECTION		
Procedure for Implementing the National Environmental Policy Act 40 CFR §6.302(a) [Executive Order 11990]	Protection of Wetlands	Federal agencies conducting certain activities must avoid, to the extent possible, the adverse impacts associated with the destruction or loss of wetlands and to avoid support of new construction in wetlands when a practicable alternative exists.	Applicable	An updated site-wide delineation of Fernald wetlands, performed in accordance with the U.S. Army Corps of Engineers Wetland Delineation Manual, was completed in March 1993. Although there are wetlands located near the Lime Sludge Ponds, the Solid Waste Landfill is the only subunit with wetlands located inside the battery limits. These wetlands may be affected during the Operable Unit 2 remedial action.
Procedures for Implementing the National Environmental Policy Act 40 CFR §6.302(b) [Executive Order 11988]	Floodplain Management	Federal agencies must evaluate the potential effects of actions they may take in a floodplain to avoid, to the extent possible, adverse effects associated with direct and indirect development of a floodplain.	Applicable	An updated floodplain determination was performed for Paddys Run in October 1993 using the Army Corps of Engineers' standard HEC2 water surface profile analysis program. The 100-year flood elevations reach the western slope of the Inactive Flyash Pile and the toe of the South Field slope.
DOE Compliance with Floodplain/Wetlands Environmental Review Requirements 10 CFR §1022.3(a), (b)(1),(2),(3),(5),(6),(c), (d),(e)	Floodplain/Wetlands	DOE shall exercise leadership and take action to: • avoid to the extent possible the long- and short-term adverse impacts associated with the destruction of wetlands and the occupancy and modification of floodplains and wetlands, and avoid direct and indirect support of floodplain and wetlands development wherever there is a practicable alternative. • incorporate floodplain management goals and wetlands protection considerations into its planning, regulatory, and decision-making processes and shall to the extent practicable: - reduce the hazard and risk of flood loss.	Applicable	

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TABLE B-5
(Continued)

Citation	Location	Requirement	Determination	Remarks
		FLOODPLAINS/WETLANDS PROTECTION (continued)		
DOE Compliance with Floodplain/Wetlands Environmental Review Requirements 10 CFR §1022.3(a),(b)(1),(2),(3),(5),(6),(c),(d),(e) (continued)	Floodplain/Wetlands	- minimize the impact of floods on human safety, health, and welfare. - restore and preserve natural and beneficial values served by the floodplains. - minimize the destruction, loss, or degradation of wetlands. - preserve and enhance the natural and beneficial values of wetlands • undertake a careful evaluation of the potential effects of any DOE action taken in a floodplain and any new construction undertaken by DOE in wetlands not located in a floodplain • identify, evaluate, and as appropriate, implement alternative actions which may avoid or mitigate adverse floodplain/wetlands impacts • provide opportunity for early public review of any plans or proposals for actions in floodplains and new construction in wetlands	Applicable	
DOE Compliance with Floodplain/Wetlands Environmental Review Requirements 10 CFR §1022.5(b),(h)	Floodplain/Wetlands	This part shall apply to all proposed floodplain/wetlands actions, including those sponsored jointly with other agencies, where practicable alternatives to the proposed actions are still available. The policies and procedures of this part which are applicable to floodplain actions shall apply to all proposed actions which occur in a wetlands located in a floodplain.	Applicable	
DOE Compliance with Floodplain/Wetlands Environmental Review Requirements 10 CFR §1022.11(a),(b),(c)	Floodplain/Wetlands	Concurrent with its review of a proposed action to determine appropriate NEPA requirements, DOE shall determine applicability of the floodplain management and wetlands protection requirements of this part.	Applicable	

TABLE B-5
(Continued)

Citation	Location	Requirement	Determination	Remarks
		FLOODPLAINS/WETLANDS (continued)		
DOE Compliance with Floodplain/Wetlands Environmental Review Requirements 10 CFR §1022.11(a),(b),(c) (continued)	Floodplain/Wetlands	In making a floodplain determination, DOE shall utilize the Flood Insurance Rate Maps (FIRMs) or the Flood Hazard Boundary Maps (FHBMs) prepared by the Federal Insurance Administration of the Department of Housing and Urban Development to determine if a proposed action is located in the base or critical action floodplain, as appropriate. For a proposed action in an area of predominantly Federal or State land holdings where FIRM or FHBM maps are not available, information shall be sought from the land administering agency (e.g., Bureau of Land Management, Soil Conservation Service, etc.) or from agencies with floodplain analysis expertise.	Applicable	
DOE Compliance with Floodplain/Wetlands Environmental Review Requirements 10 CFR §1022.12(a)	Floodplain/Wetlands	If DOE determines, pursuant to 10 CFR §§ 1022.5 and 1022.11, that this part is applicable to the proposed action, DOE shall prepare a floodplain/wetlands assessment, according to the requirements in this section (10 CFR §1022.12).	Applicable	
DOE Compliance with Floodplain/Wetlands Environmental Review Requirements 10 CFR §1022.15(a)	Floodplain/Wetlands	If DOE finds that no practicable alternative to locating in the floodplain/wetlands is available, consistent with the policy set forth in Executive Order 11988, DOE shall, prior to taking action, design, or modify its action in order to minimize potential harm to or within the floodplain/wetlands.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-07 (A)(3)	Floodway	A solid waste disposal facility may not be located in a floodway.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-07 (B)(10)	Floodplain	The limits of solid waste placement and the leachate management system cannot be located in a regulatory floodplain, unless deemed acceptable by the Director.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-07 (B)(14)	Stream, Lake, or Wetland	The limits of waste placement cannot be located within 200 feet of a stream, lake, or natural wetland, unless deemed acceptable by the Director.	Applicable	

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TABLE B-5
(Continued)

Citation	Location	Requirement	Determination	Remarks
		GROUNDWATER PROTECTION		
Safe Drinking Water Act 42 U.S.C. §1424(e)	Sole Source Aquifer	All Federal financially assisted projects constructed in the area of a sole source aquifer and its principal recharge zone will be subject to EPA's review to insure that these projects are designed and constructed so that they do not create a significant hazard to public health.	Applicable	A notice in 53 FR 15876 (May 4, 1988) designated the Buried Valley Aquifer System of the Great Miami/ Little Miami River Basins of southwestern Ohio as a sole or principal source of drinking water. The Fernald site is located above this aquifer.
Ohio Solid Waste Disposal Regulations OAC 3745-27-07 (B)(4)	Any	A sanitary landfill facility may not be located within the surface and subsurface areas surrounding a public water supply well through which contaminants may move toward and may reach the public water supply well within a period of 5 years.	Applicable	
OEPA Guidance on Solid Waste Siting Criteria: Minimum Distance From a Public Water Supply Well GD202.105	Any	To avoid the application of the siting criteria in OAC 3745-27-07 (B)(4): • It should be shown, using site-specific and publicly available information, that the nearest public water supply well hydrogeologically downgradient from the solid waste landfill facility is more than 5 years time of travel from the boundaries of the solid waste landfill facility. • The five year time of travel shall be calculated beginning at the facility boundary of the solid waste landfill facility closest to the public water supply well and proceeding in a hydraulically downgradient direction ending at the well screen of all public water supply wells intersected with the five year time of travel. • Many methods can be used to demonstrate compliance with this rule, from simple groundwater velocity equations to complex three-dimensional models. The demonstration should use the method best suited to the site-specific situation.	TBC	

TABLE B-5
(Continued)

Citation	Location	Requirement	Determination	Remarks
		GROUNDWATER PROTECTION (continued)		
OEPA Guidance on Solid Waste Siting Criteria: Minimum Distance From a Public Water Supply Well GD202.105 (continued)	Any	• To be considered for an exemption from this rule, the following will need to be demonstrated: - that there is at least 50 feet of separation between the bottom of the solid waste landfill facility liner and the aquifer system in which the public water supply well is screened. - that any release of leachate shall be detected prior to reaching the aquifer system in which the public water supply well is screened. - that once leachate is released below the liner, the leachate shall not reach the aquifer system in which the public water supply well is screened within a time span of 100 years plus the anticipated life of the solid waste landfill facility which shall include the 30 year post-closure care period.	TBC	
Ohio Solid Waste Disposal Regulations OAC 3745-27-07 (B)(5)	Any	A sanitary landfill facility cannot be located above an aquifer declared by the federal government under the Safe Drinking Water Act to be a sole source aquifer.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-07 (B)(9)	Any	A sanitary landfill facility cannot be located above an unconsolidated aquifer capable of sustaining a yield of 100 gallons per minute for a 24-hour period to a water supply well located within 1,000 feet of the limits of solid waste placement, unless deemed acceptable by the Director.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-07 (B)(11)	Water Supply Well or Developed Spring	The limits of sold waste placement cannot be located within 1,000 feet of a water supply well or developed spring unless it is deemed acceptable by the Director or it is: • controlled by the applicant, is needed as a source of nonpotable water, no other reasonable alternate water source is available, and the well is constructed to prevent contamination of the groundwater, OR	Applicable	

TABLE B-5
(Continued)

Citation	Location	Requirement	Determination	Remarks
		GROUNDWATER PROTECTION (continued)		
Ohio Solid Waste Disposal Regulations OAC 3745-27-07 (B)(11) (continued)	Water Supply Well or Developed Spring	• located at least 500 feet hydrogeologically upgradient from the limits of solid waste placement, OR • separated from the limits of solid waste placement by a hydrogeologic barrier, OR • constructed and used solely for monitoring groundwater quality	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-07 (B)(15)	Any	The isolation distance between the uppermost aquifer system and the bottom of the recompacted soil liner of a sanitary landfill system cannot be less than 15 feet of in situ or added geologic material deemed acceptable by the Director.	Applicable	
OEPA Guidance on Solid Waste Siting Criteria: Material Acceptable to the Director GD202.104	Any	For geologic material to be deemed acceptable to the Director as added fill under OAC Rule 3745-27-07 (B)(15), it must be able to meet the following criteria: • the geologic material must be impermeable enough so it will not store, transmit or yield a significant amount of water to a well or spring • the geologic material must be able to impede both physically and chemically, the flow of leachate constituents through it In order to meet both criteria listed above, the added geologic material should: • be classified as CL, SC, GC, CL-ML, or CH under the Unified Soil Classification System (USCS) • be composed of particles of which at least 25% by dry weight will pass through a No. 200 (75 μm) sieve • be composed of no more than 25% by dry weight particles which will not pass through a No. 4 sieve	TBC	

TABLE B-5
(Continued)

Citation	Location	Requirement	Determination	Remarks
		GROUNDWATER PROTECTION (continued)		
OEPA Guidance on Solid Waste Siting Criteria: Material Acceptable to the Director GD202.104 (continued)	Any	• no particle should be greater than 8 inches in diameter • have a final permeability of no more than $1x10^{-8}$ cm/sec • be recompacted in a manner that when the landfill is constructed on it, no damage to the landfill liner will occur due to settling of the added material	TBC	
Ohio Solid Waste Disposal Regulations OAC 3745-27-07 (B)(12)	Any	The limits of waste placement cannot be located within 300 feet of the sanitary landfill facility's property line, unless deemed acceptable by the Director.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-07 (B)(13)	Any	The limits of solid waste placement cannot be located within 1,000 feet of a domicile whose owner has not consented in writing to the location of the sanitary landfill facility.	Applicable	
Ohio Solid Waste Disposal Regulations OAC 3745-27-09(Y)	Exemption from Siting Criteria	Section 3745-27-09 (Y) states the permittee shall submit to the Director, upon every tenth anniversary of the effective date of a permit to install that approved the initial construction of the facility, an analysis demonstrating that the design, construction and final closure plan of the sanitary landfill facility continue to constitute best available technology. If the Director determines that the design is no longer consistent with best available technology as being applied to the sanitary landfill industry in the state of Ohio, the permittee may be required to submit a permit to install application for necessary modifications to the landfill facilities. If a permit to install is required, the Director shall not apply the siting criteria outlined in paragraph (B) of OAC 3745-27-07, when considering the permit to install application.	Applicable	

TABLE B-5
(Continued)

Citation	Location	Requirement	Determination	Remarks
		GROUNDWATER PROTECTION (continued)		
Ohio Solid and Hazardous Waste Rules ORC 3734.02(A)	Protection of Human Health and the Environment	The director of environmental protection shall adopt and may modify, suspend, or repeal rules for all solid waste facilities in order to ensure that the facilities will be located, maintained, and operated, and will undergo closure and post-closure care, in a sanitary manner so as not to create a nuisance, cause or contribute to water pollution, create a health hazard, or violate 40 CFR § 257.3-2 or 257.3-8.	Applicable	
		RADIOLOGICAL SITING CRITERIA		
Radioactive Waste Management DOE Order 5820.2A Chapter III (7)	Disposal Site Selection	Disposal site selection criteria (based on planned waste confinement technology) shall be developed for establishing new low-level waste disposal sites. Disposal site selection shall be based on an evaluation of the prospective site in conjunction with planned waste confinement technology, and in accordance with the National Environmental Policy Act process. Site selection shall also be based on the following criteria: • The disposal site shall have hydrogeologic characteristics which, in conjunction with the planned waste confinement technology, will protect the groundwater resource. • The potential for natural hazards such as floods, erosion, tornadoes, earthquakes, and volcanoes shall be considered in site selection. • Site selection criteria shall address the impact on current and projected populations, land use resources development plans and nearby public facilities, accessibility to transportation routes and utilities, and the location of waste generation.	TBC	

TABLE B-5
(Continued)

Citation	Location	Requirement	Determination	Remarks
		RADIOLOGICAL SITING CRITERIA (continued)		
Joint NRC-EPA Guidance on Siting of Mixed Low-Level Radioactive and Hazardous Waste Units (March 13, 1987)	Any	Areas with highly vulnerable hydrogeology deserve special attention in the siting of a mixed low-level waste disposal facility. Hydrogeology is considered vulnerable when groundwater travel time along any 100-foot flow path from the edge of the engineered containment structure in less than approximately 100 years. Disposal sites located in areas of vulnerable hydrogeology may require extensive, site-specific investigations which could lead to and provide bases for restrictions or modifications to design or operating practices. However, a finding that a site is located in an area of vulnerable hydrogeology alone, based on the EPA criteria, is not considered sufficient to prohibit siting under RCRA.	TBC	

TABLE B-6
NON-ARAR REQUIREMENTS

Citation	Action	Requirement
OSHA Worker Protection Requirements 29 CFR §§ 1904 and 1910	Worker Safety	These regulations establish requirements to protect workers who could be exposed to radiation, noise, hazardous wastes, or other contaminants or hazards at the remediation site.
DOT Requirements for Transportation of Hazardous Materials 49 CFR §§ 171-173 and 177-179	Transportation of Wastes Off Site	No one may transport hazardous materials on public highways except in accordance with these regulations: • Part 171 - General requirements for transporting hazardous materials. • Part 172 - This part establishes shipping papers, marking, labeling, placarding, and emergency response information requirements. • Part 173 - This part establishes packaging and other shipping requirements for hazardous materials, including radioactive materials. • Part 177 - This part establishes requirements for the transporter. • Part 178 - This part establishes specifications for shipping containers. • Part 179 - This part establishes specifications for tanks cars.
Highway Improvement Act of 1982 23 U.S.C. §127	Transportation of Wastes Off Site	Establishes vehicle weight limits for interstate highways.
Resource, Conservation, and Recovery Act 40 CFR §262.20	Transportation of Hazardous Waste	A generator who transports, or offers for transportation, hazardous waste for off-site treatment, storage, or disposal must prepare a Manifest OMB control number 2050-0039 on EPA form 8700-22, and, if necessary, EPA form 8700-22A, according to the instructions included in the Appendix to Part 262.
Resource, Conservation, and Recovery Act 40 CFR §§ 262.30 - 262.33	Transportation of Hazardous Waste	Before transporting hazardous waste or offering hazardous waste for transportation off site, a generator must package, label, mark, and placard the waste in accordance with §§ 172, 173, 178, and 179 of the Department of Transportation regulations listed above (49 CFR).
Resource, Conservation, and Recovery Act 40 CFR § 262.34	Hazardous Waste Accumulation Time	A generator may accumulate hazardous waste on-site for 90 days or less without a permit or without having interim status, provided that it is stored according to the requirements of this section. A generator who accumulates hazardous waste for more than 90 days is an operator of a storage facility and is subject to the requirements of 40 CFR Parts 264 and 265 and the permit requirements of 40 CFR Part 270 unless he has been granted an extension to the 90-day period. Such extension may be granted by EPA is hazardous wastes must remain on-site for longer than 90 days due to unforeseen, temporary, and uncontrollable circumstances.
Resource, Conservation, and Recovery Act 40 CFR §263	Transportation of Hazardous Waste	Persons transporting hazardous waste within the United States must comply with the regulations of this part, including manifest requirements and management of accidental hazardous waste discharges.

TABLE B-6
(Continued)

Citation	Action	Requirement
Nevada Test Site (NTS) Waste Acceptance Criteria, Certification, and Transfer Requirements	Disposal of Waste at NTS	Establishes the wastes that the facility will accept for disposal. See Appendix D.2 for a listing of the waste acceptance criteria.
Utah Bureau of Radiation Control, Radioactive Material License UT 2300249	Disposal of Waste at Envirocare	Establishes the wastes that the facility will accept for disposal. See Appendix D.2 for a listing of the waste acceptance criteria.
Native American Graves Protection and Repatriation Act 25 U.S.C. §3001	Protection of American Indian Grave Sites	Provides for return of human remains and cultural objects from Native American graves to affiliated tribes.
Fish and Wildlife Coordination Act 16 U.S.C. §66, *et sec.*	Protection of Fish and Wildlife	Requires consultation with state agencies for the purpose of conserving fish and wildlife resources when conducting activities that might affect any body of water.
Farmland Protection Policy Act 7 U.S.C. §4201, *et sec.*	Protection of Prime Agricultural Soils	Requires protection and maintenance of farmland for its beneficial use as national resource.
DOE Order 1540.1	Contractual obligation for activities at DOE facilities	Materials Transportation and Traffic Management
DOE Order 5440.1E	Contractual obligation for activities at DOE facilities	NEPA Compliance Program
DOE Order 5480.1B	Contractual obligation for activities at DOE facilities	Environmental, Safety, and Health Program for DOE Operations
DOE Order 5480.4	Contractual obligation for activities at DOE facilities	Environmental Protection, Safety, and Health Protection Standards
10 CFR §835 DOE Order 5480.11	Contractual obligation for activities at DOE facilities	Radiation Protection for Occupational Workers
DOE Order 5483.1A	Contractual obligation for activities at DOE facilities	Occupational Safety and Health Programs for DOE Employees at Government-Owned, Contractor-Operated Facilities
DOE Order 5700.6C	Contractual obligation for activities at DOE facilities	Quality Assurance

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Appendix C
FS Risk Evaluation

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ACRONYMS

ACGIH	American Conference of Governmental and Industrial Hygienists
AWWT	advanced waste water treatment
BSL	Biodenitrification Surge Lagoon
Ca	exposure point concentration in air
CEDE	committed effective dose equivalent
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CF	conversion factor
CRARE	Comprehensive Response Action Risk Evaluation
CSF	cancer slope factor
COC	constituent of concern
CPC	constituent of potential concern
CT	central tendency
DOE	United States Department of Energy
ED	exposure duration
EPA	United States Environmental Protection Agency
FEMP	Fernald Environmental Management Project
FS	feasibility study
HEAST	Health Effects Assessment Summary Tables
HELP	Hydrogeological Evaluation of Land Performance
HEPA	high-efficiency particulate air
HI	hazard index
HQ	hazard quotient
IARC	International Agency for Research on Cancer
ICRP	International Commission of Radiological Production
ILCR	incremental lifetime cancer risk
IR	inhalation rate
IRIS	Integrated Risk Information System
LOAEL	lowest observed adverse effect level
MCL	maximum contaminant level
NA	not applicable
NCP	National Contingency Plan
ND	not detected
NE	northeast
NOAEL	no observed adverse effect level
NRC	Nuclear Regulatory Commission
NS	not selected
NW	northwest
OAC	Ohio Administrative Code
O&M	operations and maintenance

ACRONYMS
(Continued)

OSHA	Occupational Safety and Health Administration
PAH	polycyclic aromatic hydrocarbons
PC	personal computer
PCB	polychlorinated biphenyl
PRG	preliminary remediation goal
PRL	preliminary remediation level
RA	risk assessment
Ra	radium
RCRA	Resource Conservation and Recovery Act
RfC	reference concentration
RfD	reference dose
RI	remedial investigation
RME	reasonable maximum exposure
Rn	radon
RTS	Radon Treatment System
Ru	ruthenium
SE	southeast
SF	inhalation slope factor
SOWC	Southwest Ohio Water Company
SVOC	semi-volatile organic compounds
SW	southwest
TCLP	Toxicity Characteristic Leaching Procedure
TLV	threshold limit value
TWA	time-weighted average
U	uranium
UCL	upper confidence level
UF	uncertainty factor
UMTRA	Uranium Mill Tailing Remedial Action Program
VOC	volatile organic compounds

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C.1

C.1.0 INTRODUCTION

Operable Unit 2 of the Fernald Environmental Management Project (FEMP) site contains chemical and radiological material within stored waste inventories and environmental media that present potential risks to humans and environmental resources. The nature and magnitude of these risks have been evaluated as part of the remediation process to ensure the selection of remedial alternatives that protect human health and the environment.

As part of the Operable Unit 2 Remedial Investigation (RI), a quantitative baseline risk assessment was performed for the "No Action" alternative. The baseline risk assessment estimated potential risks associated with current conditions at Operable Unit 2 and projected future risks based on the assumption that no further cleanup actions would be taken. The results of the baseline risk assessment indicate that potential risks to human health associated with the No Action alternative are unacceptably high.

The primary objective of the Operable Unit 2 Feasibility Study (FS) is to analyze various remedial alternatives based on criteria set by the U.S. Environmental Protection Agency (EPA). Part of the analysis and ultimate selection of alternatives includes an evaluation of the short-term risks associated with implementing the alternative (remedial action risk) and an evaluation of the long-term effectiveness of the alternative in protecting human health and the environment (residual risk). This appendix presents the results of both the remedial action and residual risk evaluations associated with the four remedial alternatives selected for detailed, comparative analysis in Section 5.0 of this FS report. The four alternatives are:

- Alternative 1, No Action (Baseline Conditions)
- Alternative 2, Consolidation and Capping
- Alternative 3, Excavation and Off-Site Disposal
- Alternative 6, Excavation and On-Site Disposal with Off-site Disposal of Fraction Exceeding Waste Acceptance Criteria (WAC)

Short-term by nature, remedial action risks are associated with construction and treatment activities performed during implementation of the remedial alternatives. During remediation, the federal government is assumed to continue to own and control access on site. Those individuals

or "receptors" potentially exposed to remedial action risks are remediation workers, on-property nonremediation workers, off-property residents at the FEMP site boundary, and the general public. Receptors may become exposed to contamination in several ways, including inhalation of resuspended dust and gaseous emissions, ingestion of or dermal contact with soil, and exposure to direct radiation. They are also potentially subject to accidental injury or death.

Residual risks are potential long-term risks projected to remain following completion of all remedial actions. For the purposes of this report, a period of 1000 years was used to evaluate residual risks. It was assumed that the Fernald area would retain its rural agricultural character in the future; hence, residual risks were evaluated for two scenarios: federal ownership (with access controls such as fencing) and private ownership. Receptors for the federal ownership scenario are an off-property farmer and child who live and farm adjacent to the FEMP property, and a trespasser who bypasses the access controls. Several exposure scenarios were evaluated quantitatively for the federal ownership scenario, including exposure to residual contaminants in surface soil. Receptors for the private ownership scenario are an on-property resident farmer and child who live and farm on Operable Unit 2, an off-property farmer and child, and a user of perched groundwater. The exposure scenarios evaluated quantitatively for private ownership include the use of groundwater for switch irrigation and household purposes and exposure to residual contaminants in surface soils and air. For each receptor considered, potential residual risks were evaluated either quantitatively or qualitatively, as appropriate, based on exposure to air, groundwater, or soil.

C.1.1 OBJECTIVES OF THE FS RISK ASSESSMENT

The FS report evaluates remedial alternatives in accordance with the EPA's nine FS screening criteria from the National Oil and Hazardous Substance Pollution Contingency Plan (NCP):

✓ 1. Overall protection of human health and the environment
2. Compliance with applicable or relevant and appropriate requirements (ARARs)
✓ 3. Long-term effectiveness and permanence
4. Reduction of toxicity, mobility, or volume
✓ 5. Short-term effectiveness
6. Ability to be implemented
7. Cost
8. State acceptance
9. Community acceptance

This FS risk assessment provides information relevant to Criteria 1, 3, and 5, and each Operable Unit 2 subunit is reviewed in terms of the remedial alternatives, as shown in Figure C.1-1.

This Risk Assessment follows the human-health risk assessment methodologies of the EPA Risk Assessment Guidelines for Superfund (RAGS, EPA 1989a) for Superfund, the FEMP Risk Assessment Work Plan Addendum (RAWPA, DOE 1992), and accumulated EPA comments on the RI/FS risk assessments and Comprehensive Response Action Risk Evaluations (CRAREs) performed for other operable units to date.

For determining the remedial action and residual risks from Operable Unit 2, the carcinogenic risk, noncarcinogenic hazard, risk of physical injury and fatality, and whole body radiological dose have been quantified for an array of receptors, exposure pathways, and COCs. The approach results in a matrix of risk information generated by alternative for each subunit (Figure C.1-2). This information can be used to compare the alternatives relative to the EPA's FS selection criteria.

C.1.2 FEMP SITE HISTORY

Formerly known as the Feed Materials Production Center, the FEMP site is a contractor-operated federal facility where pure uranium metals were produced for the U.S. Department of Energy (DOE) from 1951 to 1989. No isotopic separation of uranium in the starting materials was performed. After production ceased, plant resources were focused on a cleanup program. In 1991, the FEMP was officially closed as a federal production facility, but the environmental studies and cleanup activities continued. The FEMP is located on 425 hectares (1050 acres) in a rural area of Hamilton and Butler counties, approximately 29 kilometers (18 miles) northwest of Cincinnati, Ohio.

Identified environmental concerns include the potential impact to human health and the environment due to past releases of hazardous materials from the FEMP to the air, water, and surrounding soils; continuing releases of hazardous materials from the facility; and the on-site accumulation of a large inventory of uranium process materials and low-level radioactive and hazardous wastes. Operable Unit 2, the focus of this risk evaluation, consists of the following FEMP subunits, facilities, and associated environmental media:

- Solid Waste Landfill

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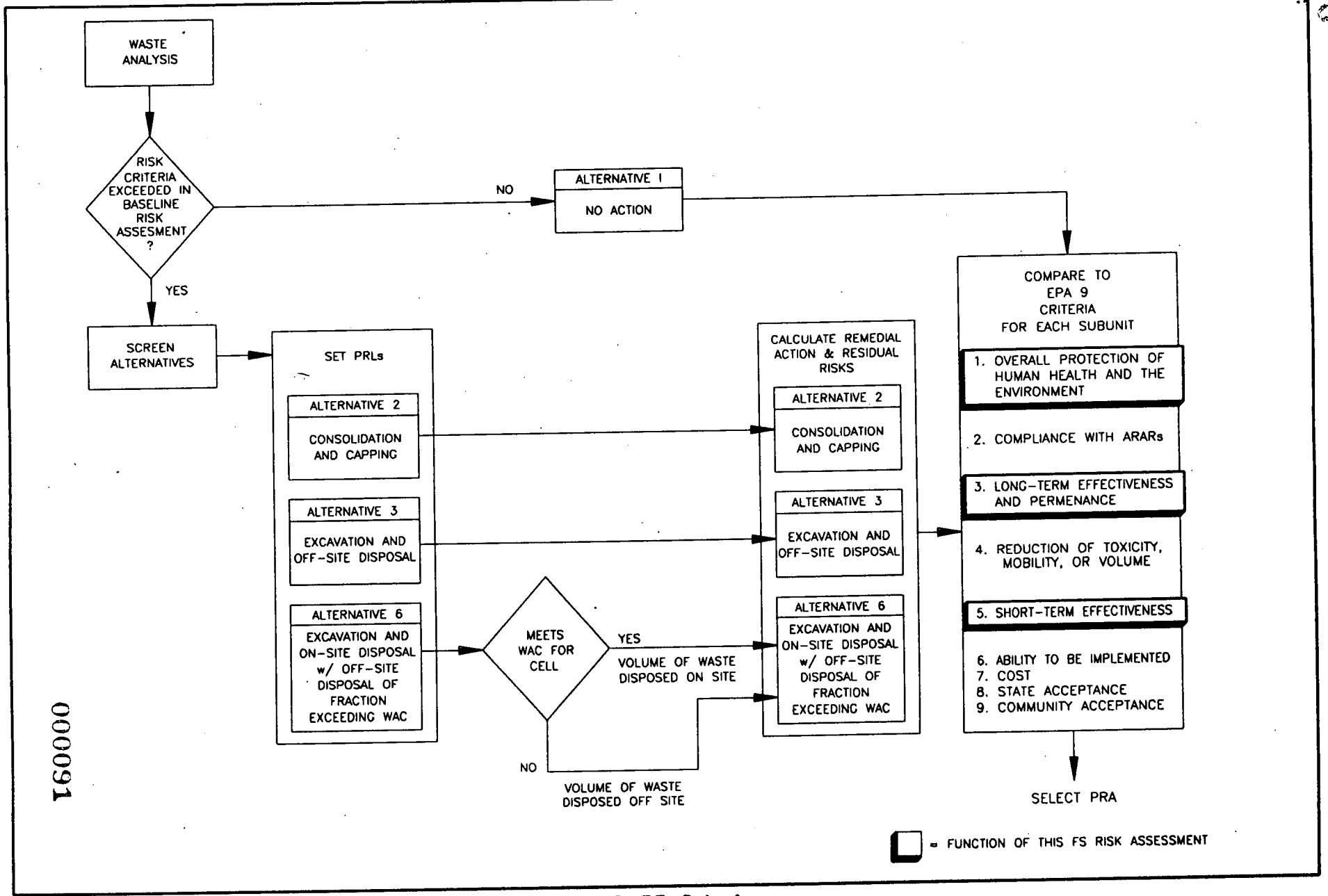

FIGURE C.1-1
OVERVIEW OF ALTERNATIVE COMPARISON PROCESS
FOR OPERABLE UNIT REMEDIAL ALTERNATIVES

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REMEDIAL ACTION RISKS

REMEDIAL ALTERNATIVE	RECEPTOR	1. ACTIVE FLYASH PILE	2. INACTIVE FLYASH PILE	3. SOUTH FIELD	4. LIME SLUDGE POND	5. SOLID WASTE LANDFILL
1 NO ACTION	ON-SITE	← RI BASELINE RISK ASSESMENT RESULTS →				
	OFF-SITE					
2 CONSOLIDATION AND CAPPING	ON-SITE	CARCINOGENIC NONCARCINOGENIC PHYSICAL INJURY & FATALITIES	CARCINOGENIC NONCARCINOGENIC PHYSICAL INJURY & FATALITIES	CARCINOGENIC NONCARCINOGENIC PHYSICAL INJURY & FATALITIES	CARCINOGENIC NONCARCINOGENIC PHYSICAL INJURY & FATALITIES	CARCINOGENIC NONCARCINOGENIC PHYSICAL INJURY & FATALITIES
	OFF-SITE	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC
3 EXCAVATION AND OFF-SITE DISPOSAL	ON-SITE	CARCINOGENIC NONCARCINOGENIC PHYSICAL INJURY & FATALITIES	CARCINOGENIC NONCARCINOGENIC PHYSICAL INJURY & FATALITIES	CARCINOGENIC NONCARCINOGENIC PHYSICAL INJURY & FATALITIES	CARCINOGENIC NONCARCINOGENIC PHYSICAL INJURY & FATALITIES	CARCINOGENIC NONCARCINOGENIC PHYSICAL INJURY & FATALITIES
	OFF-SITE	CARCINOGENIC NONCARCINOGENIC PHYSICAL INJURY & FATALITIES	CARCINOGENIC NONCARCINOGENIC PHYSICAL INJURY & FATALITIES	CARCINOGENIC NONCARCINOGENIC PHYSICAL INJURY & FATALITIES	CARCINOGENIC NONCARCINOGENIC PHYSICAL INJURY & FATALITIES	CARCINOGENIC NONCARCINOGENIC PHYSICAL INJURY & FATALITIES
6 EXCAVATION AND ON-SITE DISPOSAL WITH OFF-SITE DISPOSAL OF FRACTION EXCEEDING WAC (CELL)	ON-SITE	CARCINOGENIC NONCARCINOGENIC PHYSICAL INJURY & FATALITIES	CARCINOGENIC NONCARCINOGENIC PHYSICAL INJURY & FATALITIES	CARCINOGENIC NONCARCINOGENIC PHYSICAL INJURY & FATALITIES	CARCINOGENIC NONCARCINOGENIC PHYSICAL INJURY & FATALITIES	CARCINOGENIC NONCARCINOGENIC PHYSICAL INJURY & FATALITIES
	OFF-SITE	CARCINOGENIC NONCARCINOGENIC PHYSICAL INJURY & FATALITIES	CARCINOGENIC NONCARCINOGENIC PHYSICAL INJURY & FATALITIES	CARCINOGENIC NONCARCINOGENIC PHYSICAL INJURY & FATALITIES	CARCINOGENIC NONCARCINOGENIC PHYSICAL INJURY & FATALITIES	CARCINOGENIC NONCARCINOGENIC PHYSICAL INJURY & FATALITIES

RESIDUAL RISKS

REMEDIAL ALTERNATIVE	RECEPTOR	1. ACTIVE FLYASH PILE *	2. INACTIVE FLYASH PILE *	3. SOUTH FIELD *	4. LIME SLUDGE POND	5. SOLID WASTE LANDFILL
1 NO ACTION	ON-SITE	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC
	OFF-SITE					
2 CONSOLIDATION AND CAPPING	ON-SITE	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC
	OFF-SITE	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC
3 EXCAVATION AND OFF-SITE DISPOSAL	ON-SITE	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC
	OFF-SITE	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC
6 EXCAVATION AND ON-SITE DISPOSAL WITH OFF-SITE DISPOSAL OF FRACTION EXCEEDING WAC (CELL)	ON-SITE	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC
	OFF-SITE	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC	CARCINOGENIC NONCARCINOGENIC

LEGEND:

REMEDIAL ACTION RISK RECEPTORS

- ON-PROPERTY REMEDIATION WORKER
- ON-PROPERTY NONREMEDIATION WORKER
- OFF-PROPERTY GENERAL PUBLIC
- OFF-PROPERTY REMEDIAL WORKER (TRANSPORTATION)
- PUBLIC ALONG TRANSPORTATION ROUTE

RISKS

- CARCINOGENIC = INCREMENTAL LIFETIME CANCER RISK (ILCR) FROM CHEMICAL AND ALL RADIOLOGICAL IMPACTS.
- NONCARCINOGENIC = HAZARD INDEX (HI)
- PHYSICAL INJURY = INJURIES PREDICTED PER WORK HOUR
- FATALITIES = DEATHS PREDICTED PER WORK HOUR

RESIDUAL RISK RECEPTORS

FEDERAL OWNERSHIP

- EXPANDED TRESPASSER
- OFF-PROPERTY FARMER AND CHILD

PRIVATE OWERNERSHIP

- ON-PROPERTY RESIDENT FARMER AND CHILD
- OFF-PROPERTY FARMER AND CHILD

SOURCES:

- THE RAWPA (DOE 1992) AND PREVIOUS FS RISK ASSESSMENTS DEFINE THE SCOPE OF QUANTITATIVE ANALYSIS FOR SHORT-TERM (REMEDIAL ACTION) AND LONG-TERM (RESIDUAL) RISKS. NOTE THAT CARCINOGENIC AND NONCARCOGENIC RISKS RESULTING FROM ACCIDENTS ARE NOT INDICATED AND THEREFORE HAVE NOT BEEN CALCULATED.

* For residual risk analysis, these subunits are modeled as one combined, southern subunit, due to postremediation comingling.

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FIGURE C.1-2 RISK MATRICES FOR OU2 ALTERNATIVES AND SUBUNITS

- Lime Sludge Ponds
- Inactive Flyash Pile
- South Field
- Active Flyash Pile
- Associated berms, liners, and soil within the operable unit boundary

Significant concerns associated with waste materials include the presence of:

- Chemical contaminants in the waste material/soil
- Radionuclides in the waste material/soil
- Emission of radon gas
- Potential for leaching waste material/soil into the underlying Great Miami Aquifer and eventually to the Great Miami River

C.1.3 OPERABLE UNIT 2 SUBUNITS

Operable Unit 2 incorporates waste subunits with relatively large volumes of waste presumed to contain small quantities of hazardous materials and radionuclides. The five subunits are presented in Figure C.1-3 and are described below. The following descriptions are derived from the Operable Unit 2 RI report (DOE 1994a).

Solid Waste Landfill

The Solid Waste Landfill is located in the northeast corner of the Waste Storage Area (Figure C.1-3). This landfill, a flat rectangular area of approximately one acre, has been inactive since 1986. A soil cover has been placed over the disposal area. A drainage ditch serving the northwest portion of the former Production Area is located in the northern portion of the landfill. This drainage ditch is a jurisdictional wetland.

The operational history of the Solid Waste Landfill is not well documented. According to design drawings, the facility was planned as a sanitary landfill for nonburnable trash with up to five cells and an evaporation pond. The landfill reportedly was used to dispose of cafeteria waste, rubbish, and other types of wastes from nonprocess areas and on-site construction/demolition activities. Materials reportedly buried there include nonburnable and nonradioactive solid wastes generated

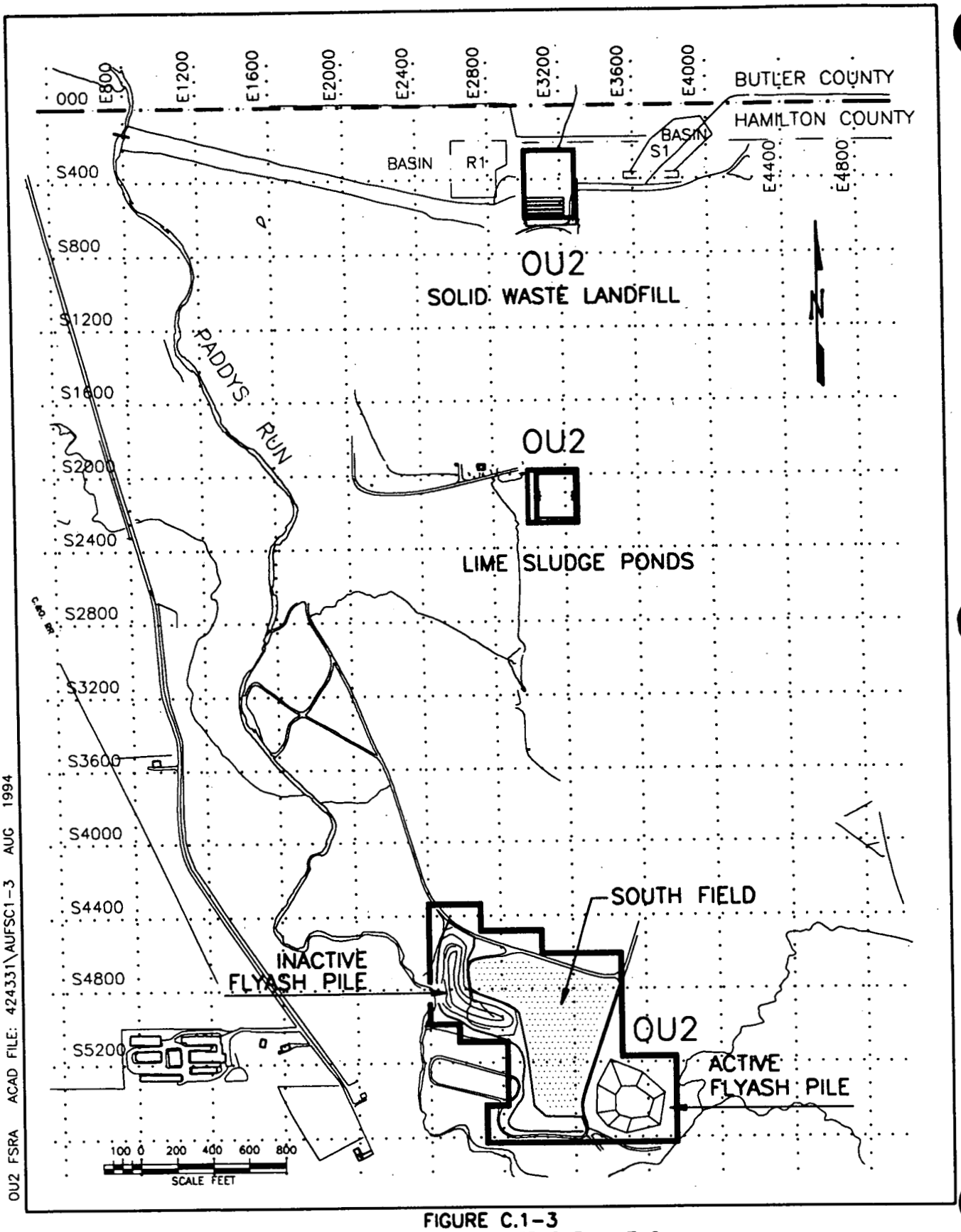

FIGURE C.1-3
EXISTING DETAIL, OPERABLE UNIT 2

on FEMP property, nonradioactive construction-related rubble, and double-bagged and bulk quantities of nonradioactive asbestos. Field investigation results, however, indicate that some apparent process wastes have been placed in the landfill. The following wastes were encountered during a trenching investigation in 1992:

- Burnable wastes - bagged trash and wood
- Possibly burnable wastes - respirator cartridges, asphalt roofing materials, medical wastes, firehoses, and rubber hoses/belts
- Nonburnable wastes - unidentified high-activity waste, medicine vials, bagged asbestos, ceramic tiles, possible magnesium fluoride, glass acid bottles, steel cables/cans, paint cans, and copper tubing

Lime Sludge Ponds

The North and South Lime Sludge Ponds are two unlined, rectangular ponds, each measuring approximately 38 by 69 meters (125 by 225 feet), and are located in the southeast corner of the Waste Storage Area (Figure C.1-3). Wastes disposed in the North and South Lime Sludge Ponds originated from water plant operations, coal pile storm water runoff, and boiler plant blowdown. The waste from the water plant operations is generated from a water softening process, which consists of adding lime and aluminum sulfate to precipitate calcium and magnesium salts.

Inactive Flyash Pile

The Inactive Flyash Pile is located approximately 610 meters (2000 feet) southwest of the former Production Area. The pile covers roughly two acres with Paddys Run as the western boundary (Figure C.1-3). The operating history of this subunit is not well understood. The Inactive Flyash Pile and the South Field are contiguous without a clearly defined boundary between the two subunits. Based on a review of historical photos and borehole logs (Weston 1988), the northern portion of this waste area is adjacent to a presently buried drainage ditch leading to Paddys Run. Beginning in 1957, flyash appears to have been trucked to the working face of the flyash pile and dumped. Aerial photographs from September 1962 indicate that the Inactive Flyash Pile was in two working piles. The photographs indicate that flyash disposal at this location ceased by the mid-1960s. Drill cuttings and water from RI/FS borings outside the former Production Area and Waste Storage Area, including off-property wells, were disposed on the Inactive Flyash Pile until March 1990. Composite samples of the water from these borings were analyzed to ensure that

total uranium was below an action limit established by the Westinghouse Environmental Management Company of Ohio (WEMCO).

Based on information provided by WEMCO, 1361 to 1814 metric tons (1500 to 2000 tons) per year of flyash were generated during the period of disposal; however, an unknown quantity of flyash was also disposed in the Burn Pit and Pit 3 within Operable Unit 1 (Weston 1988). The Inactive Flyash Pile is currently covered with vegetation and soil of unknown origin.

Nonprocess wastes from the FEMP and building rubble such as concrete, gravel, asphalt, masonry, and steel rebar from on-site construction/demolition activities were also discarded in the Inactive Flyash Pile (DOE 1988a; Weston 1987) and are visible along embankments surrounding the subunit. Transite containing asbestos was also deposited in the Inactive Flyash Pile. Field investigation results reveal that some apparent process waste may have been placed in the subunit.

South Field

The South Field is a 4.5 hectare (11-acre) area that lies between the Active Flyash Pile and the Inactive Flyash Pile. The actual boundary with the Inactive Flyash Pile is not clearly defined (Figure C.1-3). The operational history of the South Field is neither well documented nor well understood. This area was reportedly used to bury FEMP nonprocess wastes such as flyash, on-site construction/demolition rubble, including debris from the razing of the old administration building (DOE 1988a; Weston 1987), and soils that may have contained low levels of radioactivity. Disposal in the South Field apparently was performed randomly; thus the thickness of fill and the nature of waste are variable.

The southwest border of the South Field slopes toward the west and was used as the backstop for a firing range for FEMP security personnel over a period of 35 years. Lead ammunition used during target practice is deposited along the southwest border. Currently, the South Field is covered with grasses, shrubs, and trees.

Active Flyash Pile

This waste disposal area is located just east of the South Field and is bound on the east and south by the Storm Sewer Outfall Ditch (Figure C.1-3). The Active Flyash Pile has a surface area of

approximately three acres and has received flyash waste since the mid-1960s. The operational history of this unit is well understood. The flyash pile has a crusting agent sprayed upon the surface as a means of dust control. A silt fence has been constructed at the base of the pile to prevent storm water transport of the flyash off the pile.

Flyash from the FEMP coal-fired boiler plant was disposed of at the Active Flyash Pile. Flyash waste is comprised of 70 percent bottom ash collected below the boilers; the remaining 30 percent is a combination of precipitator ash collected from pollution control devices and flyash removed from the middle levels of the boiler. Some unburned coal and rock are also present in small quantities in the active flyash material. Since December 1992, newly generated flyash has been transported off site to a licensed disposal facility.

C.1.4 BASELINE RISK ASSESSMENT

As part of the Operable Unit 2 RI, an analysis was conducted to estimate the potential human-health risks from exposure to Operable Unit 2 hazardous wastes if no remediation is performed beyond that accomplished to date. This analysis is referred to as the baseline risk assessment.

The baseline risk assessment consists of five primary steps. First, the presence of chemical and radiological constituents that could potentially cause adverse health effects is determined; this is called constituent of potential concern (CPC) determination and is discussed in Section C.1.4.1. The second step defines how the land will be used, how exposure will occur and how hypothetical inhabitants, visitors and other receptors at the site will be exposed; this is called exposure assessment and is discussed in Section C.1.4.2. In the third step, the hazardous effects of all CPCs are characterized; this is the toxicity assessment and is discussed in Section C.1.4.3. The fourth step is the risk characterization in which results of the first three steps are combined to determine carcinogenic risks and noncarcinogenic hazards for all receptors; this is summarized in Section C.1.4.4. The fifth step, a semi-quantitative analysis of uncertainties and the effect of these uncertainties on the baseline risk assessment, is presented in Section C.1.4.5. A discussion of conclusions from the RI is presented in Section C.1.4.6.

Results of the baseline risk assessment were used to represent the potential impact of the No Action alternative on human health and the environment. Section 6.0 and Appendix B of the

Operable Unit 2 RI report should be reviewed for detailed information on baseline risks associated with Operable Unit 2.

C.1.4.1 Identification of Constituents of Potential Concern

As part of the Operable Unit 2 RI, CPCs were determined by performing a statistical comparison of constituent concentrations with background concentrations and then screening against conservative toxicological criteria. Constituents which had concentration terms below background concentrations were not included as possible CPCs. Those CPCs which were shown to exceed background were subjected to toxicological screening to exclude constituents that are unlikely to have human-health risk at levels detected. CPCs were retained if they did not meet the five criteria of the toxicological screening: 1) detected only once in one medium, 2) macronutrient/ micronutrient that is nontoxic, 3) ubiquitous in nature, 4) nonspecific class of compounds, and 5) representative concentrations are below the values calculated from EPA RAGS Part B (EPA 1991b), based on a hazard index of 0.1 and risk level of 1.0×10^{-7}.

Three categories of CPCs were identified: radionuclides, inorganic chemicals, and organic compounds. The identified CPCs were quantified in the baseline risk assessment. CPCs that were characterized to pose a risk greater than 1.0×10^{-6} or hazard greater than 0.2 at the end of the baseline risk assessment were identified as contaminants of concern (COCs) for evaluation in this FS report.

C.1.4.2 Exposure Assessment

The exposure assessment in the baseline risk assessment identifies current and future land use scenarios and potential receptors as well as sources and pathways of exposure. A summary is presented below. Details are presented in Appendix B of the Operable Unit 2 RI report.

Land Use Scenarios

Four land use scenarios are addressed in the Operable Unit 2 baseline risk assessment: 1) current land use with access controls, 2) current land use without access controls, 3) future land use with access controls assuming federal ownership, and 4) future land use without access controls assuming private ownership.

Assuming current land use with access controls, the site access restrictions are maintained by DOE and no further remedial actions are taken other than those completed to date. Further, it is assumed that members of the public are not allowed access to the site, and the integrity of the Operable Unit 2 subunits is maintained by inspections and repaired when necessary. The receptors evaluated under this scenario are:

- Trespassing youth
- On-property groundskeeper
- Off-property farmers (adult and child)
- Great Miami River users
  - Recreational
  - Residential
  - Agricultural

Under the current land use without access controls scenario, it is assumed that access restrictions are eliminated thus permitting livestock grazing on the site. The receptor evaluated for this scenario is the user of meat and milk. This receptor is assumed to be exposed through the consumption of meat and milk products produced from livestock grazing within Operable Unit 2.

For the future land use with access controls, it is assumed that the federal government retains ownership of the FEMP. Land use and site access are restricted for authorized government purposes only. The receptors evaluated under this scenario are:

- Expanded trespasser
- Off-property farmers (adult and child)
- Great Miami River users
  - Recreational
  - Residential
  - Agricultural

For the future land use without access controls, it is assumed that the FEMP is available for unrestricted land uses such as residential and agricultural development within the boundaries of Operable Unit 2. Receptors considered under this scenario are:

- On-property farmer (adult and child) - Reasonable Maximum Exposure (RME)
- On-property resident farmer - Central Tendency (CT)
- Off-property farmers (adult and child)
- Homebuilder
- On-property perched water user
- Great Miami River users
  - Recreational

- Residential
- Agricultural

Sources and Pathways of Exposure

Sources of exposure in Operable Unit 2 consist of the waste materials in the five subunits, and the media affected by the waste materials. These media include air, soil, surface water (including water from the Great Miami River affected by surface water), sediment, perched water, and groundwater from the Great Miami Aquifer.

The pathways of exposure evaluated for each media are summarized below:

- Air:
  Inhalation of particulates, VOCs, and gases
- Soil:
  Ingestion, dermal contact, and external radiation
- Surface water:
  Ingestion and dermal contact
- Sediment:
  Ingestion, dermal contact, and external radiation
- Perched water:
  Ingestion, dermal contact and inhalation of volatiles released during household use
- Groundwater:
  Ingestion, dermal contact, and inhalation of volatiles released during household use

Additional sources of exposure include food products (fruits, vegetables, meat, and milk) affected by contaminated dust and/or groundwater (through irrigation). Receptors may be exposed to site contaminants through ingestion of these food products.

C.1.4.3 Toxicity Assessment

Two human health effects are addressed in the toxicity assessment for Operable Unit 2: carcinogenic risk and noncarcinogenic hazards. Carcinogenic risks may be due to exposure to a chemical carcinogen or from ionizing radiation from a radionuclide. Effects caused by carcinogenic exposure include lung tumors, bone sarcomas, and skin cancer. Noncarcinogenic hazard effects are numerous and range from kidney or liver damage to localized effects such as skin or eye irritation.

Carcinogenic risk is quantified by the incremental lifetime cancer risk (ILCR) and is expressed in terms of the probability that a given receptor will develop cancer due to estimated exposures. For example, if the receptor has an additional risk of 1 in 10,000 of developing cancer due to these exposures, the probability is expressed as a 10^{-4} (1/10,000) risk. Chemical intakes calculated in the exposure assessment are used in conjunction with the cancer slope factor (CSF) to determine the ILCR.

In the evaluation of potential exposures for the noncarcinogenic hazard, it was assumed that a dose threshold exists below which no toxic effect will occur. This threshold is used to develop an acceptable intake level, known as the reference dose (RfD). To estimate the noncarcinogenic health hazard, the estimated intake (calculated from the exposure assessment) was divided by the acceptable intake. This ratio is called the hazard quotient (HQ). When HQs for multiple CPCs are summed for a particular pathway, the resultant value is the hazard index (HI). If the ratio of estimated intake to the acceptable intake is greater than 1, the site-related intake may increase the risk of noncarcinogenic toxic effects.

C.1.4.4 Risk Characterization Results

Table C.1-1 summarize the results of the baseline risk assessment by subunit, land use scenario, and receptors. These results may be compared to the ranges of generally acceptable risk under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), which are an ILCR of 10^{-6} to 10^{-4} or an HI less than 1. Those constituents that contribute an ILCR greater than 1 in 1 million (1.0×10^{-6}) or an HQ greater than 0.2 were designated as the COCs for the FS.

C.1.4.5 Summary of Uncertainties

It is generally recognized that uncertainty is inherent in quantitative risk assessments. The objective of the uncertainty analysis is to identify key site-related variables that contribute most to uncertainty, and to characterize the nature and magnitude of impact of these uncertainties on the conclusions of the risk assessment.

Sources of uncertainty have been identified in all steps of the baseline risk assessment. These sources include: selection of CPCs, exposure assessment, toxicity assessment, and risk characterization. The majority of uncertainties tend toward increased conservatism of the risk

TABLE C.1-1

SUMMARY OF BASELINE RISK ASSESSMENT RESULTS
OU2 REMEDIAL INVESTIGATION

		Current Land Use						Future Land Use, Federal Ownership		
Waste Subunit	Risk Type[a]	Trespassing Youth	On-Property Groundskeeper	Off-Property Farmer	Off-Property Child	User of Meat & Milk	GMR Rec User	Expanded Trespasser	Off-Property Farmer	Off-Property Child
Solid Waste Landfill	Carcinogenic	$1.5x10^{-5}$	$3.4x10^{-5}$	$6.0x10^{-8}$	$2.7x10^{-9}$	$9.0x10^{-9}$	$2.8x10^{-10}$	$2.0x10^{-5}$	$6.7x10^{-8}$	$3.5x10^{-9}$
	Noncarcinogenic	8.6	$4.3x10^{-3}$	$1.8x10^{-6}$	$6.4x10^{-6}$	$5.8x10^{-7}$	$1.1x10^{-7}$	$2.7x10^{-1}$	$1.8x10^{-6}$	$6.4x10^{-6}$
Lime Sludge Ponds	Carcinogenic	$1.1x10^{-5}$	$4.5x10^{-5}$	$1.5x10^{-7}$	$1.4x10^{-8}$	$1.4x10^{-6}$	NA[b]	$2.4x10^{-5}$	$1.7x10^{-7}$	$1.6x10^{-8}$
	Noncarcinogenic	$2.1x10^{-1}$	$1.3x10^{-1}$	$2.0x10^{-5}$	$9.3x10^{-5}$	$4.3x10^{-4}$	NA	$2.2x10^{-1}$	$2.0x10^{-5}$	$9.3x10^{-5}$
Inactive Flyash Pile	Carcinogenic	$1.5x10^{-5}$	$5.0x10^{-5}$	$6.1x10^{-7}$	$7.9x10^{-8}$	$1.1x10^{-7}$	$8.4x10^{-9}$	$3.0x10^{-5}$	$7.5x10^{-5}$	$4.0x10^{-6}$
	Noncarcinogenic	$1.0x10^{-1}$	$2.0x10^{-2}$	$5.5x10^{-5}$	$2.0x10^{-4}$	$1.4x10^{-5}$	$1.9x10^{-6}$	$1.0x10^{-1}$	1.2	2.5
South Field	Carcinogenic	$1.0x10^{-4}$	$2.2x10^{-4}$	$6.4x10^{-7}$	$2.4x10^{-7}$	$4.5x10^{-6}$	$4.2x10^{-6}$	$1.4x10^{-4}$	$8.7x10^{-5}$	$4.2x10^{-6}$
	Noncarcinogenic	$5.3x10^{-1}$	ND[c]	$2.0x10^{-5}$	$7.2x10^{-5}$	$3.0x10^{-5}$	$8.0x10^{-07}$	$8.0x10^{-2}$	1.1	3.1
Active Flyash Pile	Carcinogenic	$2.6x10^{-5}$	$8.0x10^{-5}$	$4.7x10^{-7}$	$6.6x10^{-8}$	$4.7x10^{-7}$	$1.37x10^{-9}$	$4.9x10^{-5}$	$1.1x10^{-5}$	$7.2x10^{-7}$
	Noncarcinogenic	$3.6x10^{-2}$	$5.9x10^{-2}$	$6.2x10^{-4}$	$2.1x10^{-3}$	$3.7x10^{-3}$	$6.1x10^{-6}$	$4.2x10^{-2}$	$1.9x10^{-1}$	$7.9x10^{-1}$

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See footnotes at end of table.

TABLE C.1-1
(Continued)

Waste Subunit	Risk Type[a]	Future Land Use, Private Ownership							
		On-Property Resident Farmer (RME)[b]	On-Property Resident Farmer (CT)[c]	On-Property Resident Child	Home Builder	Perched Groundwater User	GMR Recreational User	GMR Residential User	GMR Agricultural User
Solid Waste Landfill	Carcinogenic	$2.8x10^{-3}$	$2.0x10^{-4}$	$6.4x10^{-4}$	$9.0x10^{-6}$	$2.8x10^{-3}$	$2.8x10^{-10}$	$4.2x10^{-9}$	$6.5x10^{-7}$
	Noncarcinogenic	$2.9x10^{-1}$	$1.2x10^{-1}$	1.0	$4.8x10^{-1}$	ND	$1.1x10^{-7}$	$2.2x10^{-6}$	$1.1x10^{-4}$
Lime Sludge Ponds	Carcinogenic	$1.3x10^{-5}$	$9.3x10^{-7}$	$1.2x10^{-6}$	NA	$7.7x10^{-5}$	NA	NA	NA
	Noncarcinogenic	$1.7x10^{-3}$	$7.3x10^{-4}$	$7.9x10^{-3}$	NA	$3.1x10^{-3}$	NA	NA	NA
Inactive Flyash Pile	Carcinogenic	$1.5x10^{-3}$	$8.6x10^{-5}$	$7.7x10^{-5}$	NA	NA	$8.4x10^{-9}$	$3.0x10^{-9}$	$5.4x10^{-10}$
	Noncarcinogenic	22	9.8	65	NA	NA	$1.9x10^{-6}$	$4.2x10^{-6}$	$3.6x10^{-5}$
South Field	Carcinogenic	$3.4x10^{-2}$	$2.0x10^{-3}$	$9.2x10^{-3}$	$1.1x10^{-5}$	NA	$4.2x10^{-6}$	$6.3x10^{-8}$	$4.2x10^{-6}$
	Noncarcinogenic	23	11	63	$5.4x10^{-1}$	NA	$2.5x10^{-6}$	$1.4x10^{-4}$	$4.0x10^{-5}$
Active Flyash Pile	Carcinogenic	$8.4x10^{-5}$	$4.8x10^{-6}$	$5.7x10^{-6}$	NA	NA	$1.4x10^{-9}$	$7.7x10^{-9}$	$3.5x10^{-9}$
	Noncarcinogenic	$9.9x10^{-1}$	$4.5x10^{-1}$	2.8	NA	NA	$6.1x10^{-6}$	$1.5x10^{-5}$	$6.7x10^{-6}$

GMR = Great Miami River.
NA = The indicated land use is not applicable to the waste subunit.
ND = Not determined because toxicity data are not available.
[a]The carcinogenic risk value is the Incremental Lifetime Cancer Risk (ILCR), and the noncarcinogenic hazard value is the hazard index (HI).
[b]RME = Reasonable Maximum Exposure.
[c]CT = Central Tendency.

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TABLE C.1-1
(Continued)

Source: OU2 RI report, Table 7-1 (DOE 1994a)

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evaluation. Taken together, the uncertainties identified with site data, exposure parameters, fate and transport, toxicity assessment and risk characterization are judged to be high and could overestimate risk by two or more orders of magnitude. Appendix B of the Operable Unit 2 RI report provides a detailed discussion of uncertainties.

C.1.4.6 Conclusion

The objective of the Operable Unit 2 baseline risk assessment was to evaluate and quantify potential risks and hazards to human health that may be posed by current and predicted future exposures to contaminants within Operable Unit 2 if no remedial action is taken. This objective was met. Results of the RI baseline risk assessment indicate that the actual or threatened release of hazardous substances from Operable Unit 2 present a potential future threat to public health if no remedial actions are taken. Therefore, remedial alternatives should be considered to reduce potential threat.

C.1.5 OPERABLE UNIT 2 CONTAMINANTS OF CONCERN

Not all constituents identified during the Operable Unit 2 baseline risk assessment pose significant health risks. The baseline risk assessment evaluated constituents and exposure pathways to ascertain their potential present and future impacts on human health. In general, constituents that resulted in risks to a receptor of greater than 10^{-6} or which yielded an HQ greater than 0.2 were designated as COCs to be considered in the selection of remedial alternatives. Those COCs and the media in which the carcinogenic risk level or HQ was greater than 10^{-6} or 0.2, respectively, are presented in Table C.1-2.

C.1.6 ORGANIZATION OF THIS APPENDIX

To accomplish the identified objectives, this FS risk assessment is organized as follows:

- C.1.0 Introduction:
  This section outlines the objectives of the FS risk assessment, presents a brief FEMP site history and subunit description and provides a summary of the RI baseline risk assessment. Operable Unit 2 COCs evaluated in this risk assessment are also identified.

- C.2.0 Overview of Technical Approach and Assumptions:
  The four FS remedial alternatives are compared, and based on these alternatives, the remedial and residual conceptual models are presented. To execute these models, several factors and assumptions are identified.

- C.3.0 Exposure Quantification Methodology:
  This section presents the equations used to quantity risk through air, water, and soil exposures. Equations for calculating remedial action risks, including direct radiation, physical injury, inhalation and transportation, are also presented.

- C.4.0 Toxicity Assessment:
  In this section, a toxicity assessment is presented for a qualitative evaluation of the scientific data to determine the nature and severity of the toxic properties associated with the COCs. Toxicity profiles are included for the radionuclides and chemicals that may result in an adverse effect on a biological receptor. The relationship between the dose received by a receptor and the incidence of an adverse effect is defined.

- C.5.0 Fate and Transport Modeling:
  This section describes the methodology used to quantitatively predict COC concentrations for remedial activities and residual sources. It includes discussions of: 1) the fate and transport models used, 2) the required data and default parameter values, 3) the technical approach that determines the appropriate model for each potential exposure assessment, and 4) model results.

- C.6.0 Remedial Action Risk Characterizations:
  The methodology used and the results of the risk estimates for remedial action activities are presented.

- C.7.0 Residual Risk Characterizations:
  This section defines the methodology used in generating the residual risks to human health from exposure to residual COCs. This information is presented as qualitative and quantitative estimates of health risk for each alternative.

- C.8.0 Uncertainty Analysis:
  This section discusses the uncertainties associated with the results of the remedial and residual risks.

- C.9.0 Summary of Risk Assessment Results:
  A summary of remedial action and residual risks is presented by receptor, subunit, and remedial alternative.

- References:
  Literature cited is presented in this section.

TABLE C.1-2

OPERABLE UNIT 2 CONTAMINANTS OF CONCERN

COC	Solid Waste Landfill	Lime Sludge Ponds	Inactive Fly Ash Pile	South Field	Active Fly Ash Pile
Chemicals					
Antimony	●				
Aroclor-1254				●	
Aroclor-1260				●	
Arsenic	●		●	●	●
Benzo(a)anthracene	●			●	
Benzo(a)pyrene	●			●	
Benzo(b)fluoranthene	●			●	
Benzo(k)fluoranthene				●	
Beryllium	●			●	●
Carbazole	●				
Dibenzo(a,h)anthracene	●		●	●	
Dieldrin				●	
Indeno(1,2,3-cd)pyrene	●			●	
Uranium (Total)	●	●	●	●	●
Radionuclides					
Cs-137		●		●	●
Np-237	●	●		●	●
Pu-238	●				
Ra-226	●	●	●	●	●
Ra-228	●	●	●	●	●
Rn-222	●		●	●	●
Sr-90		●		●	●
Tc-99	●	●		●	
Th-228	●	●	●	●	●
Th-230	●	●		●	
Th-232	●	●	●	●	●
U-234	●	●	●	●	●
U-235/236	●	●	●	●	
U-238	●	●	●	●	●

Source: Operable Unit 2 RI report, Appendix B, Table 4-0 (DOE 1994a)

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C.2

C.2.0 OVERVIEW OF TECHNICAL APPROACH AND ASSUMPTIONS

To evaluate feasible alternatives for the Operable Unit 2 subunits, two types of risk were assessed: short-term or "remedial action" risks, and long-term or "residual" risks. Remedial action risks are the direct result of implementing activities such as excavation and transportation of waste materials, while residual risks result from exposure to postremediation sources such as the disposal cell or covers, that is, those sources remaining on site after all remedial actions have been completed. For Operable Unit 2, four remedial alternatives have been selected for consideration (see Section 5.0 of this FS report), which implies four different sets of remedial activities and postremediation site conditions. This risk assessment is designed to evaluate the potential risks to various receptors under each alternative due to exposure during remedial activities or from residual contamination.

The methodology used in this risk assessment is consistent with the Amended Consent Agreement and follows the approach presented in the RAWPA (DOE 1992), which in turn derives much of its methodology from the EPA RAGS (EPA 1989a). The technical approach was developed within the context of the overall RI/FS process for the FEMP to determine if the Operable Unit 2 remedial alternatives protect human health and the environment or, if they do not, to provide information useful in developing the best path forward. This risk assessment has been prepared in conjunction with EPA, Ohio Environmental Protection Agency (OEPA), and DOE guidelines to assess the potential risk of exposure to radionuclides and hazardous chemicals.

Section C.2.1 summarizes the four remedial alternatives for Operable Unit 2. Sections C.2.2 and C.2.3 describe the conceptual models for remedial action risks and residual risks, respectively. The conceptual models are used to examine the potential sources, mechanisms, and pathways of contamination for receptors under each alternative. Section C.2.4 discusses the major assumptions used to estimate conditions.

After the conceptual models were developed, fate and transport computer codes were used to simulate the transport processes. A discussion of the computer codes can be found in Section C.5.0.

C.2.1 REMEDIAL ALTERNATIVES

As previously stated, the role of this FS is to analyze and select potential remedial alternatives. The elements involved in screening, evaluating, and selecting alternatives are outlined in Section 4.0 of this FS report. The evaluations of remedial action and residual risks presented in this appendix support the selection of a final remedy by focusing on the four potential remedial alternatives identified in the FS. The four alternatives analyzed are briefly described in this section, as are the postremediation site conditions under each.

C.2.1.1 Alternative 1: No Action

Alternative 1, No Action, provides a baseline against which other alternatives can be evaluated (Figure C.2-1). Under this alternative, no remedial action would be taken and the material in the subunits would be considered left in-place, "as is," with no containment, removal, treatment, or other mitigating actions.

C.2.1.2 Alternative 2: Consolidation and Capping

Alternative 2 includes consolidation of contaminated materials within each subunit and subsequent capping with a composite capping system (Figure C.2-2). Materials would be excavated, consolidated and placed under caps in three areas: South Field, Solid Waste Landfill and the Lime Sludge Ponds. The following describes the implementation of this alternative for each of these areas.

At the Active Flyash Pile, Inactive Flyash Pile, and South Field, contaminated material directly overlying the Great Miami Aquifer (GMA) and/or down surface from the old terrace face would be excavated and moved to the northeastern side of the boundary limits, where the undisturbed till is at least 5 meters (16 feet) deep. All contaminated material within the floodplain would also be moved.

After excavation and consolidation of the materials at the Active Flyash Pile, Inactive Flyash Pile, and South Field, a subsurface drain would be constructed along the southwestern side of the consolidation area to collect groundwater from the underlying perched aquifer. The drain would discharge by gravity into a pumping station. Collected leachate and groundwater would be pumped to the Advanced Wastewater Treatment (AWWT) facility for treatment. Excavation

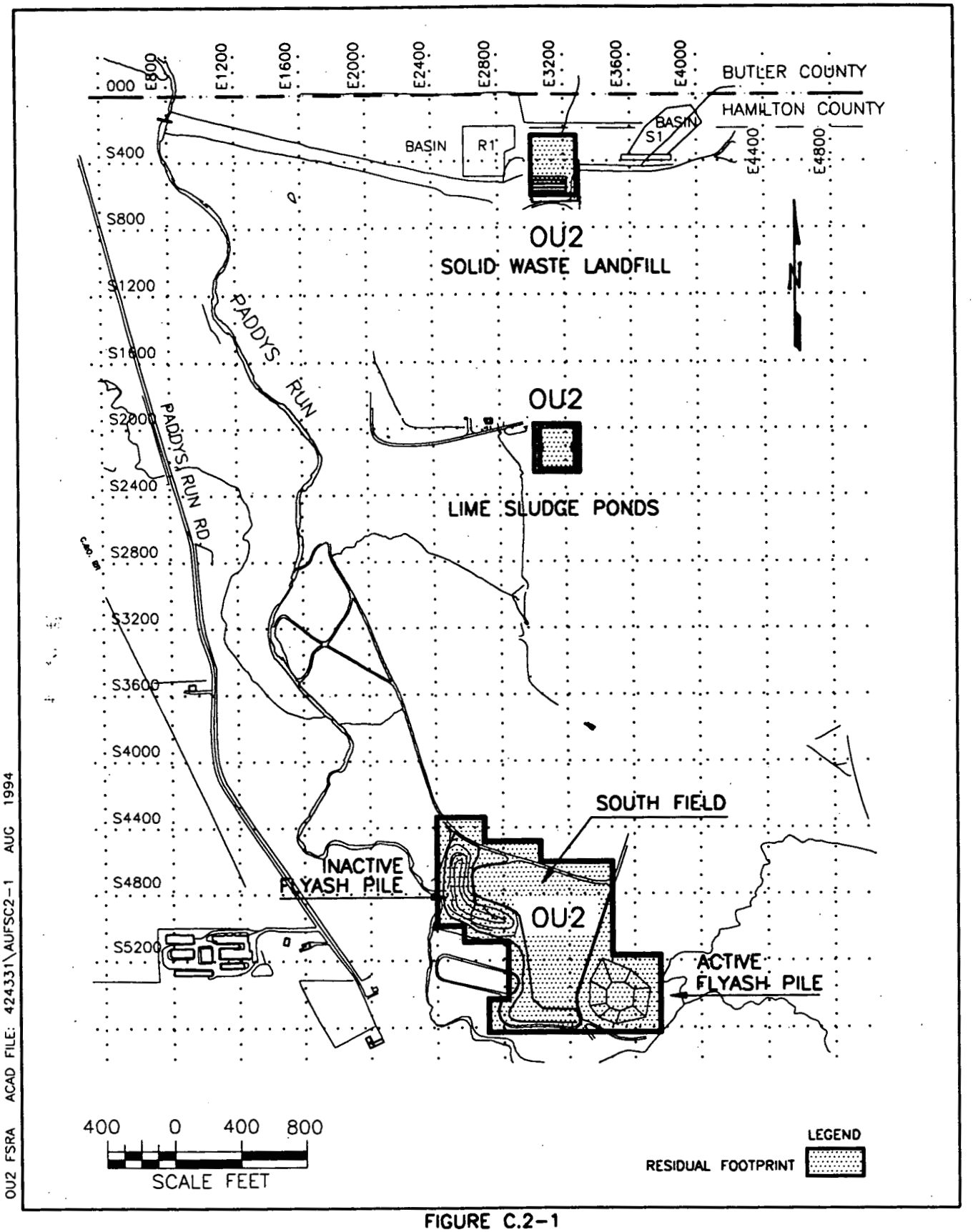

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FIGURE C.2-1
POSTREMEDIATION SITE, OU2 ALTERNATIVE 1, NO ACTION

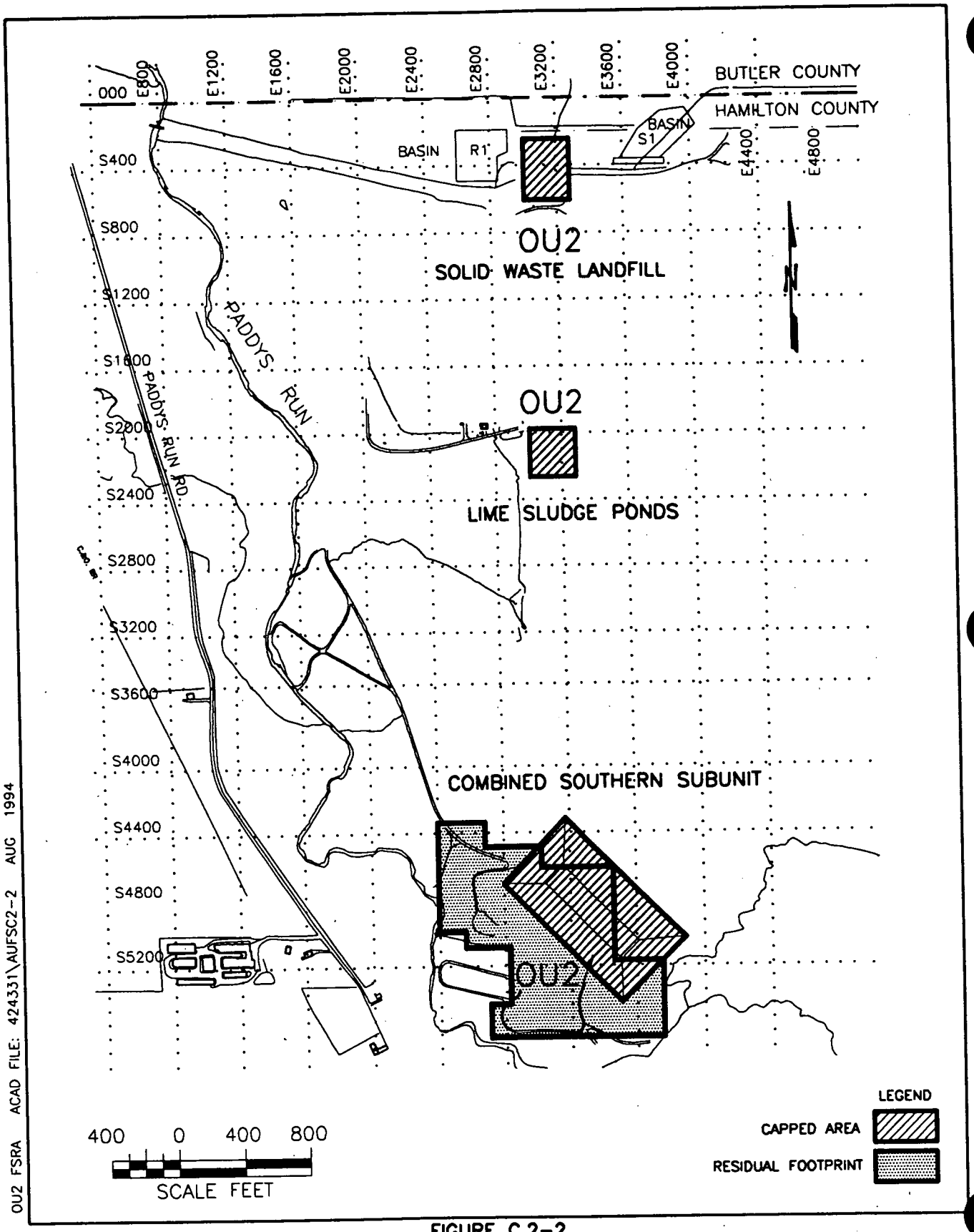

FIGURE C.2-2
POSTREMEDIATION SITE, OU2 ALTERNATIVE 2, CONSOLIDATION AND CAPPING

operations along the eastern boundary of the South Field would impact an existing 15-centimeter (6-inch) water line and the 61-centimeter (24-inch) South Plume extraction system force main. These lines would be relocated.

For the Solid Waste Landfill, material close to the interbedded sand in the southeast corner of the landfill would be excavated. This excavated material would be replaced by clean clay to retard migration of contaminants into interbedded sand. Material along the south side of the landfill would be removed to allow placement of a proper foundation for the capping system adjacent to the railroad track. Material in the northeast corner of the landfill would be consolidated under the cap in order to simplify the design geometry and subsequent construction of the composite cap. A drainage swale immediately north of the Solid Waste Landfill would be impacted. This swale was delineated as a wetland in a 1993 study (DOE 1994a). Replacement of drainage systems and/or wetlands would be required. Wetlands restoration will be addressed as part of a site-wide plan to be developed under Operable Unit 5. Monitoring wells encountered during the excavation activities would be plugged in accordance with appropriate abandonment procedures.

Following completion of consolidation activities at each subunit, excavated areas would be backfilled, and the entire consolidation area at each subunit would be regraded to match the surrounding topography. A multi-layer capping system would then be constructed over the consolidated materials.

Water generated during construction would be collected as required to maintain a dry excavation and then transferred to a holding/sedimentation tank for gravity settling of suspended solids. The overflow from the holding tank would be pumped to the AWWT facility for treatment and disposal.

Alternative 2 would include the following institutional controls at each of the consolidation areas: access restrictions, groundwater monitoring, cap maintenance, and deed restrictions to prohibit groundwater use and future development.

C.2.1.3 Alternative 3: Excavation and Off-Site Disposal

This alternative involves excavating all material contaminated above PRLs, visual segregation, staging, shredding or crushing for size reduction, drying for moisture control, packaging, and off-

site disposal (Figure C.2-3). To evaluate potential off-property disposal sites and associated treatment, transportation and disposal costs, Alternative 3 would provide for disposal of contaminated material at a commercial facility, assumed to be EnviroCare in Utah.

The excavation would be completed to the required depth established by modelling. Upon reaching this predetermined depth, verification sampling and testing would be completed to confirm that all contaminated material had been removed. If the results of the verification sampling and testing indicate that unacceptable contamination levels remain, the excavation would be extended in increments until acceptable test results are obtained. Upon verification that the required removal has been accomplished, the excavated area would be backfilled and graded to match the surrounding topography, provided with adequate runoff control, and revegetated.

All excavated material would be visually segregated into flyash, lime sludge, soil, trash, and debris. The trash or debris would be shredded or crushed, packaged, and transported off-site for disposal. Soil containing lead (from the firing range) which has been characterized using the Toxicity Characteristics Leaching Procedure (TCLP) as Resource Conservation and Recovery Act (RCRA) waste would be excavated, containerized, and transported to a RCRA approved facility for treatment and disposal. The quantity of soil requiring disposal is estimated at 230 cubic meters (300 cubic yards). The fraction of soil, sludge, flyash, and debris would be dried as required and transported off site for disposal.

The remedial activities for the following items are described in Alternative 2 (Section C.2.1.2): construction-generated water, the South Field water line and South Plume extraction system, and the Solid Waste Landfill drainage swale and monitoring wells. Since all contaminated material would be transported off-site, no long-term institutional controls would be required.

C.2.1.4 Alternative 6: Excavation and On-Site Disposal with Off-Site Disposal of Fraction Exceeding WAC

Under this alternative, material contaminated above PRLs would be excavated from each subunit and transported to an on-site, engineered disposal cell (Figure C.2-4). Waste material failing to meet the disposal cell WAC would be disposed off-site at a permitted commercial facility. As described in Alternative 3 (Section C.2.1.3), the excavation would be completed to the required depth established by modelling. Upon verification that the required removal has been

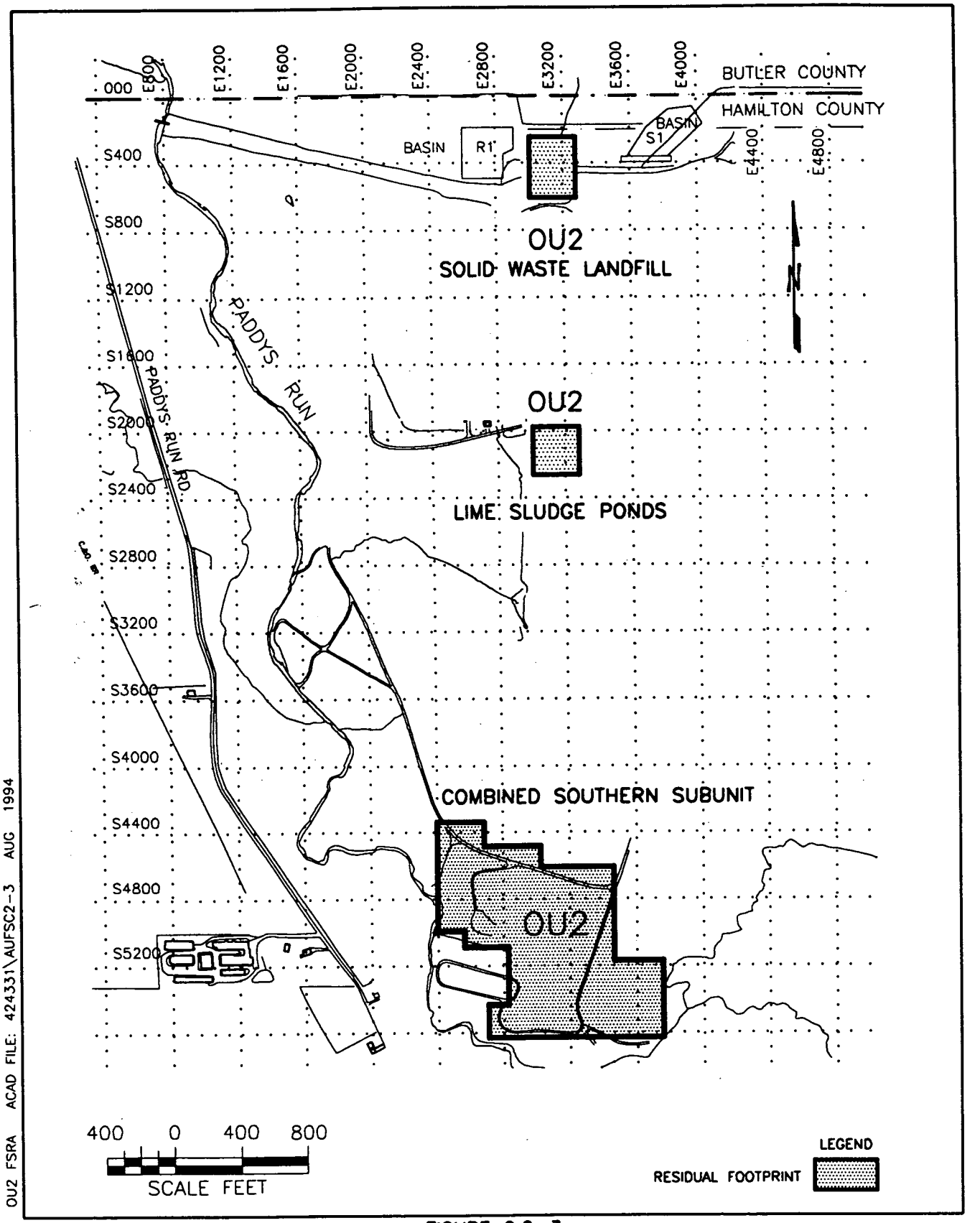

FIGURE C.2-3
POSTREMEDIATION SITE, OU2 ALTERNATIVE 3, OFF-SITE DISPOSAL

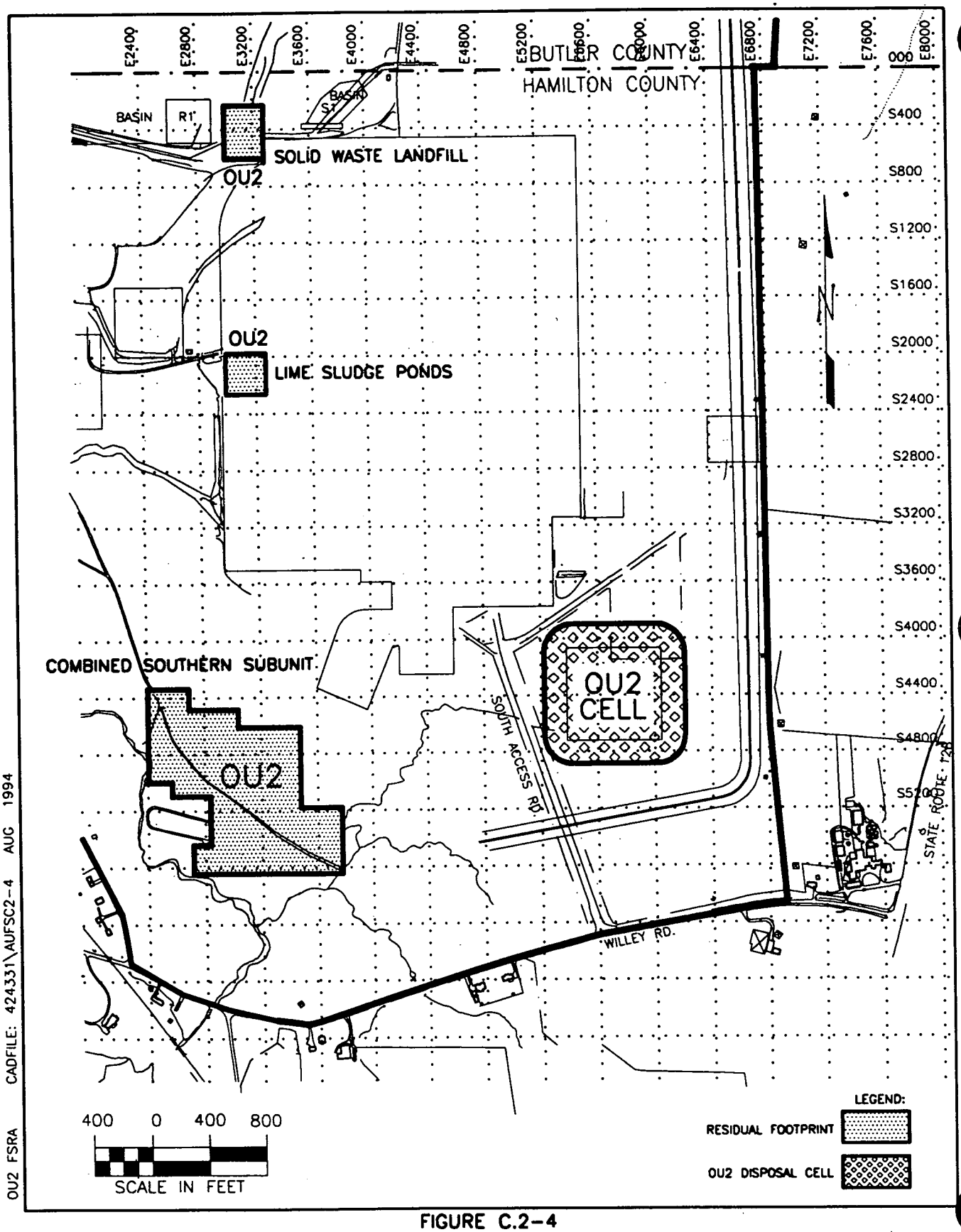

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FIGURE C.2-4

POSTREMEDIATION SITE, OU2 ALTERNATIVE 6, EXCAVATION AND ON-SITE DISPOSAL

accomplished, the excavated area would be backfilled and graded to match the surrounding topography, provided with adequate runoff control, and revegetated.

Contaminated material such as trash and construction or demolition debris (e.g., concrete, drums, steel, pallets) would be crushed or shredded to reduce volume and placed in the on-site disposal facility. As in Alternative 3 (Section C.2.1.3), lead-contaminated soil from the firing range would be analyzed by the TCLP for lead. Soils passing the TCLP for lead would not be considered a hazardous waste and would be disposed with the consolidated material in the South Field.

The remedial activities for the following items are described in Alternative 2 (Section C.2.1.2): construction-generated water, the South Field water line and South Plume extraction system, and the Solid Waste Landfill drainage swale and monitoring wells. Alternative 6 would also include the following institutional controls at the disposal cell: access restrictions, groundwater monitoring, disposal cell maintenance, and deed restrictions to prohibit groundwater use and future development.

C.2.2 DEVELOPMENT OF REMEDIAL RISK CONCEPTUAL MODELS

Conceptual models have been developed to provide a framework for identifying and evaluating the potential risk to human health during remediation of the FEMP. The models facilitate the analysis of exposure routes and receptors, focusing on those pathways and sources that drive the potential impacts to human-health risk and screening out other exposure pathways that are likely to pose minor risks. As shown in Figure C.2-5, the models trace the exposure pathways from each alternative activity through the exposure media and exposure pathways to the affected receptors. The models also indicate which exposure routes are carried through the quantitative risk assessment for each receptor.

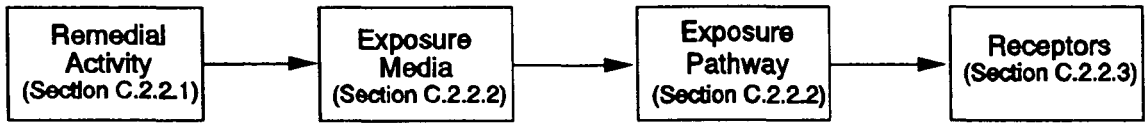


FIGURE C.2-5
FLOW OF REMEDIAL RISK CONCEPTUAL MODEL (ALL ALTERNATIVES)

Section C.2.2.1 describes the different work activities for each remedial action alternative. Section C.2.2.2 describes the alternative exposure scenarios that pose a short-term risk to the receptors discussed in Section C.2.2.3. Detailed conceptional models are presented in Section C.2.2.4.

C.2.2.1 Remedial Activities

Except for Alternative 1 (No Action), the remedial action alternatives involve a range of work activities and varying degrees of physical risk and potential exposure to Operable Unit 2 COCs. The remedial activities for the feasible remedial alternatives identified for Operable Unit 2 (Alternatives 2, 3, and 6) are summarized in Table C.2-1 and described below for each alternative. Note that emission controls will be used to mitigate exposure due to sorting/separating and crushing/shredding activities.

- Alternative 2 - Consolidation and Capping:

  Water extraction and transfer to AWWT facility; mechanical and slurry removal of waste and associated materials; waste segregation; stockpiling materials; crushing and shredding of materials; runoff control construction; surface soil excavation; monitoring of air, groundwater, leachate, surface water, and sediment; consolidation area capping and site restoration; and administrative controls.

- Alternative 3 - Excavation and Off-Site Disposal:

  All remedial activities of Alternative 2 plus activities involved with off-site disposal. Off-site disposal involves material stockpiling, blending, and bulk loading for transport, off-site shipment and ultimate disposal.

- Alternative 6 - Excavation and On-site Disposal with Off-site Disposal of Fraction Exceeding WAC:

  In addition to the remedial activities identified in Alternative 2, this alternative involves the construction and closure of a disposal cell.

  Waste material failing to meet the disposal cell WAC would be disposed off-site at a permitted commercial facility. This includes remedial activities associated with off-site disposal as defined in Alternative 3.

C.2.2.2 Remedial Action Exposure Scenarios

To estimate remedial action risks, the phases of an alternative that may contribute to short-term risks have been identified. Figures C.2-6, C.2-7 and C.2-8 show the significant remedial activities

TABLE C.2-1

RELATIONSHIP BETWEEN OU2 REMEDIAL ACTIVITIES AND REMEDIAL ALTERNATIVES

	Remedial Alternative			
	1	2	3	6
Remedial Activity	No Action	Consolidation and Capping	Excavation and Off-Site Disposal	Excavation and On-Site Disposal with Off-Site Disposal of Fraction Exceeding WAC
Soil/Sediment/Waste				
Physical Barriers		o		o
Security Guards		o		o
Deed Restrictions		o		o
Composite Cap		o		o
Restoration (backfilling)		●	●	●
Surface Water Controls		o	o	o
Mechanical Excavation		●	●	●
Sorting/Separating		o	o	o
Revegetation			o	o
Crushing/Shredding*		o	o	o
Drying			●	
On-Site Disposal Facility				●
Off-Site Disposal Facility			●	●
Off-Site Hazardous Waste Disposal Facility		o	o	o
Truck Transportation (on-site)		●	●	●
Rail Transportation			●	●
Groundwater/Construction Water				
Groundwater Monitoring Wells		o		o
French Drains/Interception Trenches		o		
Excavation Dewatering		o	o	o
Sedimentation		o	o	o
AWWT Facility		o	o	o
Discharge to Great Miami River		o	o	o

Legend:
● = Remedial Activity associated with remedial action risk (see Section C.2.2.1).
o = Remedial Activity does not affect remedial action risk.
AWWT = Advanced wastewater treatment.
*Potential emissions associated with these activities will be controlled.

for Alternatives 2, 3 and 6, respectively. As a result, this assessment examines seven distinct remedial alternative activities that have the potential for contributing to remedial action risks. Risks from individual activities comprising a remedial alternative have been combined to develop an overall estimate for the risk associated with the alternative. The following list presents the activities and the alternatives that contain the activity:

Remedial Activity	Alternative Containing Activity
Excavation	Alternatives 2, 3, and 6
Drying	Alternatives 3
On-Site Disposal	Alternatives 2 and 6
Off-Site Waste Transportation	Alternatives 3 and 6
Restoration	Alternatives 2, 3 and 6
On-Site Waste Transportation	Alternatives 2, 3, and 6
Waste Storage	Alternatives 3 and 6

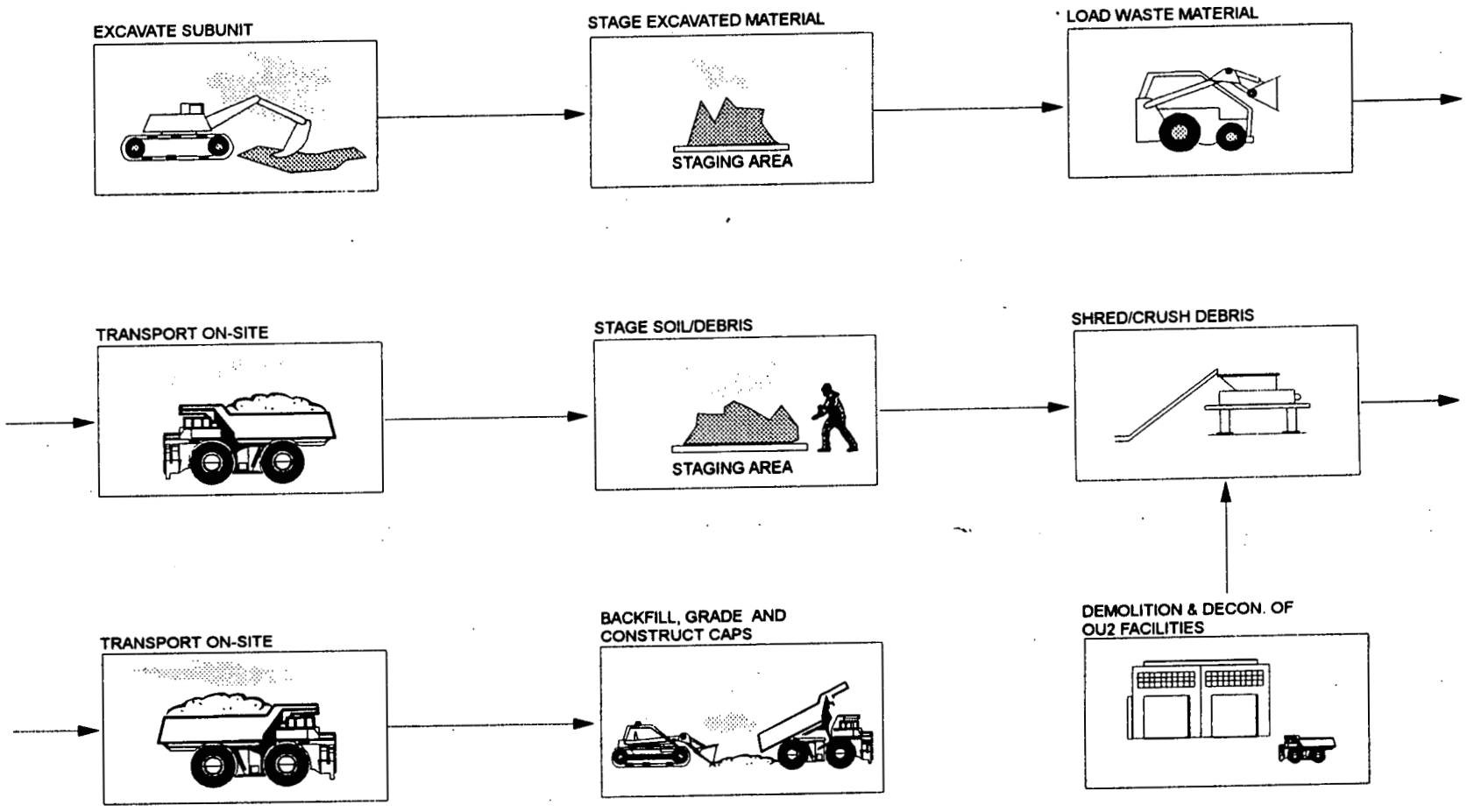
Excavation

During excavation, heavy equipment would remove the contaminated surface soil, berms, liners, and underlying soil for ultimate disposal. This remedial activity has the potential to suspend dust containing COCs in the air. Remediation workers monitoring soil contamination levels would be exposed to ionizing radiation from inhalation, external radiation, and immersion in the contaminated air. Airborne COCs would be transported to nonremediation workers on property and to individuals off property. These receptors would also be exposed via inhalation and immersion. Finally, remediation workers would be subject to mechanical hazards during excavation and construction of ancillary facilities.

The number of hours and persons involved in monitoring activities would be considerably less than those for excavation activities. Exposures due to monitoring activities would constitute only a small fraction of the intakes due to excavation activities; hence, intakes and exposures of monitoring workers have not been expressly analyzed.

Drying

During drying, volatile organic compounds (VOCs) would be released through the off-gas system. The remediation workers, nonremediation workers, and off property individuals would inhale chemical COCs and be exposed from immersion in the contaminated air. Particles from drying



NOTE: FOR THE SOUTH FIELD, STABILIZE MATERIAL CONTAMINATED WITH LEAD AND DISPOSE AT ENVIROCARE.

FIGURE C.2-6
ALTERNATIVE 2 REMEDIAL ACTIVITIES
CONSOLIDATION AND CAPPING

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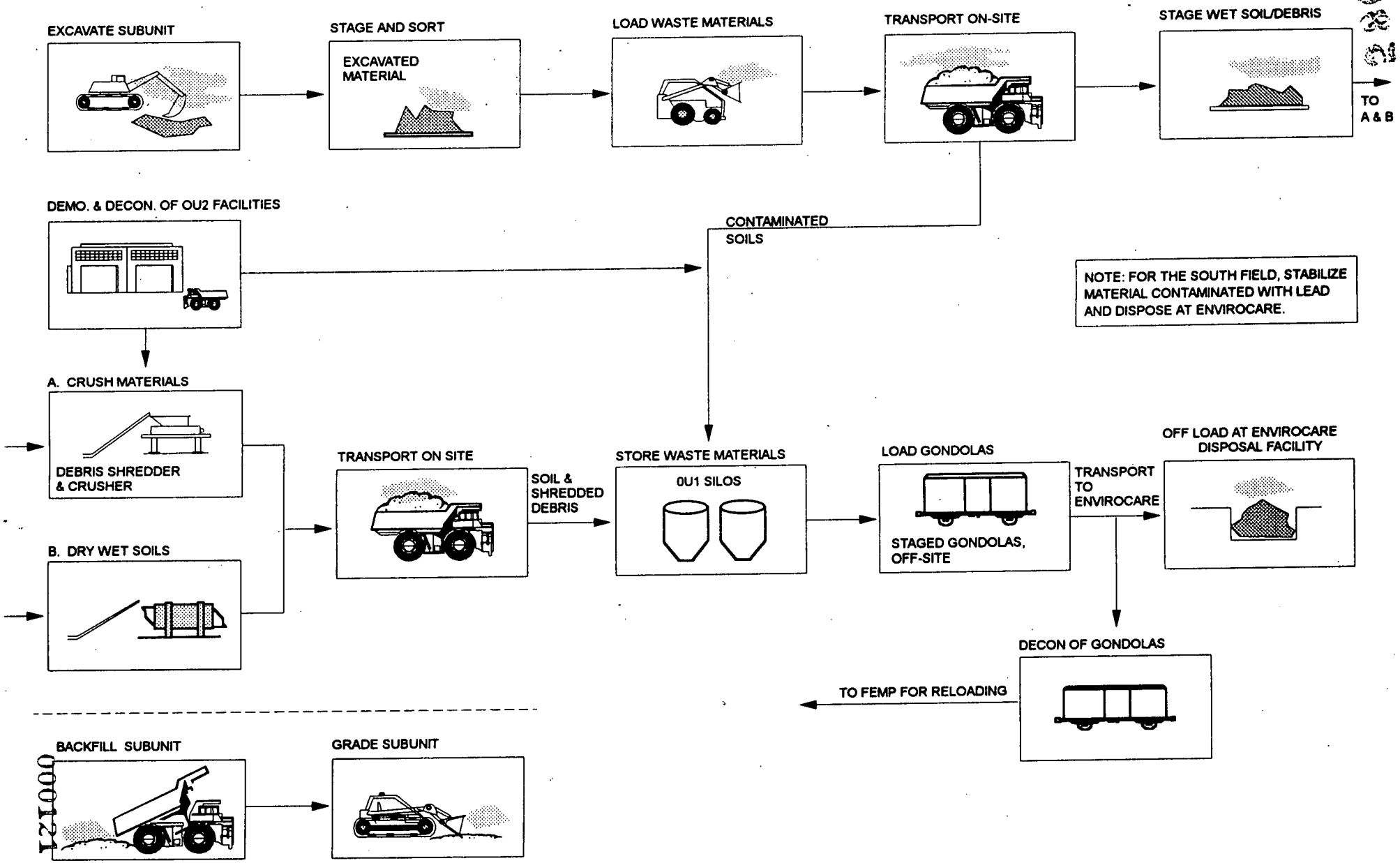

FIGURE C.2-7
ALTERNATIVE 3 REMEDIAL ACTIVITIES,
EXCAVATION AND OFF-SITE DISPOSAL

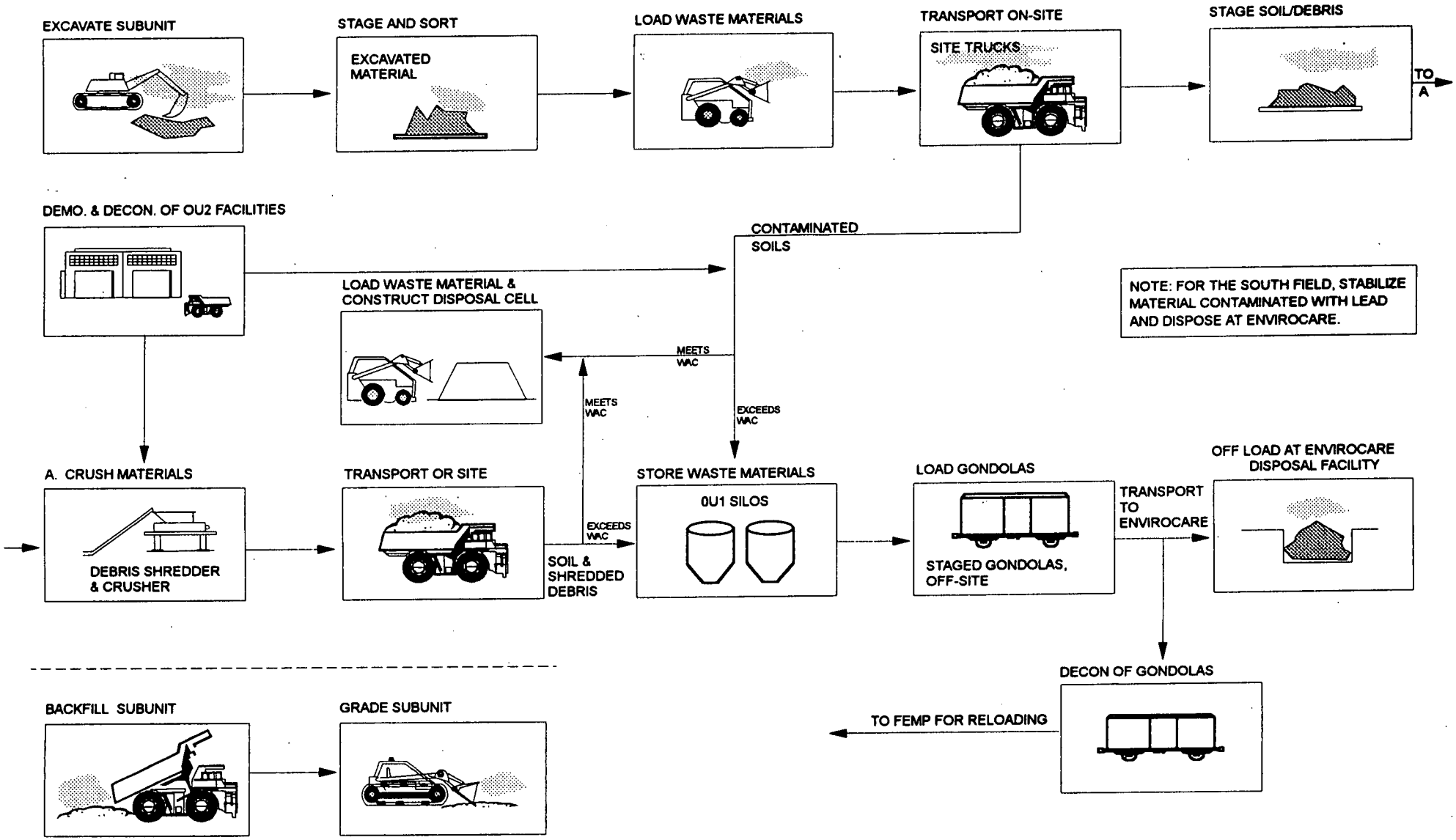

FIGURE C.2-8
ALTERNATIVE 6 REMEDIAL ACTIVITIES,
EXCAVATION AND ON-SITE DISPOSAL WITH OFF-SITE DISPOSAL
OF FRACTION EXCEEDING WAC

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would be controlled using the best available technology. Remediation workers would be subject to mechanical hazards during construction of the drying facility.

Remediation workers (operators) would be exposed to external radiation that constitutes only a fraction of the dose received by excavation workers because of shielding from the equipment. Also, inhalation and immersion would be only a small fraction of that which the remediation workers, nonremediation workers, and public could receive from excavation activities. This is because all air COCs would be treated in the off-gas system, which removes all but a very small fraction of the particulate through the HEPA filter. Radon would not be removed by the off-gas system, but the majority would be released through soil disturbance during excavation, and the residence time in the dryer would not be sufficient to cause the further generation of substantial amounts of radon. Therefore, no intakes or exposures to radioactive materials have been assumed for any receptors.

On-Site Disposal

The on-site disposal facility would be constructed on a portion of the site that had been cleaned. Remediation workers would be subject to mechanical hazards during construction of the facility and waste emplacement. During waste emplacement, all receptors would be exposed to COCs through inhalation and immersion and to external radiation at levels equal to or less than those encountered during the excavation activities. These exposures have been estimated using ratios of person-hours of exposure and intake for the two activities.

Off-Site Waste Transportation

Following drying, the excavated material would be loaded onto rail cars (gondolas). During loading, remediation workers would be exposed to contaminated dust and external radiation from the material. The worker exposures to contaminated dust are bounded by those encountered during excavation by duration alone; therefore, this pathway has not been specifically evaluated. These workers would also be placed at risk from mechanical hazards. During transport, train crews would be exposed to external radiation from the material. Individuals living on the transportation route or sharing the transportation route would also be exposed to external radiation. Workers in the vicinity of the rail staging area would be exposed to external radiation. Finally, members of the public would potentially be exposed to external radiation from air and ground contamination and inhale COCs following a postulated transportation accident.

A contingency plan would be developed and submitted to the agencies for approval prior to the implementation of remedial activities. The plan would address on-site waste transportation.

Restoration

Following remediation of contaminated materials in Operable Unit 2, existing equipment, slabs, and roadways would be decontaminated and demolished. Excavated areas would be backfilled with clean soil and caps constructed. Remediation workers would be placed at risk from exposure to contaminated materials and mechanical hazards associated with these activities. The exposures and intakes from decontamination of equipment and materials would be only a fraction of those encountered during excavation and have therefore not been specifically evaluated.

On-Site Waste Transportation

All alternatives would require the transportation of contaminated materials by truck. Remediation workers (truck drivers) would be at risk from direct radiation and mechanical hazards (i.e., accidents) incurred when driving the truck. Note that inhalation risks have been considered as part of excavation activities.

Waste Storage

Wastes would be stored in silos pending disposition, and therefore the silos would pose a external radiation hazard to workers. Silos would be used for Alternatives 3 and 6 only.

C.2.2.3 Receptors Impacted

Remedial action risks are lifetime cancer risks associated with the exposure to chemical carcinogens and ionizing radiation, toxic effects associated with noncarcinogenic chemicals, and direct physical injuries associated with construction and transportation activities. This risk assessment estimates risks from exposures to three groups of individuals: remediation workers, nonremediation workers, and the general public. These remedial action receptors were selected for the Operable Unit 2 FS based on EPA comments on the Operable Unit 1 FS, which included the addition of a remedial worker.

On-Property Remediation Workers

On-property remediation workers would be placed at risk through their direct participation in remedial activities. They may be exposed to contaminated materials either through routine

operations or accidents. Remediation workers would be subject to mechanical hazards while relocating contaminated soil and while constructing or operating the physical plant performing the remediation.

On-Property Nonremediation Workers

On-property nonremediation workers include all other workers on the FEMP. These workers include the administrative and clerical staff of the Fernald Environmental Restoration Management Company (FERMCO) and its subcontractors, and workers at sites adjacent to the remediation effort. Nonremediation workers would be at potential risk from exposure to airborne COCs released during remedial activities. They are not considered to be subject to an increased level of mechanical hazards and would be too far away from the contaminated soil to receive significant external radiation exposure from soil.

Off-Property Remediation Workers

Off-property remedial workers are envisioned to be the train crew and rail workers who would transport the FEMP waste to off-site disposal facilities. The magnitude of impact to these receptors depends on the level of COCs in the transported waste, the degree of shielding provided by the rail cars, the receptor's proximity to the rail cars, and the duration of transport, including stops.

Near-Property Public

For those scenarios in which contaminants would be dispersed in the air and carried to the FEMP site boundary, members of the public are assumed to be located at the fenceline.

Public Along the Transportation Route

For transportation scenarios, the off-property general public are those who live along the transport route. The magnitude of impact to the off-property general public depends on the level of COCs in the transport containers, the receptor's proximity to the rail cars, the duration of transport (including stops), and the severity of potential accidents. The public along the transportation route would be exposed to direct radiation as the train passes by. Members of the public would potentially inhale radionuclides and be exposed to external radiation from air and ground contamination following a postulated transportation accident.

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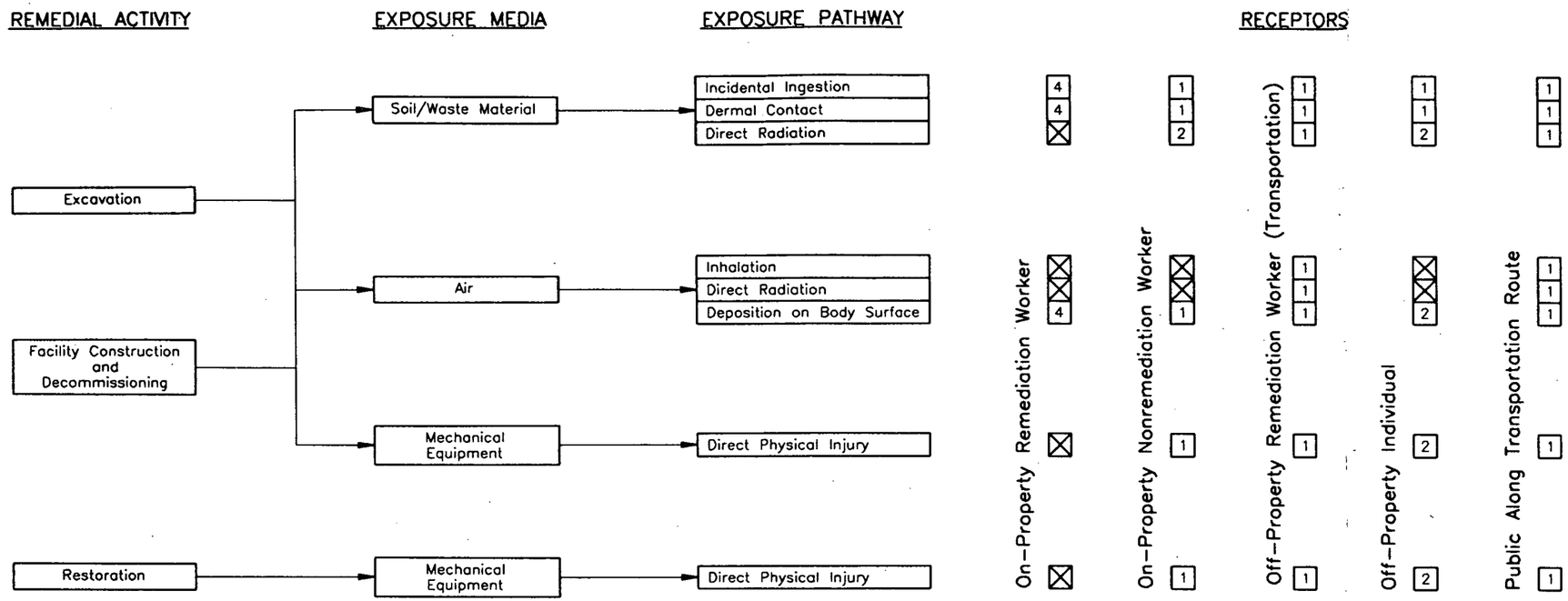
REMEDIAL RISK CONCEPTUAL MODEL, ALTERNATIVE 2
CONSOLIDATION AND CAPPING



Legend:

- ☒ Denotes a complete pathway. Pathway-specific risk is quantified in this risk assesment.
- 1 Exposure route incomplete or not applicable.
- 2 Potential impact of this exposure pathway is insignificant when compared to the other exposure pathways for the same receptor.
- 3 CERCLA risk assessment methodology for radionuclides does not address this exposure route.
- 4 Denotes that pathway is mitigated by use of PPE and other administrative controls.

FIGURE C.2-9 REMEDIAL RISK CONCEPTUAL MODEL FOR ALTERNATIVE 2

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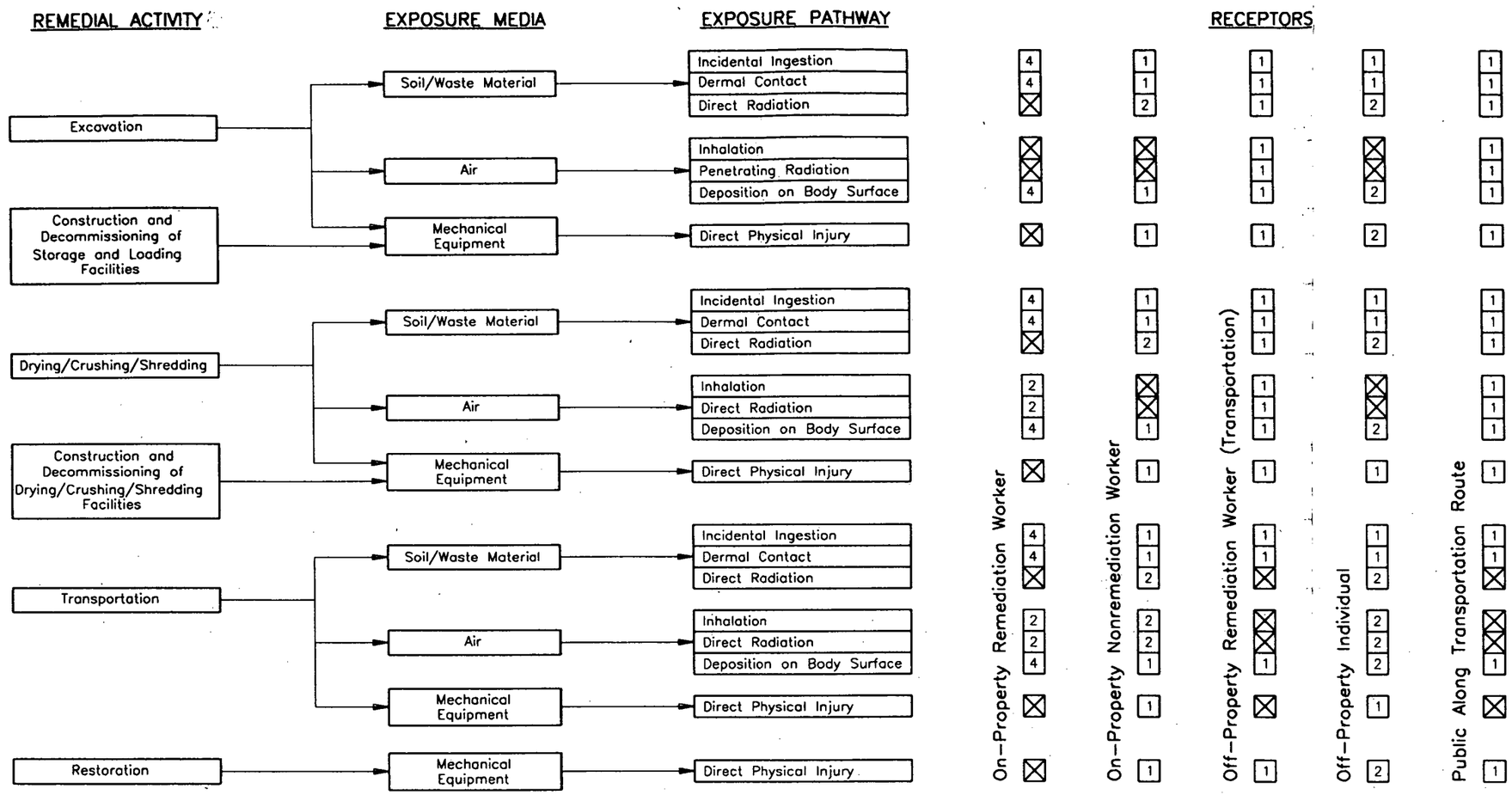
REMEDIAL RISK CONCEPTUAL MODEL, ALTERNATIVE 3
EXCAVATION AND OFF-SITE DISPOSAL



Legend:

- ☒ Denotes a complete pathway. Pathway-specific risk is quantified in this risk assesment.
- 1 Exposure route incomplete or not applicable.
- 2 Potential impact of this exposure pathway is insignificant when compared to the other exposure pathways for the same receptor.
- 3 CERCLA risk assessment methodology for radionuclides does not address this exposure route.
- 4 Denotes that pathway is mitigated by use of PPE and other administrative controls.

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FIGURE C.2-10 REMEDIAL RISK CONCEPTUAL MODEL FOR ALTERNATIVE 3

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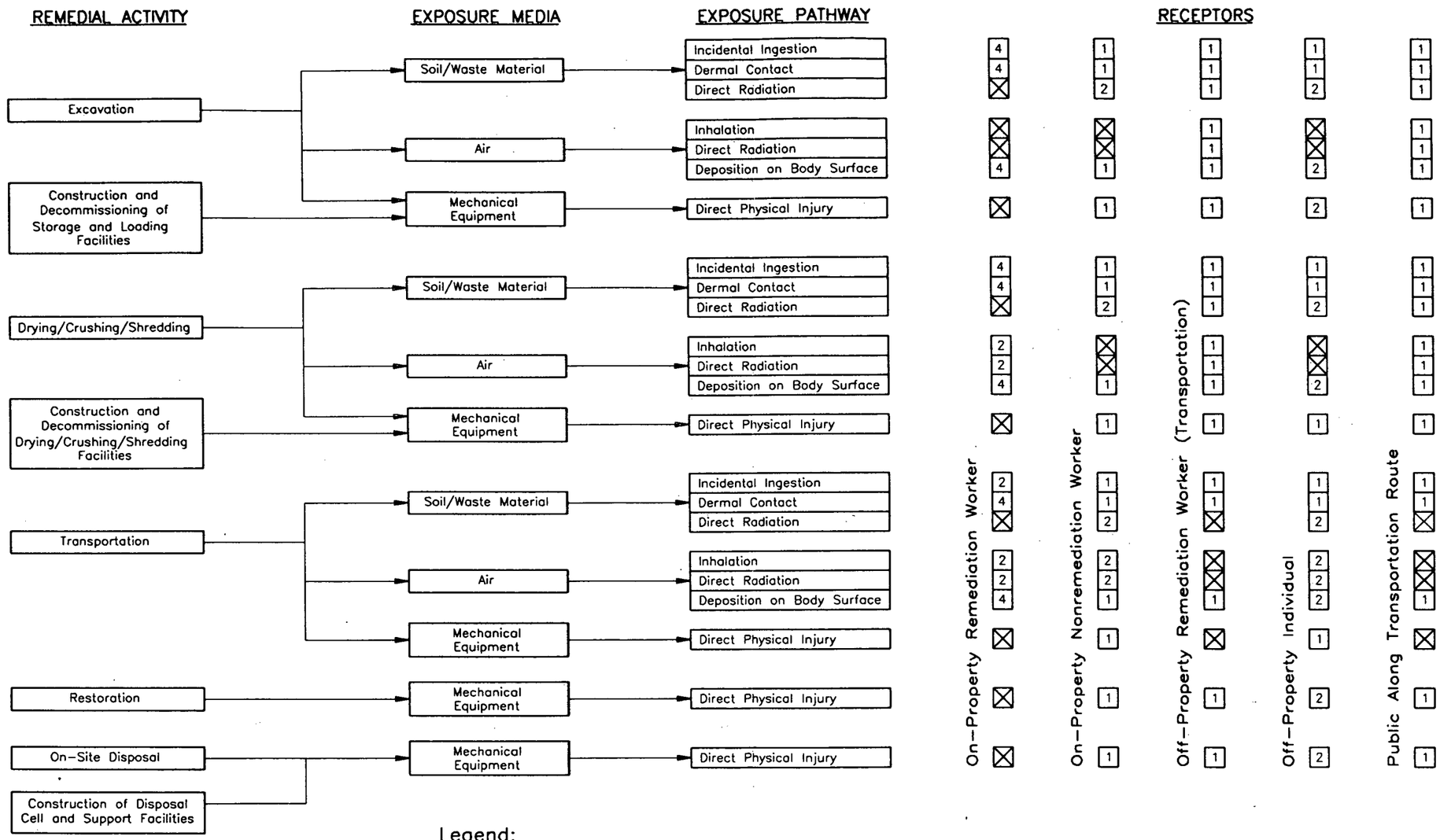
REMEDIAL RISK CONCEPTUAL MODEL, ALTERNATIVE 6
EXCAVATION AND ON-SITE DISPOSAL WITH OFF-SITE DISPOSAL OF FRACTION EXCEEDING WAC



Legend:

- ☒ Denotes a complete pathway. Pathway-specific risk is quantified in this risk assesment.
- 1 Exposure route incomplete or not applicable.
- 2 Potential impact of this exposure pathway is insignificant when compared to the other exposure pathways for the same receptor.
- 3 CERCLA risk assessment methodology for radionuclides does not address this exposure route.
- 4 Denotes that pathway is mitigated by use of PPE and other administrative controls.

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FIGURE C.2-11 REMEDIAL RISK CONCEPTUAL MODEL FOR ALTERNATIVE 6

C.2.2.4 Remedial Risk Conceptual Models

This section presents the detailed conceptual models developed to describe the remedial risk for each of the four alternatives outlined in Section C.2.2.1. Figure C.2-9 represents the remedial exposure under Alternative 2 - Consolidation and Capping. Figure C.2-10 illustrates the remedial exposure for Alternative 3 - Excavation and Off-site Disposal. Figure C.2-11 presents Alternative 6 - Excavation and On-site Disposal with Off-site Disposal of Fraction Exceeding WAC. No conceptual model is presented for Alternative 1, which has no remedial activities.

C.2.3 DEVELOPMENT OF RESIDUAL RISK CONCEPTUAL MODELS

The conceptual models developed for residual risk have the same function and follow the same principles as the models for remedial risk (Section C.2.2). Both types are used to analyze exposure routes and receptors, focusing on those pathways and sources that drive the potential impacts to human-health risk and screening out other exposure pathways that are likely to pose minor risks. Figure C.2-12 presents the general flow of the residual risk conceptual models. As shown in the figure, the models trace the exposure pathways from the residual sources through the release mechanisms and exposure routes to the affected receptors. The models also indicate which exposure routes are carried through the quantitative risk assessment for each receptor under varying postremediation uses.

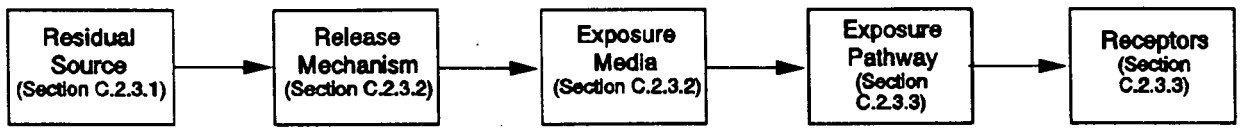

FIGURE C.2-12
FLOW OF RESIDUAL RISK CONCEPTUAL MODEL
(ALL ALTERNATIVES)

Section 2.3.1 presents a discussion of residual contaminant sources. Section 2.3.2 provides the land-use scenarios assumed for the Operable Unit 2 subunits. Section 2.3.3 gives a detailed description of each receptor and their routes of exposure used in the residual risk assessment. Section 2.3.4 presents the detailed residual risk conceptual models for each of the four alternatives.

C.2.3.1 Residual Risk Sources

This FS risk assessment evaluates the human-health risks associated with residual COCs for each of the five subunits in Operable Unit 2. The extent of this residual contamination will vary according to the selected alternative. Figures C.2-1 through C.2-4 (Section C.2.1) illustrate the postremediation site conditions for each of the four alternatives. Based on these four alternatives, the sources of residual contaminations are limited to:

- Residual soil and groundwater contamination
- Caps/covers for on-property contaminant
- Materials deposited in any on-site disposal cell

C.2.3.2 Residual Risk Land-Use Scenarios

Two future land-use scenarios were evaluated for residual risk, federal ownership and private ownership. Section 10.0 of the RAWPA specifies the evaluation of both scenarios. A brief description of each follows.

Federal Ownership

Under this land-use scenario, the federal government would maintain ownership of the property, provide access controls, and restrict future residential, farm, and industrial use. Potential receptors include an off-property farmer and child and an expanded trespasser. This scenario assumes that a farm family lives immediately adjacent to the FEMP property boundary and is exposed through groundwater and surface soil pathways.

Private Ownership

Under this land-use scenario, there would be neither access controls nor continued federal ownership to restrict land use. Therefore, it is assumed that FEMP land use may revert to residential and farming uses. For this FS risk assessment, a family is assumed to reside on and farm the Operable Unit 2 property. Increased erosion as a result of the farming activities is accounted for by the analysis of exposures to the major runoff-receiving water body, the Great Miami River. A farm family is also assumed to be living and farming immediately adjacent to the FEMP property boundary. This scenario would include exposure routes that require development time such as establishing a home and farm operations on property.

C.2.3.3 Receptors Impacted

This section presents the human receptors on or in the vicinity of the FEMP who have been identified in the RAWPA and the Operable Unit 2 RI under future land-use conditions. These populations have been examined to determine if they have the potential for significant exposure to COCs under future site conditions. Those populations determined to present a reasonable possibility of significant exposure based on postremediation site conditions have been retained for examination in this FS (Table C.2-2). The following paragraphs provide details on the nature of the receptors and their pertinent exposure pathways.

On-Property Resident Farmer (Ingests Great Miami Aquifer Water). Consistent with the RME concept and to ensure the estimated risk values protect human health and the environment, it was assumed that the remediated FEMP site could revert to residential and agricultural uses in the future and that an adult farmer could reside on the site after it is remediated. Potential exposures to this receptor may be caused by residual contamination from remediated subunit footprints, and/or leachate from the disposal cell.

Exposure pathways examined for this receptor include growing food, tending livestock, and performing general farm work. These activities may result in direct exposure to residual site contamination through the consumption of contaminated produce, dairy products, and meat; ingestion of contaminated water from the Great Miami Aquifer; ingestion of, dermal contact with, and direct radiation from residual contaminated soil; and inhalation of gases, vapors, and dust. The selected RME locations for this receptor are presented in Section C.5.2.

On-Property Resident Farmer (Ingests Perched Water). This receptor addresses the potential additional exposure incurred by the on-property resident farm adult if the water source is the perched water. The exposure pathways examined for this receptor are the same as those for the on-property farmer (both ingest water from the Great Miami Aquifer). The selected RME location is presented in Section C.5.2.

On-Property Resident Farm Adult (Central Tendency). This receptor addresses the potential exposure incurred by the on-property resident farm adult using slightly less conservative, central-tendency exposure parameters. Exposure pathways examined include growing food, tending livestock, and performing general farm work. These activities may result in direct exposure to

TABLE C.2-2

RECEPTORS EVALUATED FOR OU2 RESIDUAL RISK

Receptors	Federal Ownership	Private Ownership	Comments
Expanded Trespasser	Yes	No	Composite adult/child who illegally uses site
Off-Property Farmer	Yes	Yes	
Off-Property Child	Yes	Yes	
On-Property Resident Farmer (GMA)	No	Yes	Ingests groundwater from Great Miami Aquifer
On Property Resident Farmer Perched Water	No	No	Ingests perched water
On-Property Resident Child	No	Yes	Ingests groundwater from Great Miami Aquifer

residual site contamination through the consumption of contaminated produce, dairy products, and meat; ingestion of contaminated water from the Great Miami Aquifer; ingestion of, dermal contact with, and direct radiation from residual contaminated soil; and inhalation of gases, vapors, and dust.

The inclusion of a central-tendency analysis does not significantly reduce the overall health risks for the adult farm receptor. An examination of the impact of including central-tendency parameters in the calculation of on-property farm adult risks has indicated that a reduction of approximately a factor of 3 can be achieved. This reduction is mainly due to the slight reduction in exposure duration (350 versus 275 days) and minor reductions in the individual pathway contact rate.

Because of the postremediation setting of the residual risk assessment, all exposure parameters have been estimated. The uncertainty inherent in all FS exposure estimates makes the additional uncertainty of central tendency inappropriate. In addition, recent discussions with EPA Region V have led to requests for exposure parameters with more conservatism than those previously used to describe the FS RME receptors. Therefore, a central-tendency analysis was not evaluated for this FS risk assessment.

On-Property Resident Farm Child. Young children (age 1 through 6) living on the property would form a subpopulation of concern, because they may be more sensitive to a given exposure than are adults. A young child residing on the remediated FEMP could be exposed directly to residual site contaminants remaining in soils, and could inhale gases, vapors, and dust. In FS risk calculations, this hypothetical child of the on-property resident farmer is assumed to come in direct contact with residual soil, receive external radiation, drink Great Miami Aquifer water from an on-property well, and consume vegetables, fruit, meat, and dairy products produced on property. The selected RME locations of this receptor are presented in Section C.5.2.

Off-Property Resident Farmer. The inclusion of a farmer, assumed to live immediately adjacent to the remediated FEMP property boundary, was determined to be highly likely based on current conditions and has therefore been included in this risk assessment. The major concern for this receptor is the exposure received from regular use of water from the Great Miami Aquifer (for drinking and agricultural uses). This farmer could also be exposed to COCs from remote on-property residual sources, and/or COCs carried by the wind as gases, vapors, and dust. However, he would not be exposed through dermal contact or receive external radiation from on-property soil. The selected RME locations of this receptor are presented in Sections C.5.1 and C.5.2.

Off-Property Resident Farm Child. This hypothetical child (age 1 through 6) of the off-property resident farmer is assumed to have the same diet as the parent. This child could also be exposed to COCs from remote on-property residual sources, and/or COCs carried by the wind as gases, vapors, and dust. The selected RME locations are presented in Sections C.5.1 and C.5.2.

Expanded Trespasser. The expanded trespasser is a composite adult/child who illegally uses the site for recreational purposes. This hypothetical individual is assumed to roam about the operable unit despite continued government ownership. Exposure pathways include inhalation of fugitive dusts, volatile organics, and gases, dermal contact with and incidental ingestion of site soil, and exposure to direct radiation while on site.

Homebuilder. The homebuilder receptor was originally considered for evaluation based on exposure to subsurface soils during the construction of a residence. After remediation, the subsurface soil concentrations would be the same as the surface soil concentrations which impact

the RME on-property resident farmer. Due to greatly reduced exposure duration and pathways (as well as the identical soil concentrations) for the homebuilder receptor, a less conservative evaluation of risk would have been generated when compared to the resident farmer. Therefore, the homebuilder was not evaluated in this risk assessment.

Great Miami River User. This scenario was designed to evaluate surface water impacts to the Great Miami River and the exposures incurred during the activities of an off-property receptor who frequently uses the Great Miami River for recreational, residential, and agricultural purposes. Residual soil concentrations would be significantly below the level necessary to impact the Great Miami River (see Section 2.0 of this FS). Therefore, the Great Miami River was not evaluated in this risk assessment.

C.2.3.4 Residual Risk Conceptual Models

Residual conceptual models were developed for each of the four alternatives under federal and private ownership, except for Alternative 2. Under Alternative 2, no private ownership scenario is envisioned because the alternative would require upkeep and maintenance. The conceptual models present the primary source, release mechanisms, exposure media and pathways, and receptors evaluated for this FS risk assessment. Figures C.2-13 through C.2-19 present the conceptual models developed for residual risk.

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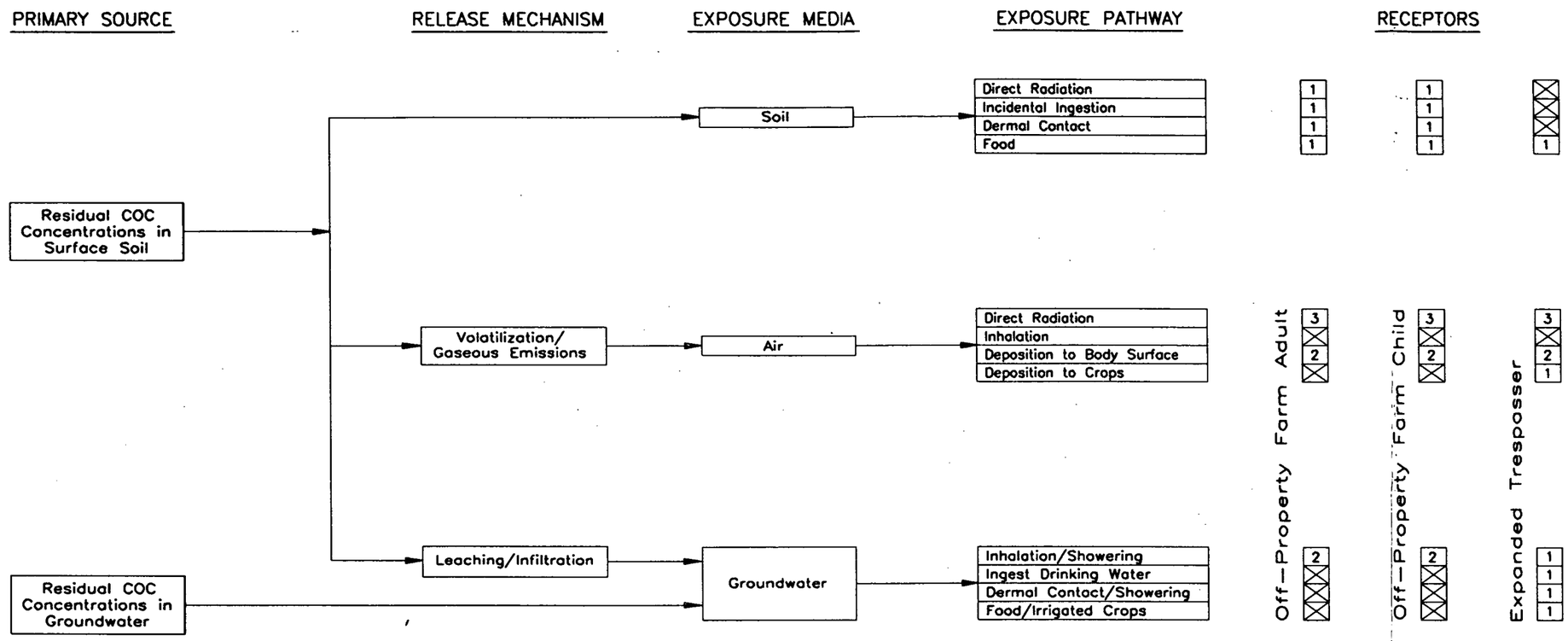
RESIDUAL RISK CONCEPTUAL MODEL, ALTERNATIVE 1
NO REMEDIAL ACTION – FEDERAL LAND USE



LEGEND:

- ☒ Denotes a complete pathway. Pathway-specific risk is quantified in this risk assesment.
- 1 Exposure route incomplete or not applicable.
- 2 Potential impact of this exposure pathway is insignificant when compared to the other exposure pathways for the same receptor.
- 3 CERCLA risk assessment methodology for radionuclides does not address this exposure route.

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FIGURE C.2-13 RESIDUAL RISK CONCEPTUAL MODEL FOR ALTERNATIVE 1 (FEDERAL)

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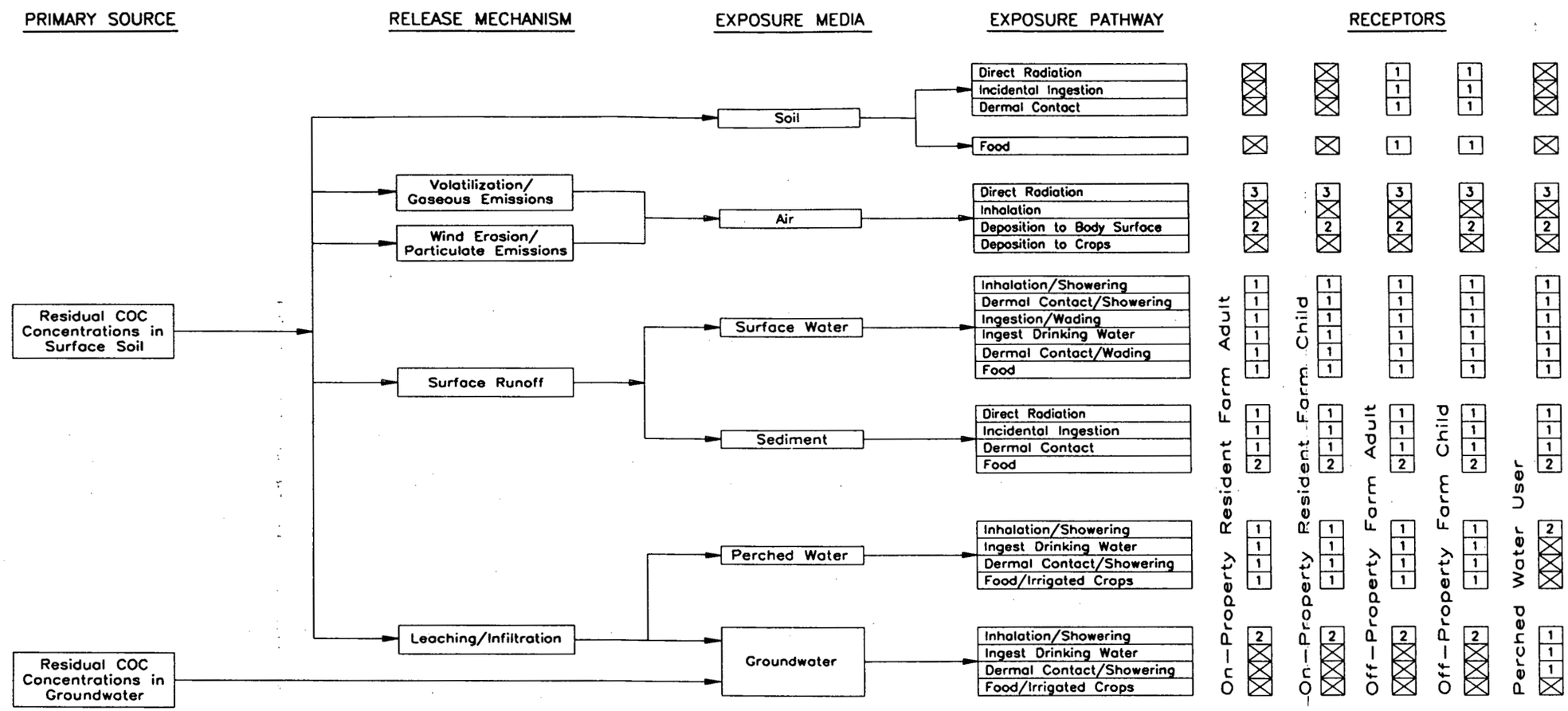
RESIDUAL RISK CONCEPTUAL MODEL, ALTERNATIVE 1
NO REMEDIAL ACTION – PRIVATE LAND USE



LEGEND:

- ☒ Denotes a complete pathway. Pathway-specific risk is quantified in this risk assesment.
- 1 Exposure route incomplete or not applicable.
- 2 Potential impact of this exposure pathway is insignificant when compared to the other exposure pathways for the same receptor.
- 3 CERCLA risk assessment methodology for radionuclides does not address this exposure route.

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FIGURE C.2-14 RESIDUAL RISK CONCEPTUAL MODEL FOR ALTERNATIVE 1 (PRIVATE)

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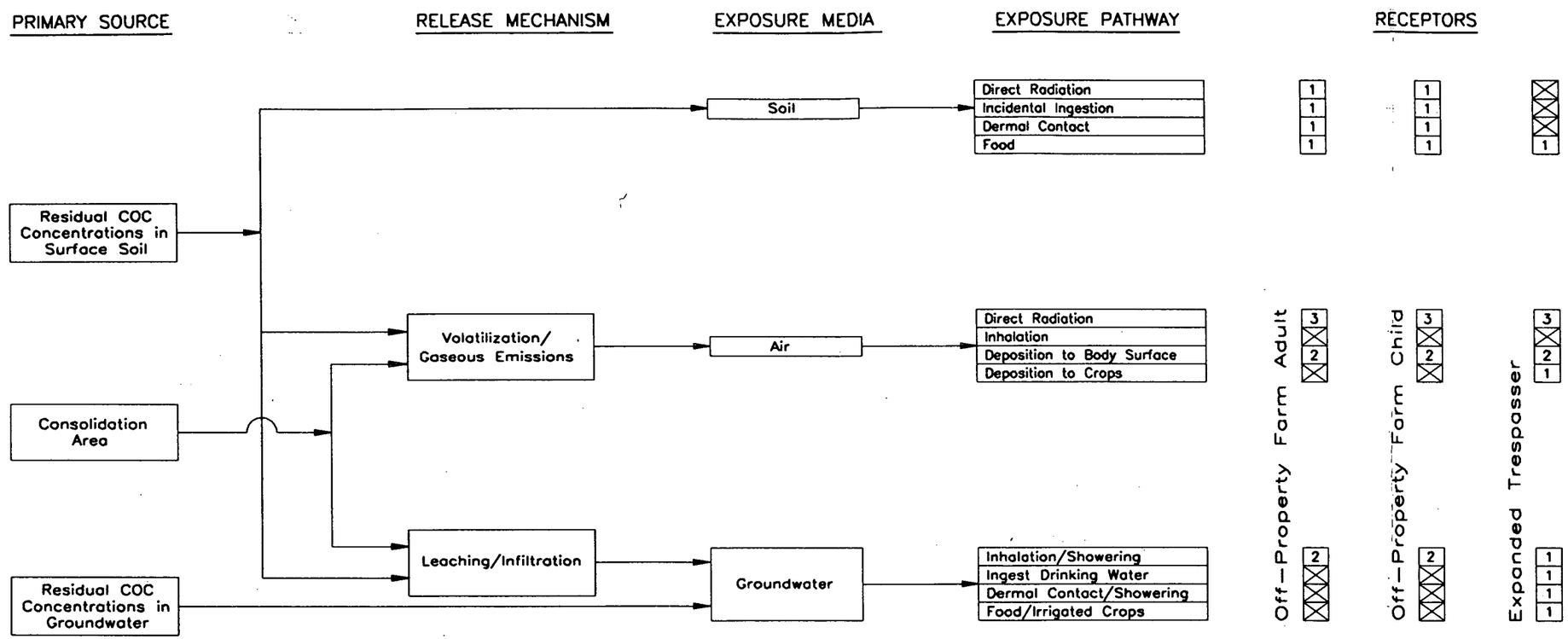
RESIDUAL RISK CONCEPTUAL MODEL, ALTERNATIVE 2
CONSOLIDATION AND CAPPING - FEDERAL LAND USE



LEGEND:

- ☒ Denotes a complete pathway. Pathway-specific risk is quantified in this risk assesment.
- 1 Exposure route incomplete or not applicable.
- 2 Potential impact of this exposure pathway is insignificant when compared to the other exposure pathways for the same receptor.
- 3 CERCLA risk assessment methodology for radionuclides does not address this exposure route.

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FIGURE C.2-15 RESIDUAL RISK EXPOSURE MODEL ALTERNATIVE 2 (FEDERAL)

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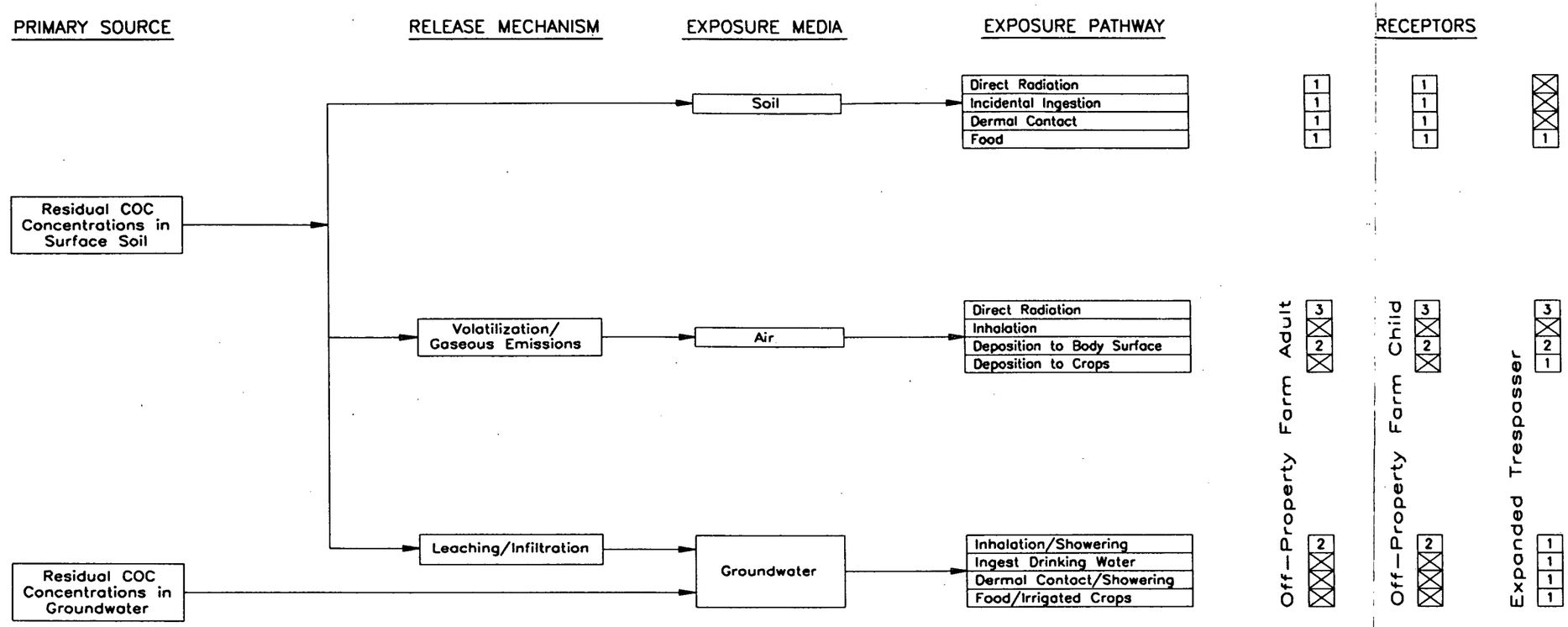
RESIDUAL RISK CONCEPTUAL MODEL, ALTERNATIVE 3
EXCAVATION AND OFF-SITE DISPOSAL - FEDERAL LAND USE



LEGEND:

- ☒ Denotes a complete pathway. Pathway-specific risk is quantified in this risk assesment.
- 1 Exposure route incomplete or not applicable.
- 2 Potential impact of this exposure pathway is insignificant when compared to the other exposure pathways for the same receptor.
- 3 CERCLA risk assessment methodology for radionuclides does not address this exposure route.

FIGURE C.2-16 RESIDUAL RISK CONCEPTUAL MODEL FOR ALTERNATIVE 3 (FEDERAL)

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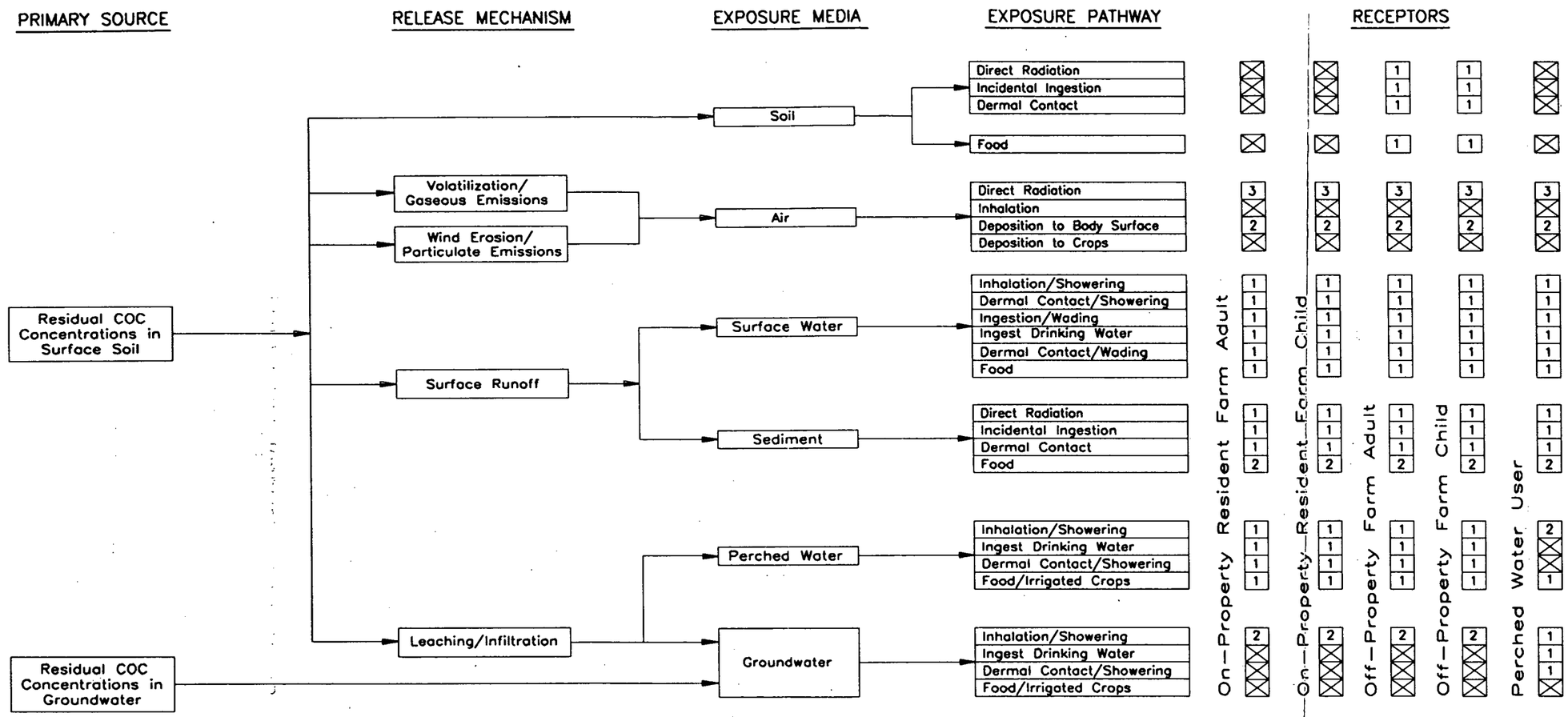
RESIDUAL RISK CONCEPTUAL MODEL, ALTERNATIVE 3
EXCAVATION AND OFF-SITE DISPOSAL – PRIVATE LAND USE



LEGEND:

- ☒ Denotes a complete pathway. Pathway-specific risk is quantified in this risk assesment.
- 1 Exposure route incomplete or not applicable.
- 2 Potential impact of this exposure pathway is insignificant when compared to the other exposure pathways for the same receptor.
- 3 CERCLA risk assessment methodology for radionuclides does not address this exposure route.

FIGURE C.2-17 RESIDUAL RISK CONCEPTUAL MODEL FOR ALTERNATIVE 3 (PRIVATE)

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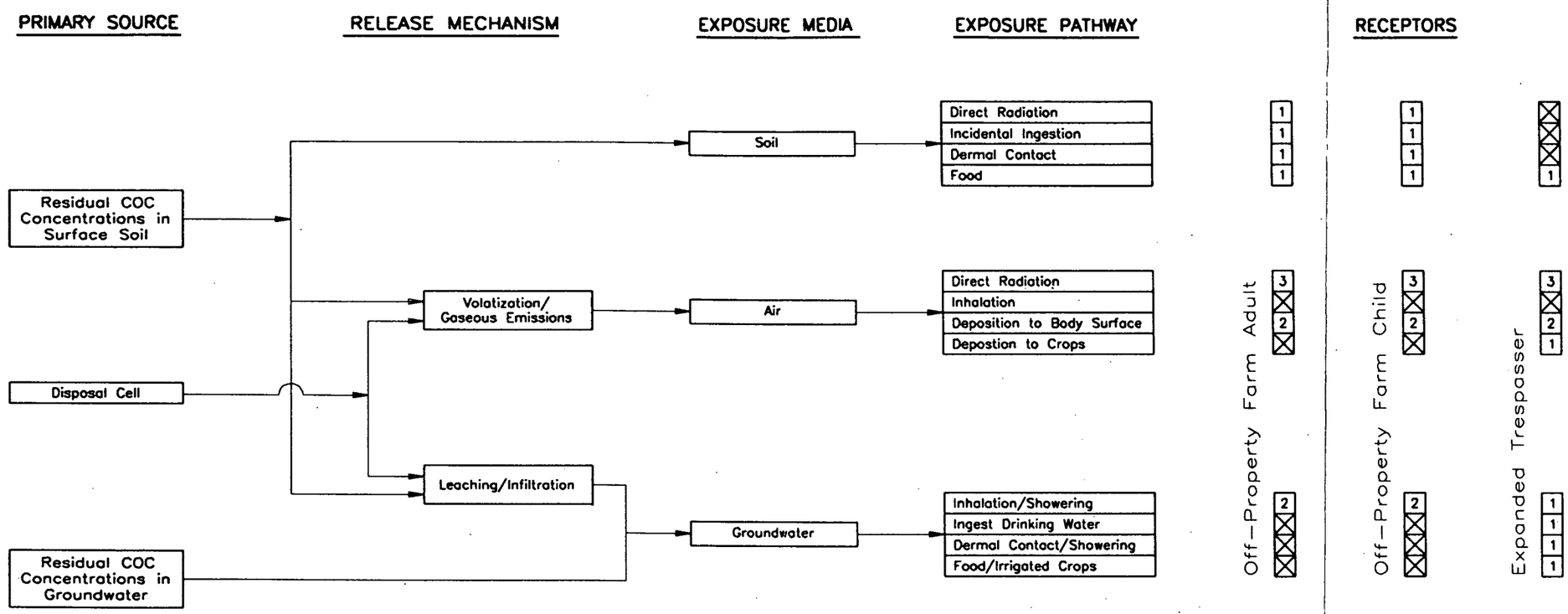
RESIDUAL RISK CONCEPTUAL MODEL, ALTERNATIVE 6
ESCAVATION AND ON-SITE DISPOSAL WITH OFF-SITE DISPOSAL OF FRACTION EXCEEDING WAC
FEDERAL LAND USE



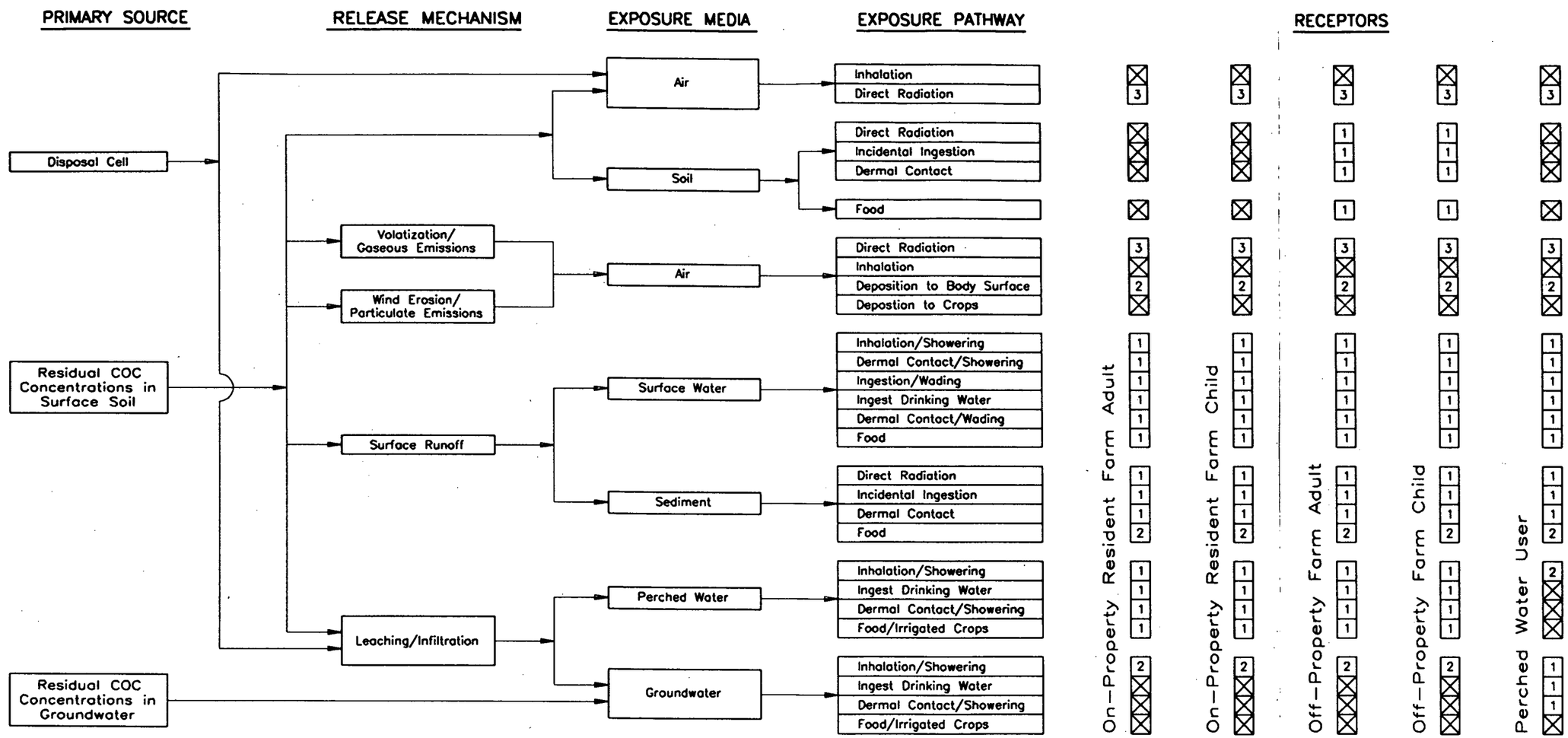
Legend:

- ☒ Denotes a complete pathway. Pathway-specific risk is quantified in this risk assesment.
- 1 Exposure route incomplete or not applicable.
- 2 Potential impact of this exposure pathway is insignificant when compared to the other exposure pathways for the same receptor.
- 3 CERCLA risk assessment methodology for radionuclides does not address this exposure route.

FIGURE C.2-18 RESIDUAL RISK CONCEPTUAL MODEL FOR ALTERNATIVE 6 (FEDERAL)

5860

RESIDUAL RISK CONCEPTUAL MODEL, ALTERNATIVE 6
EXCAVATION AND ON-SITE DISPOSAL WITH OFF-SITE DISPOSAL OF FRACTION EXCEEDING WAC
PRIVATE LAND USE



Legend:

- ☒ Denotes a complete pathway. Pathway-specific risk is quantified in this risk assesment.
- [1] Exposure route incomplete or not applicable.
- [2] Potential impact of this exposure pathway is insignificant when compared to the other exposure pathways for the same receptor.
- [3] CERCLA risk assessment methodology for radionuclides does not address this exposure route.

FIGURE C.2-19 RESIDUAL RISK CONCEPTUAL MODEL FOR ALTERNATIVE 6 (PRIVATE)

C.2.4 ASSUMPTIONS FOR ANALYSIS OF REMEDIAL ACTION AND RESIDUAL RISKS

The assumed scope of analysis, exposure parameters, pathways, and receptors, the extent and type of remedial activity, the COCs, and other factors establish the complexity and usefulness of the results of any risk evaluation. The following discussion highlights the key assumptions used to develop the risk assessment analyses.

C.2.4.1 Assumptions for Analysis of Remedial Action Risks

The assessment of remedial action risks requires numerous assumptions for each element of the assessment, including exposure scenarios, receptors, exposure models, and exposure parameters. The assumptions are listed below:

1. During excavation and other soil handling activities, remediation workers are subject to airborne contamination, both by inhalation and immersion, based on dust loading levels and soil concentrations. They are also subject to direct physical injury from, for example, a heavy-equipment accident.

2. During excavation, remediation workers monitoring soil contamination levels are exposed to a small fraction of the contaminated air or radiation. While personnel protective equipment (PPE) will be used to meet ALARA guidelines, it cannot be assumed to eliminate all exposures. For bounding purposes, no credit is assumed for PPE.

3. At the end of excavation, remediation workers monitoring soil contamination levels are exposed to contaminated soil at soil action levels. The monitoring is assumed to take place at the end of remediation when the levels are at or near the action levels. Exposures and/or intakes are only a fraction of those encountered during excavation.

4. During all activities of a given remedial alternative (i.e., excavation, drying, on-property disposal, transportation, and restoration), the mechanical injury rate is constant. The only exceptions are for truck drivers and train crews, whose injury rates are specific to their operations.

5. All radiation exposures/intakes are bounded by the excavation activities.

6. During restoration, the only risks are associated with mechanical hazards since backfilling will cover any residual contamination. Backfilling will use only clean soils. Direct radiation constitutes only a small fraction of the amount received during excavation.

7. While waste is being placed in the on-site disposal cell, remediation workers will not receive exposures in excess of those occurring during excavation activities.

8. Operators of the dryer are not subject to mechanical hazards, since most of their operations involve remote handling equipment.

9. Impacts from the on-property transport and temporary stockpiling of waste material are not specifically evaluated. It is assumed that such impacts are bounded by excavation impacts.

10. There are no ingestion pathway risks associated with transportation accidents.

11. It is assumed that for Alternative 3, segregation of wastes for on-site and off-site disposal results in a factor of 2 increase in soil concentration for off-site shipment and silo storage.

12. On-site truck drivers are assumed to be exposed to a full truck load, at a maximum concentration for 6 hours per day, for direct radiation evaluations.

13. The evaluation of exposures from materials stored in silos prior to off-site shipment were made assuming that a worker is exposed to fully loaded silos which are located 20 feet above the ground surface, for direct exposure calculations.

14. Direct radiation exposure of workers to loaded gondolas assumes that a worker is standing between two fully loaded gondolas containing the concentration as described in Assumption 12.

C.2.4.2 Assumptions for Analysis of Residual Risks

The evaluation of residual risks remaining after Operable Unit 2 remediation requires numerous assumptions regarding future land use, receptors, exposure scenarios and exposure parameters. The following assumptions have been adopted from EPA guidance documents or are the result of agreements between the FEMP and EPA.

1. Two future land-use scenarios are considered: federal ownership with access controls, and private ownership with a residential farm family on the property.

2. For the case of federal ownership with access controls, evaluated receptors include an off-property farmer and child and an expanded trespasser.

3. For the case of future private ownership, evaluated receptors include an on-property resident farmer and child, off-property farmer and child, and a perched water user.

4. The on-property farmer and child are part of a family living on the Operable Unit 2 site, growing crops and raising dairy and beef cows, and using groundwater for routine household and agricultural purposes.

5. The off-property farmer and child are part of a family living and actively farming adjacent to the FEMP site boundary. Exposure to COCs is through groundwater and resuspended surface soil pathways.

6. The expanded trespasser occasionally visits the Operable Unit 2 property for hiking, roaming, or bird watching. Activities such as jogging, biking, or ball playing are not feasible because administrative controls will prevent development of the land.

7. The adult and child exposure periods (70 years and 0 to 6 years, respectively) are included in the residual risk analysis. The FEMP has agreed with the EPA to use a 70-year exposure period for adult residential exposure because residents in the Fernald area tend to remain in the area for their lifetimes.

8. COCs were chosen based on Operable Unit 2 RI baseline risk assessment results. Constituents with a greater than 10^{-6} incremental lifetime cancer risk (ILCR) or hazard quotient (HQ) of greater than 0.2 by all combined exposure pathways are considered COCs.

9. Groundwater COC input concentrations for the residual risk assessment are based on groundwater modeling, not ambient sampling data.

10. Chronic reference doses (RfDs) are used for all risk calculations.

11. No exposure pathways are eliminated due to the presence of clean backfill.

12. The impact of Operable Unit 2 residual contaminant sources on perched groundwater in the sand lens beneath the waste pits (perched groundwater) and groundwater in the Great Miami Aquifer is included in the Operable Unit 2 residual risk evaluation. By agreement with the EPA, existing groundwater contamination is considered part of Operable Unit 5.

C.3.0 EXPOSURE QUANTIFICATION METHODOLOGY

This section presents the equations used to quantify the magnitude of exposure expected to result from all reasonable exposure pathways at Operable Unit 2. The calculations reflect changes in the risk assessment methodology resulting from revisions to the RAWPA (DOE 1992) and comments received from the EPA and OEPA on the Operable Unit 1, 2, and 4 RI/FS risk assessments.

Section C.3.1 presents the exposure models for remedial action risks, while Section C.3.2 covers residual risks. Parameters and equations are drawn from the RAWPA unless noted otherwise. The exposure parameters used to model remedial action and residual risks are presented in Section C.3.3. Source terms (e.g., soil or air concentrations) are presented in Section C.5.1 (for remedial action risks) and Section C.5-2 (for residual risks).

C.3.1 EXPOSURE MODELS FOR REMEDIAL ACTION RISKS

This section presents the exposure models used to estimate the Operable Unit 2 remedial action risks. The section has been divided into subsections for each remedial/action exposure mode combination described in the remedial action conceptual models (Section C.2.2).

C.3.1.1 Excavation/Direct Radiation

During excavation, the remediation worker would be exposed to direct radiation from radionuclides in the soil. The 95 percent UCL subsurface soil COC concentrations, as defined in the Operable Unit 2 RI report (DOE 1994a), were used to calculate exposure doses. The majority of excavated material consists of subsurface soil. Direct radiation were calculated using the MICROSHIELD computer code (see Section C.5.1.2 for details). Direct radiation exposure is a function of the soil concentration, effective soil depth, exposure duration, and soil density. The code accounts for both buildup and self-shielding. Output is an effective dose equivalent in mrem, for each radionuclide identified as a COC.

C.3.1.2 Excavation/Direct Physical Injury

The risk of mechanical injury, both for injuries and fatalities, is based on a risk-conversion factor developed by the U.S. Department of Labor. This conversion factor translates hours worked to risk from a mechanical hazard using the following equation:

$$\text{Risk} = (\text{MHRF})(T_1)(N_E) \qquad \text{(C.3-1)}$$

where

MHRF = mechanical hazard risk factor (injuries or fatalities per person hour worked)(see Table C.II-21),
T_1 = hours worked during excavation (per person) (see Table C.II-21), and
N_E = number of persons involved in excavation (Table C.II-21).

C.3.1.3 Excavation/Immersion

A remediation worker would be exposed to direct radiation from immersion in contaminated air. The magnitude of immersion exposure for each radionuclide is given by the following equation:

$$H_{E,i} = (C_{a,i})(DCF_{a,i})(T_1)(UCF_1) \qquad \text{(C.3-2)}$$

where

$H_{E,i}$ = effective dose equivalent from radionuclide i (mrem),
$C_{a,i}$ = air concentration for radionuclide i (pCi/m^3) (Table C.5-5),
$DCF_{a,i}$ = dose conversion factor for immersion for radionuclide i in air (mrem/y per μCi/m^3)(DCFs can be found in Table C.3-5),
T_1 = fraction of one year exposed to contaminated air (yr)(Table C.5-1), and
UCF_1 = unit conversion factor (10^{-6} mCi/pCi).

The concentration of a radionuclide in air is based on a dust-loading factor for soil and the concentration of the radionuclide in the soil. The following equation provides the expression for the air concentration of the ith radionuclide. This concentration in soil is the 95 percent UCL of subsurface soils.

$$C_{a,i} = (DL)(C_{s,i}) \qquad \text{(C.3-3)}$$

where

$C_{a,i}$ = air concentration for radionuclide i (pCi/m^3)(Table C.5-5),
DL = dust-loading factor for construction (g of soil/m^3 of air)(Table C.3-1), and
$C_{s,i}$ = concentration of contaminant in soil(Table C.5-4).

C.3.1.4 Excavation/Inhalation

The dose from inhalation of radionuclides by a remediation worker is given by:

$$H_{E,i} = (C_{a,i})(DCF_{b,i})(T_1)(UCF_1) \qquad \text{(C.3-5)}$$

where

$H_{B,i}$	=	effective dose equivalent from radionuclide i (mrem),
$C_{a,i}$	=	air concentration for radionuclide i (pCi/m^3)(Table C.5-5),
$DCF_{b,i}$	=	dose conversion factor for inhalation for radionuclide i (mrem/yr per $\mu Ci/m^3$)(Table C.3-5,
T_1	=	fraction of one year exposed to contaminated air (yr)(Table C.II-1 through 12), and
UCF_1	=	unit conversion factor (10^{-6} mCi/pCi).

The concentration of a radionuclide is given in Equation C.3-3. The intake from inhalation as a result of exposures to airborne chemical contaminants is calculated as follows:

$$I_{a,n} = (C_{a,n})(IR)(T_3)/(BW)(AT) \qquad \text{(C.3-6)}$$

where

$I_{a,n}$	=	intake from air of chemical contaminant n (mg/kg/day),
IR	=	receptor specific inhalation rate (m^3/h)(Table C.II-1 through 12),
$C_{a,n}$	=	concentration of chemical contaminant n in air (mg/m^3)(Table C.5-5),
T_3	=	receptor specific exposure at time (h)(Table C.II-1 through 12),
BW	=	body weight (kg)(Table C.3-1), and
AT	=	average time (d); for noncarcinogens, AT equals (ED)(365 d/y); for chemical carcinogens, AT equals (70y)(365 d/y)(Table C.3-1).

C.3.1.5 Drying/Direct Physical Injury

Mechanical hazard impacts were calculated identically to the impacts for the Excavation/Direct Physical Injury pathway (Section C.3.1.2). The only difference is the total person hours for constructing the drying facility.

C.3.1.6 Drying/Inhalation and/or Immersion

A Gaussian plume dispersion model was used to estimate the concentration at the receptor location. The concentrations in air as a result of dryer activities are located in Table C.5-10. Immersion doses for remedial workers are provided in Table C.5-12. Dose equivalent intake from VOCs were calculated as described for the Excavation/Inhalation Equation C.3-6.

C.3.1.7 Transportation

The magnitude of the transportation impacts was calculated by the RADTRAN 4 computer code (see Section C.5.2).

Mechanical hazards are based on miles traveled. The following equation presents the calculation for the mechanical hazard impacts for both workers and members of the public:

$$\text{Risk} = (RCF_m)(DST_m) \qquad \text{(C.3-9)}$$

where

RCF_m = risk conversion factor for worker or member of the public for rail transportation (fatalities or injuries per mile)(see Table C.II-23), and

DST_m = distance traveled by transportation mode m, (i.e., truck or rail miles)(Table C.II-23).

Risks to package handlers were assessed similarly to other remediation workers. Dose rates were calculated by MICROSHIELD, and for mechanical hazards, time variables were used for the person hours worked loading trains.

C.3.1.8 On-property Disposal/Direct Physical Injury

Mechanical hazard impacts were calculated identically to the impacts for the Excavation/Direct Physical Injury pathway (Section C.3.1.2). The only difference is the total person hours worked.

Restoration/Direct Physical Injury

Mechanical hazard impacts were calculated identically to the impacts for the Excavation/Direct Physical Injury pathway (Section C.3.1.2). The only difference is the total person hours worked.

C.3.2 EXPOSURE MODELS FOR RESIDUAL RISKS

To quantify risk as a result of residual COCs, several equations were used. This section presents the equations used according to exposure media. All parameters and equations were taken from the RAWPA and the Supplemental Guidance to RAWPA unless otherwise noted. The exposure media considered for residual risks are groundwater, air, and soil. Exposures from sediment are included in the group detailing the soil exposure pathways. Exposure to surface water is not a viable pathway to potential Operable Unit 2 receptors and is therefore not provided for discussion in this section. Equations for quantifying risk through the food pathway (e.g., ingestion of vegetables, fruit, milk, and meat) are provided. The development of concentration terms for air, groundwater, soil, and food products are presented in Section C.5.2. These concentrations were used to quantify intake. The parameters used in the following equations are provided in Tables C.3-2 and 3 or the Tables in C.III.

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C.3.2.1 Air Exposure from Inhalation

The amount of a COC a receptor takes in as a result of respiration is determined using the concentration of the chemical in the air. Equations 7-5 and 7-6 from the RAWPA were used to quantify intake from the inhalation pathway. These equations are as follows:

$$\text{(radionuclides)}\quad I_{ai} = (C_{ai})(IR)(EF)(ED) \qquad \text{(C.3-10)}$$

$$\text{(chemicals)}\quad I_{ai} = (C_{ai})(IR)(EF)(ED)/(BW)(AT) \qquad \text{(C.3-11)}$$

where

I_{ai} = intake from inhalation (pCi or mg/kg/d),
C_{ai} = concentration in air (pCi/m^3 or mg/m^3),
IR = inhalation rate (m^3/d),
EF = exposure frequency (d/y),
ED = exposure duration (y),
BW = body weight (kg), and
AT = averaging time (d); for noncarcinogens, AT equals (ED)(365 d/y); for chemical carcinogens, AT equals (70)(365 d/y).

C.3.2.2 Groundwater Exposures

This section discusses the quantification methodologies used to evaluate groundwater exposures. Exposure routes for exposure to groundwater include ingestion, inhalation, and dermal contact.

Ingestion of Drinking Water

Ingestion of contaminated drinking water can be a major contributor to environmental intake of COCs. An estimate of intake from drinking water was calculated from Equations 7-3 and 7-4 of the RAWPA. The intake equations are:

$$\text{(radionuclides)}\quad I_{wi} = (C_{wi})(IR)(EF)(ED) \qquad \text{(C.3-12)}$$

$$\text{(chemicals)}\quad I_{wi} = (C_{wi})(IR)(EF)(ED)/(BW)(AT) \qquad \text{(C.3-13)}$$

where

I_{wi} = intake of ith contaminant from drinking water (pCi or mg/kg/d),
C_{wi} = ith concentration in water (pCi/l or mg/l),
IR = ingestion rate (l/d),
EF = exposure frequency (d/y),
ED = exposure duration (y),
BW = body weight (kg), and
AT = averaging time (d); for noncarcinogens, AT equals (ED)(365 d/y) [EPA 1991a]); for chemical carcinogens, AT equals (70 y) (365 d/y).

Dermal Contact

The estimation intake of total uranium in water via absorption though the skin was estimated using the concentration of the chemical in the water source evaluated. The dermal absorption pathway was evaluated for adults and children. The amount of a chemical taken into the body upon exposure via dermal contact is referred to as an absorbed dose. The absorbed dose for total uranium can be calculated using EPA's dermal guidance (EPA 1989a, EPA 1992b, and EPA 1993d):

$$I_{ws} = (DA_{event})(EF)(ED)(SA)/(BW)(AT) \qquad \text{(C.3-14)}$$

where

I_{ws}	=	intake though skin from showering (mg/kg/d),
DA_{event}	=	absorbed dose per event (mg/cm^2/event),
SA	=	surface area (cm^2),
EF	=	exposure frequency (d/y),
ED	=	exposure duration (y),
BW	=	body weight (kg), and
AT	=	averaging time (d); for carcinogens, AT equals (ED)(365 d/y) [EPA 1989a]; for chemical carcinogens, AT equals (70y)(365 d/y).

DA_{event} can be calculated for inorganics as:

$$DA_{event} = (C_v)(K_p)(CF)(ET) \qquad \text{(C.3-15)}$$

where

C_v	=	concentration of COC in the source (mg/l),
K_p	=	COC-specific permeability constant 10^{-3} (cm/h),
CF	=	unit conversion factor 10^{-3} (L/cm^3)
ET	=	exposure time (h/d)

C.3.2.3 Soil and Sediment Exposures

The following sections discuss the quantification methodologies used to evaluate soil and sediment exposures.

Incidental Ingestion of Soil or Sediment

Evaluation of the soil/sediment ingestion pathway was performed using Equations 7-7 and 7-8 from the RAWPA:

$$\text{(radionuclides) } I_{si} = (C_{si})(IR)(FI)(EF)(ED) \qquad \text{(C.3-16)}$$

$$\text{(chemicals) } I_{si} = (C_{si})(IR)(CF)(FI)(EF)(ED)/(BW)(AT) \qquad \text{(C.3-17)}$$

where

I_{si}	=	intake from soil or sediment for COC i (pCi or mg/kg/d),
C_{si}	=	concentration of COC i in soil or sediment (pCi/kg or mg/kg),
IR	=	ingestion rate (kg/d) (mg/d),
CF	=	conversion factor 10^{-6} kg/mg,
FI	=	fraction ingested from contaminated source (unitless),
EF	=	exposure frequency (d/y),
ED	=	exposure duration (y),
BW	=	body weight (kg), and
AT	=	averaging time (d); for noncarcinogens, AT equals (ED)(365 d/y); for chemical carcinogens, AT equals (70 y)(365 d/y).

Dermal Contact with Soil or Sediment

Dermal absorption may also occur upon contact with contaminated soil and sediment and was calculated using Equation 7-25 of the RAWPA:

$$AB_{si} = (C_{si})(CF)(SA)(AF)(ABS)(ED)(EF)/(BW)(AT) \qquad \text{(C.3-18)}$$

where

AB_{si}	=	amount of ith COC absorbed during contact with soil or sediment (mg/kg/d),
C_{si}	=	concentration of ith COC in soil or sediment (mg/kg),
SA	=	skin surface area available for contact (cm^2/event),
AF	=	skin adherence factor (mg/cm^2),
ABS	=	absorption factor (unitless),
CF	=	conversion factor (10^{-6} kg/mg),
ED	=	exposure duration (y),
EF	=	exposure frequency (event/y),
BW	=	body weight (kg), and
AT	=	averaging time (d); for noncarcinogens, AT equals (ED)(365 d/y); for chemical carcinogens, AT equals (70 y/lifetime)(365 d/y).

Dermal absorption is not a significant pathway for radionuclides because penetration through the skin is minimal (EPA 1992b). Therefore, radionuclides were not quantified under this exposure pathway.

Direct Radiation Exposure

Since the publication of the RAWPA, the EPA has published a new set of slope factors. Changes in these slope factors require the use of a different equation to calculate risks resulting from direct radiation exposures from soils than the one originally presented in the RAWPA. The new equation is:

$$DE = (C_s)(ED)(EF)(CF)[(ET_{in})(1-S_i) + (ET_{out})(1-S_o)] \qquad \text{(C.3-19)}$$

where

DE	=	direct radiation exposure (pCi-y/g),
C_s	=	concentration in surface soil (pCi/g),
ED	=	exposure duration (y),
EF	=	exposure frequency (d/y),
ET_{in}	=	exposure time indoors on-property (h/d),
ET_{out}	=	exposure time outdoors on-property (h/d),
S_i	=	indoor shielding factor (0.5, from RAWPA),
S_o	=	outdoor shielding factor outdoors (0, assumes no shielding), and
CF	=	1/8760 y/h.

C.3.2.4 Food Products Exposure

This section presents the methodologies used to quantify intake through the food pathways (ingestion of vegetables, meat, and milk).

Ingestion of Vegetables

Evaluation of the vegetable ingestion pathway was performed using Equations 7-15 and 7-16 from the RAWPA:

$$\text{(radionuclides) } I_{iv} = (C_{iv})(IR)(ED)(EF)(FI) \qquad \text{(C.3-20)}$$

$$\text{(chemicals) } I_{iv} = (C_{iv})(IR)(FI)(EF)(ED)/(BW)(AT) \qquad \text{(C.3-21)}$$

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where

I_{iv} = intake from vegetation (pCi or mg/kg/d),
C_{iv} = total concentration of COCs in vegetables or fruit (pCi/kg or mg/kg),
IR = ingestion rate (kg/day)
FI = fraction ingested from contaminated source (unitless),
EF = exposure frequency (d/y),
ED = exposure duration (y),
BW = body weight (kg)
AT = averaging time (d); for noncarcinogens, AT equals (ED)(365 d/y); for carcinogens, AT equals (70-year lifetime)(365 d/y).

Ingestion of Meat and Milk

Evaluation of the meat and milk ingestion pathway was performed using Equations 7-19 and 7-20 from the RAWPA:

$$\text{(radionuclides) } I_{Ai} = (C_{Ai})(IR)(ED)(EF)(FI) \qquad \text{(C.3-22)}$$

$$\text{(chemicals) } I_{Ai} = (C_{Ai})(FI)(EF)(ED)(BW)(AT) \qquad \text{(C.3-23)}$$

where

I_{Ai} = intake from COC in animal product (pCi or mg/kg/d),
C_{Ai} = concentration of ith COC in the animal product (pCi/l or mg/l for milk, pCi/kg or mg/kg for beef)
IR = ingestion rate (l/d for milk; kg/d for beef)
EF = exposure frequency(d/y)
ED = exposure duration (y),
FI = fraction ingested from contaminated source (unitless)
BW = body weight (kg),
AT = averaging time (d); for noncarcinogens, AT equals (ED) (365 d/y); for carcinogens, AT equals (70-year lifetime)(365 d/y).

C.3.3 EXPOSURE PARAMETERS

Exposure parameters used in the remedial action and residual exposure models are summarized in the following sections. The RAWPA is the primary source for these values; other values were used in accordance with EPA and/or DOE guidance.

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C.3.3.1 Exposure Parameters for Remedial Action Risks

This section presents parameter values for the remedial action risk models (Section C.3.1). Each presentation includes the parameter, its value or values, units, and reference. Many of the parameter values are from the RAWPA.

Table C.3-1 presents most of the noncontaminant-specific parameters. Toxicity values are presented in Section C.4.0. Exposure point concentrations are presented by receptor in Section C.5.1.

TABLE C.3-1

NONCONTAMINANT-SPECIFIC EXPOSURE PARAMETERS FOR REMEDIAL ACTION RISK

Parameter	Value	Unit	Reference
Effective Soil Depth - ESD	1	m	DOE 1988a
Dust Loading (Remediation Worker) - DL	6×10^{-4}	g/m^3	RAWPA
Average Soil Density for FEMP - ρ	1.7×10^6	g/m^3	RAWPA
Soil Density For Shielding	1.5×10^6	g/m^3	
Inhalation Rate - IR (Remediation)[a]	2	m^3/hr	RAWPA
Inhalation Rate - IR (Off-property Individual)	0.83	m^3/hr	RAWPA
Body Weight - BW	70	kg	RAWPA
Averaging Time - AT (Carcinogens)	25550	days	RAWPA
Ave. Time - AT (Noncarcinogens)	T_3 or T_4	See Table C.3-2	RAWPA
Mean wind speed - U_m	4.6	m/sec	RAWPA

C.3.3.2 Exposure Parameters for Residual Risks

This section presents parameter values for the residual risk models (Section C.3.2). Each presentation includes the parameter, its value or values, units, and reference. Many of the parameter values are from the RAWPA.

Table C.3-2 presents the exposure parameters for potential receptors of residual risk under the federal ownership scenario. Table C.3-3 presents the exposure parameters for potential receptors of residual risk under private ownership. Table C.3-4 presents the chemical-specific calculated dermal absorbed dose values for dermal soil exposures.

TABLE C.3-2

PARAMETERS USED FOR RESIDUAL RISK WITH FEDERAL OWNERSHIP[a,b]

	RME Receptor			
			Expanded Trespasser[b]	
	Off-Property Resident Farm		Childhood	Adulthood
Exposure Pathway	Adult	Child	Years	Years
Inhalation of Particulates				
IR (m^3/hr)	0.83	0.5	0.5	0.83
ET (hr/d)	24	24	2	1
EF (d/yr)	350	350	110	40
ED (yr)	70	6	12	30
BW (kg)	70	15	43	70
AT Noncancer (d)	25550	2190	4380	10950
AT Cancer (d)	25550	25550	25550	25550
C_a (mg/m^3 or pCi/m^3)	CSV	CSV	CSV	CSV
Drinking Water Ingestion				
IR (l/d)	2	1	NA	NA
FI (unitless)	1	1	1	1
EF (d/yr)	350	350	NA	NA
ED (yr)	70	6	NA	NA
BW (kg)	70	15	NA	NA
AT Noncancer (d)	25550	2190	NA	NA
AT Cancer (d)	25550	25550	NA	NA
C_w (pCi/l or mg/l)	CSV	CSV	NA	NA
Incidental Ingestion of Soil				
IR (mg/d)	NA	NA	100	100
FI (unitless)	NA	NA	.125	.125
EF (d/yr)	NA	NA	110	40
ED (yr)	NA	NA	12	30
BW (kg)	NA	NA	43	70
AT Noncancer (d)	NA	NA	4380	10950
AT Cancer (d)	NA	NA	25550	25550
CF-Chem (kg/mg)	NA	NA	1×10^{-6}	1×10^{-6}
C_s (mg/kg or pCi/g)	NA	NA	CSV	CSV

TABLE C.3-2
(Continued)

Exposure Pathway	RME Receptor			
	Off-Property Resident Farm		Expanded Trespasser[b]	
	Adult	Child	Childhood Years	Adulthood Years
Dermal Contact with Soil				
SA (cm^2)	NA	NA		5750
AF ($mg/cm^2/d$)	NA	NA	1	1
ABS (unitless)	NA	NA	CSV	CSV
EF (d/yr)	NA	NA	110	40
ED (yr)	NA	NA	12	30
BW (kg)	NA	NA	43	70
AT Noncancer (d)	NA	NA	4380	10950
AT Cancer (d)	NA	NA	25550	25550
CF-Chem (kg/mg)	NA	NA	1×10^{-6}	1×10^{-6}
C_s (mg/kg)	NA	NA	CSV	CSV
Direct Radiation Exposure				
ET Indoors (hr/d)	NA	NA	NA	NA
ET Outdoors(hr/d)	NA	NA	2	1
EF (d/yr)	NA	NA	110	40
ED (yr)	NA	NA	12	30
SH Indoors (unitless)	NA	NA	NA	NA
SH Outdoors (unitless)	NA	NA	0	0
CF (yr/hr)	NA	NA	1.14 x 10-4A	1.14×10^{-4}
C_r (pCi/g)	NA	NA	CSV	CSV
Ingestion of Home Produced Meat				
IR (kg/d)	0.101	0.039	NA	NA
FI (unitless)	0.75	0.75	NA	NA
EF (d/yr)	350	350	NA	NA
ED (yr)	70	6	NA	NA
BW (kg)	70	15	NA	NA
AT Noncancer (d)	25550	2190	NA	NA
AT Cancer (d)	25550	25550	NA	NA
C_m (mg/kg or pCi/kg)	CSV	CSV	NA	NA
Ingestion of Milk				
IR (l/d)	0.4	0.9	NA	NA
FI (unitless)	0.75	0.75	NA	NA
EF (d/yr)	350	350	NA	NA
ED (yr)	70	6	NA	NA
BW (kg)	70	15	NA	NA
AT Noncancer (d)	25550	2190	NA	NA
AT Cancer (d)	25550	25550	NA	NA
C_m (mg/l or pCi/l)	CSV	CSV	NA	NA

TABLE C.3-2
(Continued)

	RME Receptor			
			Expanded Trespasser[b]	
	Off-Property Resident Farm		Childhood	Adulthood
Exposure Pathway	Adult	Child	Years	Years
Dermal Contact While Wading				
DA (mg/cm²/d)	NA	NA	CSV	NA
EF (d/yr)	NA	NA	110	NA
ED (yr)	NA	NA	12	NA
BW (kg)	NA	NA	43	NA
AT Noncancer (d)	NA	NA	4380	NA
AT Cancer (d)	NA	NA	25550	NA
SA (cm²	NA	NA	8000	NA
Incidental Ingestion While Wading				
IR (l/d)	NA	NA	0.035	NA
EF (d/yr)	NA	NA	110	NA
ED (yr)	NA	NA	12	NA
BW (kg)	NA	NA	43	NA
AT Noncancer (d)	NA	NA	4380	NA
AT Cancer (d)	NA	NA	25550	NA
C_w (mg/l or pCi/l)	NA	NA	CSV	NA
Dermal Contact while Bathing				
SA (cm²)	23000	8000	NA	NA
EF (d/yr)	350	350	NA	NA
ED (yr)	70	6	NA	NA
BW (kg)	70	15	NA	NA
AT Noncancer (d)	25550	2190	NA	NA
AT Cancer (d)	25550	25550	NA	NA
DA (mg/cm²/d)	CSV	CSV	NA	NA

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TABLE C.3-2
(Continued)

Exposure Pathway	RME Receptor			
	Off-Property Resident Farm		Expanded Trespasser[b]	
	Adult	Child	Childhood Years	Adulthood Years
Ingestion of Vegetables				
IR (kg/d)	.122	.106	NA	NA
FI (unitless)	0.5	0.5	NA	NA
EF (d/yr)	350	350	NA	NA
ED (yr)	70	70	NA	NA
BW (kg)	70	70	NA	NA
AT Noncancer (d)	25550	2190	NA	NA
AT Cancer (d)	25550	25550	NA	NA
C[a] (mg/kg or pCi/kg)	CSV	CSV	NA	NA

Acronyms used in this table:

ABS = Absorption factor
AF = Soil-to-skin adherence factor
AT = Averaging time
BW = Body weight
CF = Conversion factor
CSV = Chemical specific value
ED = Exposure duration
EF = Exposure frequency
ET = Exposure time
FI = Fraction ingested from contaminated source
IR = Average inhalation rate or average ingestion rate based on pathway
NA = Not applicable
SA = Skin surface area available for contact
SH = Building shielding factor

[a]Except where qualified by other footnotes, the values in this table are from the OU2 RI report (DOE 1994a).
[b]Justification and clarification for this scenario and receptors are provided in the OU4 FS report (DOE 1993a).
[c]The CSVs for concentrations are presented in Section C.5.0.

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TABLE C.3-3

PARAMETERS USED FOR RESIDUAL RISK WITH PRIVATE OWNERSHIP[a,b]

	RME Receptor				
	On-Property Resident Farm			Off-Property Resident Farm	
Exposure Pathway	Adult(GMA)	Adult(P)	Child	Adult	Child
Inhalation of Particulates					
IR (m^3/hr)	0.83	0.83	0.5	0.83	0.5
ET (hr/d)	24	24	24	24	24
EF (d/yr)	350	350	350	350	350
ED (yr)	70	70	6	70	6
BW (kg)	70	70	15	70	15
AT Noncancer (d)	25550	25550	2190	25550	2190
AT Cancer (d)	25550	25550	25550	25550	25550
C_a (mg/m^3 or pCi/m^3)	CSV	CSV	CSV	CSV	CSV
Drinking Water Ingestion					
IR (l/d)	2	2	1	2	1
FI (unitless)	1	1	1	1	1
EF (d/yr)	350	350	350	350	350
ED (yr)	70	70	6	70	6
BW (kg)	70	70	15	70	15
AT Noncancer (d)	25550	25550	2190	25550	2190
AT Cancer (d)	25550	25550	25550	25550	25550
C_w (pCi/l or mg/l)	CSV	CSV	CSV	CSV	CSV
Incidental Ingestion of Soil					
IR (mg/d)	180	180	200	NA	NA
FI (unitless)	1	1	1	NA	NA
EF (d/yr)	350	350	350	NA	NA
ED (yr)	70	70	6	NA	NA
BW (kg)	70	70	15	NA	NA
AT Noncancer (d)	25550	25550	2190	NA	NA
AT Cancer (d)	25550	25550	25550	NA	NA
CF-Chem (kg/mg)	1×10^{-6}	1×10^{-6}	1×10^{-6}	NA	NA
C_s (mg/kg or pCi/g)	CSV	CSV	CSV	NA	NA
Dermal Contact with Soil					
SA (cm^2)	5750	5750	2000	NA	NA
AF (mg/cm^2/d)	1.0	1.0	1.0	NA	NA
ABS (unitless)	CSV	CSV	CSV	NA	NA
EF (d/yr)	350	350	350	NA	NA
ED (yr)	70	70	6	NA	NA
BW (kg)	70	70	15	NA	NA
AT Noncancer (d)	25550	25550	2190	NA	NA
AT Cancer (d)	25550	25550	25550	NA	NA
CF-Chem (kg/mg)	1×10^{-6}	1×10^{-6}	1×10^{-6}	NA	NA
C_s (mg/kg)	CSV	CSV	CSV	NA	NA

TABLE C.3-3
(Continued)

Exposure Pathway	RME Receptor				
	On-Property Resident Farm			Off-Property Resident Farm	
	Adult(GMA)	Adult(P)	Child	Adult	Child
Direct Radiation Exposure					
ET Indoors (hr/d)	18.3	18.3	22	NA	NA
ET Outdoors(hr/d)	5.7	5.7	2	NA	NA
EF (d/yr)	350	350	350	NA	NA
ED (yr)	70	70	6	NA	NA
SH Indoors (unitless)	0.5	0.5	0.5	NA	NA
SH Outdoors (unitless)	0	0	0	NA	NA
CF (yr/hr)	1.14×10^{-4}	1.14×10^{-4}	1.14×10^{-4}	NA	NA
C_r (pCi/g)	CSV	CSV	CSV	NA	NA
Ingestion of Home Produced Meat					
IR (kg/d)	0.101	0.101	0.039	0.101	0.039
FI (unitless)	0.75	0.75	0.75	0.75	0.75
EF (d/yr)	350	350	350	350	350
ED (yr)	70	70	6	70	6
BW (kg)	70	70	15	70	15
AT Noncancer (d)	25550	25550	2190	25550	2190
AT Cancer (d)	25550	25550	25550	25550	25550
C_m (mg/kg or pCi/kg)	CSV	CSV	CSV	CSV	CSV
Ingestion of Milk					
IR (l/d)	0.4	0.4	0.9	0.4	0.9
FI (unitless)	0.75	0.75	0.75	0.75	0.75
EF (d/yr)	350	350	350	350	350
ED (yr)	70	70	6	70	6
BW (kg)	70	70	15	70	15
AT Noncancer (d)	25550	25550	2190	25550	2190
AT Cancer (d)	25550	25550	25550	25550	25550
C_m (mg/l or pCi/l)	CSV	CSV	CSV	CSV	CSV
Dermal Contact While Wading					
DA ($mg/cm^2/d$)	NA	NA	NA	NA	NA
EF (d/yr)	NA	NA	NA	NA	NA
ED (yr)	NA	NA	NA	NA	NA
BW (kg)	NA	NA	NA	NA	NA
AT Noncancer (d)	NA	NA	NA	NA	NA
AT Cancer (d)	NA	NA	NA	NA	NA
SA (cm^2)	NA	NA	NA	NA	NA

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TABLE C.3-3
(Continued)

Exposure Pathway	RME Receptor				
	On-Property Resident Farm			Off-Property Resident Farm	
	Adult(GMA)	Adult(P)	Child	Adult	Child
Incidental Ingestion While Wading					
IR (l/d)	NA	NA	NA	NA	NA
EF (d/yr)	NA	NA	NA	NA	NA
ED (yr)	NA	NA	NA	NA	NA
BW (kg)	NA	NA	NA	NA	NA
AT Noncancer (d)	NA	NA	NA	NA	NA
AT Cancer (d)	NA	NA	NA	NA	NA
C_w (mg/l or pCi/l)	NA	NA	NA	NA	NA
Dermal Contact while Bathing					
SA (cm^2)	23000	23000	8000	23000	8000
EF (d/yr)	350	350	350	350	350
ED (yr)	70	70	6	70	6
BW (kg)	70	70	15	70	15
AT Noncancer (d)	25550	25550	2190	25550	2190
AT Cancer (d)	25550	25550	25550	25550	25550
DA ($mg/cm^2/d$)	CSV	CSV	CSV	NA	NA
Ingestion of Vegetables					
IR (kg/d)	.122	.122	.106	.122	.106
FI (unitless)	0.5	0.5	0.5	0.5	0.5
EF (d/yr)	350	350	350	350	350
ED (yr)	70	70	6	70	6
BW (kg)	70	70	15	70	15
AT Noncancer (d)	25550	25550	2190	25550	2190
AT Cancer (d)	25550	25550	25550	25550	25550
C[c] (mg/kg or pCi/kg)	CSV	CSV	CSV	CSV	CSV

Acronyms used in this table:

ABS = Absorption factor
AF = Soil-to-skin adherence factor
AT = Averaging time
BW = Body weight
CF = Conversion factor
CSV = Chemical specific value
ED = Exposure duration
EF = Exposure frequency
ET = Exposure time
FI = Fraction ingested from contaminated source
GMA = Great Miami Aquifer (ingestion of water)
IR = Average inhalation rate or average ingestion rate based on pathway
NA = Not applicable
P = Perched groundwater (ingestion of)
SA = Skin surface area available for contact
SH = Building shielding factor

[a] Except where qualified by other footnotes, the values in this table are from the OU2 RI report (DOE 1994a)
[b] Justification for this scenario and receptors is provided in the OU4 FS report (DOE 1993a)
[c] The CSVs for concentrations are presented in Section C.5.0.

TABLE C.3-4

DERMAL SOIL ABSORPTION COEFFICIENTS USED IN EXPOSURE MODEL

COC	ABS
Antimony	1.00×10^{-2}
Aroclor-1254	0.06
Aroclor-1260	0.06
Arsenic	1.00×10^{-3}
Benzo(a)pyrene	N/A[a]
Beryllium	1.00×10^{-2}
Carbazole	3.00×10^{-1}
Dieldrin	3.00×10^{-1}
Uranium-Total	1.00×10^{-3}

SOURCE: OU2 RI report (DOE 1994a)

[a]Dermal Exposure to PAHs: Current policy indicates it is inappropriate to extrapolate dermal slope factors from oral slope factors for PAHs. Also, extrapolation from other routes of exposure is inappropriate due to varied absorption, metabolic transformations, and target organ end point responses. However, PAHs are potent skin carcinogens. Current information on the contribution to cancer risk from dermal exposure to PAHs indicates the toxicity from the dermal pathway may be as toxic as from oral route of exposure. To estimate the risk contribution from PAHs via dermal exposure for all direct contact pathways, the risk posed for dermal exposure was assumed equal to the risk from oral exposure.

TABLE C.3-5
DOSE EQUIVALENT FACTORS

Radionuclide	Direct Radiation from Soil Dose Factor, mrem/yr per $\mu Ci/m^2$	Inhalation Dose Factor, rem/μCi (Solubility Class)[a]	Immersion Dose Factor, mrem/yr per $\mu Ci/m^3$
Sr-90	6.75×10^{1} [b]	1.3 (Y)	0.0
Tc-99	6.26×10^{-5}	7.5×10^{-3} (W)	2.65×10^{-3}
Cs-137	6.11×10^{1} [c]	3.2×10^{-2} (D)	3.06×10^{3} [c]
Rn-220	5.38×10^{-2}	0.0	1.95
Ra-226	7.6×10^{-1}	7.9 (W)	3.43×10^{1}
Th-228	2.77×10^{-1}	2.5×10^{2} (W)	9.89
Th-230	9.07×10^{-2}	3.2×10^{2} (W)	1.96
Th-232	6.66×10^{-2}	1.6×10^{3} (W)	9.33×10^{-1}
U-234	8.07×10^{-2}	1.3×10^{2} (Y)	7.65×10^{-1}
U-235	1.71×10^{1}	1.2×10^{2} (Y)	7.70×10^{2}
U-238	6.46×10^{-2}	1.2×10^{2} (Y)	6.19×10^{-1}
Np-237	3.24	4.9×10^{2} (W)	1.15×10^{2}
Pu-238	8.58×10^{-2}	4.6×10^{2} (W)	4.41×10^{-1}
Pu-239/240	8.20×10^{-2} [d]	5.1×10^{2} (W)	4.32×10^{-1} [c]

[a] D = Day, W = Week, Y = Year
[b] Includes Y-90 and Y-90m
[c] Includes Ba-137m
[d] Based on Pu-240

SOURCE:

U.S. Dept. of Energy, 1988a, "Internal Dose Conversion Factors," DOE/EH-0071, Washington, DC (for inhalation).

U.S. Dept. of Energy, 1988b, "External Dose Conversion Factors," DOE/EH-0070, DOE, Washington, DC (for direct soil and immersion).

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C.4.0 TOXICITY ASSESSMENT

This section examines information concerning the potential effects of exposure to Operable Unit 2 COCs. For this toxicity assessment, the goal was to quantitatively estimate the relationship between COC exposure and the severity or probability of human biological effect. Throughout this assessment, potential health effects caused by concurrent exposure to multiple COCs were assumed to be additive in nature. This assumption ignores possible synergisms or antagonisms among chemicals. However, data to assess interactions are lacking. In the absence of adequate information, EPA guidelines indicate that carcinogenic risks should be treated as additive and that noncancer hazard indices should also be treated as additive. These assumptions help prevent an underestimation of cancer risk or potential noncancer health effects (EPA 1989a).

This section contains a compilation of chronic noncarcinogenic and carcinogenic risk parameters followed by detailed toxicity profiles of the COCs. The toxicity profiles emphasize chronic noncarcinogenic and carcinogenic health effects. Subchronic health effects as a result of short-term exposures during remedial action were assessed in this FS using chronic risk parameters. This assumption was made because the duration of on-property exposures during remediation could potentially exceed the two-week to seven-year exposure period defined for subchronic exposures. In addition, chronic risk parameters provide a more conservative approximation of health effects with less uncertainty. Therefore, the toxicity parameters presented below have been used for both the remedial action and residual risk assessments.

C.4.1 NONCARCINOGENS

For noncarcinogens, it is assumed that a dose exists below which no adverse health effects will be seen. Below this "threshold" dose, exposure to a chemical can be tolerated without adverse effects. The potential for noncarcinogenic health effects resulting from exposure to chemical contaminants is assessed by comparing an exposure estimate (intake) to a reference dose (RfD).

The RfD is expressed in units of milligrams per kilograms per day (mg/kg/day) and represents a daily intake of the contaminant, per kilogram of body weight, that is, not sufficient to cause the threshold effect of concern.

An RfD is specific to the chemical, the route of exposure, and exposure duration. To derive an RfD, the EPA reviews all relevant human and animal studies for each compound and selects the study (or studies) pertinent to the derivation of the specific RfD. Each study is evaluated to determine the no-observed-adverse-effect level (NOAEL) or, if data are inadequate for such a determination, the lowest-observed-adverse-effect level (LOAEL). The NOAEL corresponds to the dose, in mg/kg/day, that can be administered over a lifetime without inducing observable adverse effects. The LOAEL corresponds to the lowest daily dose, in mg/kg/day, that induces an observable adverse effect when administered over a lifetime. The toxic effect characterized by the LOAEL is referred to as the "critical effect."

To derive an RfD, the NOAEL (or LOAEL) is divided by uncertainty factors to ensure that the RfD will protect human health. Uncertainty factors are applied to account for:

- Extrapolation of data from laboratory animals to humans (interspecies extrapolation)
- Variation in human sensitivity to the toxic effects of a compound (intraspecies differences)
- Derivation of a chronic RfD based on a subchronic rather than a chronic study
- Derivation of an RfD from the LOAEL rather than the NOAEL.

In addition to these uncertainty factors, modifying factors between 0 and 10 may be applied to reflect additional qualitative considerations in evaluating the data. For most compounds, the modifying factor is 1.

Separate RfDs are needed for ingestion and inhalation pathways. EPA (1992b) presents reference concentrations (RfC) for the inhalation route. Inhalation noncancer toxicity values are usually expressed as inhalation RfCs in units of mg/m^3. Because noncancer risk characterization requires an estimate of dose in units of mg/kg/day, the inhalation RfC must be converted to an inhalation RfD. This conversion is performed by assuming humans weigh 70 kilograms and inhale 20 cubic meters of air per day; that is, the inhalation RfC (mg/m^3) multiplied by 20 m^3/day and divided by 70 kilograms yields an inhalation RfD (mg/kg/day).

The primary sources of values for RfDs are the Integrated Risk Information System (IRIS) and the Health Effects Assessment Summary Tables (HEAST), which are compiled and maintained by the EPA (EPA 1994a and 1994b). IRIS was used as the primary source for toxicity information. HEAST was used only if IRIS values were unavailable (RAGS). Since dermal RfDs are derived from oral RfDs, the oral target organ is adopted as the dermal target organ. RfDs for noncarcinogenic COCs in Operable Unit 2 are presented in Table C.4-1.

C.4.2 CHEMICAL CARCINOGENS

The toxicity information considered in the assessment of potential carcinogenic risks includes a weight-of-evidence classification and a slope factor. The weight-of-evidence classification qualitatively describes the likelihood that a chemical is a human carcinogen and is based on an evaluation of available data from human and animal studies. A chemical may be placed in one of five groups in EPA's classification system to indicate its potential for carcinogenic effects: Group A, human carcinogen; Group B1 or B2, probable human carcinogen; Group C, possible human carcinogen; Group D, not classifiable as a human carcinogen because of a lack of data; or Group E, noncarcinogen based on evidence of noncarcinogenicity in humans.

The cancer slope factor is the toxicity value used to quantitatively express the carcinogenic risk of cancer-causing constituents. It is defined as the upper-bound estimate of the probability of cancer incidence per unit dose averaged over a lifetime. Slope factors are derived from studies of carcinogenicity in humans and/or laboratory animals and are typically calculated for compounds in Groups A, B1, and B2.

In developing the cancer slope factors, the EPA gives preference to human epidemiology studies; however, the slope factors for most chemicals were derived from animal exposure studies. An inherent assumption in the EPA's approach is that there is no threshold for a carcinogenic effect. That is, smaller doses result in a lower risk, but any dose, no matter how small, carries some risk. The dose-related number of tumors and the time of incidence of tumors were fitted using a linear multi-stage model. A slope factor describing the linear relationship of lifetime risk to dose was computed using the 95 percent upper confidence unit (UCL) of this slope. This approach is inherently conservative because of the no-threshold assumption and the use of the 95 percent UCL.

TABLE C.4-1
REFERENCE DOSES[a]

Chemical	Chronic Oral Reference Dose (mg/kg/day)	Chronic Inhalation Reference Dose (mg/kg/day)	Reference Concentration (mg/m^3)	Target Organ (Critical Effect)		Uncertainty Factor	
				Oral	Inhalation	Oral	Inhalation
Inorganics							
Antimony	4×10^{-4}	ND	ND	Whole body (Increased Mortality); Blood (Altered Chemistries)	ND	1000	ND
Arsenic	3×10^{-4}	ND	ND	Skin (Keratosis; Hyperpigmentation)	ND	3	ND
Beryllium	5×10^{-3}	ND	ND	None (None Observed)	ND	100	ND
Uranium (Soluble Salts)	3×10^{-3}	ND	ND	Kidney (Nephritis)	ND	1000	ND
Semivolatiles							
Carbazole	ND	ND	ND	ND	ND	ND	ND
Benzo(a)pyrene	ND	ND	ND	ND	ND	ND	ND
Pesticides/PCBs							
Aroclors	ND	ND	ND	ND	ND	ND	ND
Dieldrin	5×10^{-5}	ND	ND	Liver (Lesions)	ND	100	ND

[a]The values in this table, except if noted in other footnotes, are from the IRIS or HEAST.

ND = No data available

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Slope factors are specific to a chemical and route of exposure and expressed in units of $(mg/kg/day)^{-1}$ for both oral and inhalation routes. The induction of cancer by dermal absorption is evaluated using oral slope factors. Inhalation cancer toxicity values are usually expressed as inhalation unit risks in units of reciprocal $\mu g/m^3$ ($1/\mu g/m^3$). Because cancer risk characterization requires an estimate of reciprocal dose in units of 1/mg/kg/day, the inhalation unit risk must be converted to the mathematical equivalent of an inhalation cancer slope factor, or risk per unit dose (mg/kg/day). This conversion is performed by assuming humans weigh 70 kilograms and inhale 20 cubic meters of air per day; that is, the inhalation unit risk ($1/\mu g/m^3$) divided by 20 m^3/day, multiplied by 70 kilograms and multiplied by 1000 $\mu g/mg$ yields the mathematical equivalent of an inhalation slope factor (1/mg/kg/day).

Slope factors for COCs are presented in Table C.4-2. The primary sources of these toxicity values are EPA's IRIS and the quarterly updated HEAST. Other EPA sources of cancer slope factors were also consulted when available. Surrogate chemicals were not used for cancer slope factor derivation unless the chemical similarity was close and the derivation was highly defensible.

The following exceptions, where information from one chemical was used to model a compound class, are noted:

- The carcinogenicity of all polychlorinated biphenyl (PCB) isomers is assumed to be equal to the carcinogenicity of Aroclor-1260.
- The carcinogenicity of polycyclic aromatic hydrocarbons (PAHs) is determined using a relative potency approach (Clement International 1988, 1990).

Carcinogenic risks associated with PAHs are evaluated using the relative potency approach described by Clement International (1988 and 1990). This approach, approved by EPA Region V, considers the relative potency of the individual PAHs and allows site-specific relative concentrations to be expressed in the risk assessment. The relative potency factors for PAHs are presented in Table C.4-3.

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TABLE C.4-2

CANCER SLOPE FACTORS FOR CHEMICALS[a]

Chemical	Oral Cancer Slope Factor [(mg/kg/day)$^{-1}$]	Inhalation Cancer Slope Factor [(mg/kg/day)$^{-1}$]	Unit Risk ($\mu g/m^3$)$^{-1}$	Tumor Site		Cancer Classification
				Oral	Inhalation	
Inorganics						
Antimony	ND	ND	ND	ND	ND	ND
Arsenic	1.8×10^0	1.5×10^1	4.3×10^{-3}	Skin, Lung	Respiratory System	A
Beryllium	4.3×10^0	8.4×10^0	2.4×10^{-3}	Total Tumors	Lung	B2
Uranium Soluble Salts	ND	ND	ND	ND	ND	ND
Semivolatiles						
Carbazole	2.0×10^{-2}	ND	ND	Liver	ND	B2
Benzo(a)pyrene[b]	7.3×10^0	6.1×10^0	ND	Forestomach	ND	B2
Pesticides / PCBs						
Aroclors	7.7×10^0	ND	ND	Liver	ND	B2
Dieldrin	1.6×10^1	1.6×10^1	4.6×10^{-3}	Liver	Liver	B2

ND = No data available

[a]Except where qualified by other footnotes, the values in this table are from IRIS or HEAST.
[b]Toxicity equivalency factors (TEFs) and corresponding oral and inhalation slope factors for the Group B2 PAHs are presented in Table C.4-3.

TABLE C.4-3

TOXICITY EQUIVALENCY FACTORS
AND CORRESPONDING ORAL AND INHALATION SLOPE FACTORS
FOR THE GROUP B2 PAHs

PAH	Relative Potency	Oral Slope Factor $(mg/kg/day)^{-1}$	Inhalation Slope Factor $(mg/kg/day)^{-1}$
Benzo(a)pyrene	1.0	7.3	6.1
Benzo(a)anthracene	0.145	1.1	0.89
Benzo(b)fluoranthene	0.1228	0.90	0.75
Benzo(k)fluoranthene	0.0523	0.38	0.32
Dibenzo(a,h)anthracene	1.11	8.1	6.8
Indeno(1,2,3-cd)pyrene	0.278	2.0	1.7

SOURCE: Clement International 1990.

Dermal Reference Doses and Cancer Slope Factors

For this FS, dermal RfD values and cancer slope factors were calculated from the corresponding oral values. To calculate a dermal RfD, the oral RfD was multiplied by the gastrointestinal (GI) absorption efficiency factor, expressed as a fraction. The resulting dermal RfD is based on absorbed dose. This is the appropriate value with which to compare dermal doses, because they are expressed as absorbed rather than exposed doses. In a similar manner, and for the same reasons, to calculate a dermal cancer slope factor, the oral slope factor was divided by the GI adsorption efficiency because cancer slope factors are expressed as reciprocal doses. Dermal RfD values and cancer slope factors for the COCs in Operable Unit 2 are presented in Table C.4-4.

The most important aspect in calculating a dermal RfD or cancer slope factor is the accuracy of the GI absorption efficiency factor. For this reason, the toxicity profiles contain pharmacokinetics discussions in which the oral absorption data were evaluated. Where appropriate, the low (i.e., most conservative) end of the range of available GI absorption data for humans was used to derive the dermal RfD or cancer slope factor. When the human data were insufficient, animal data were used. Data from high-dose experiments were not used if more suitable data were available and it appeared the GI absorption process could have been saturated. When adequate quantitative data were not available, a default GI absorption factor was used.

TABLE C.4-4

DERMAL REFERENCE DOSES AND CANCER SLOPE FACTORS FOR COCs

Chemical	Gastrointestinal Absorption Fraction	Dermal Reference Dose (mg/kg/day)	Dermal Slope Factor $(mg/kg/day)^{-1}$
Inorganics			
Antimony	0.15[a]	6.00×10^{-5}	ND
Arsenic	0.95[b]	2.85×10^{-4}	1.90×10^{0}
Beryllium	1.00[c]	5.00×10^{-3}	4.30×10^{0}
Uranium	0.05[d]	1.50×10^{-4}	ND
Semivolatiles			
Carbazole	0.90	ND	2.22×10^{-2}
Polycyclic aromatic hydrocarbons (PAHs)[f]	NA	NA	NA
Pesticides/PCBs			
Aroclors	0.75[a]	5.30×10^{-5}	1.03×10^{1}
Dieldrin	0.90	4.50×10^{-5}	1.78×10^{1}

ND = Not derived
NA = Not applicable

[a] See the Toxicity Profile for this chemical in Section C.4.5.
[b] EPA 1993f
[c] EPA Region V guidance, July 1994 (Saunders 1994)
[d] RAGS, pp. A-2 to A-3: Recommended default Gastrointestinal Absorption Fraction for inorganic chemicals = 0.05.
[e] Jones and Owen 1989
[f] Dermal Exposures to PAHs: Reliable cancer slope factors for dermal exposure to PAHs are currently unavailable. Current policy indicates it is inappropriate to extrapolate dermal slope factors from oral slope factors for PAHs. Also, extrapolation from other routes of exposure is inappropriate due to varied absorption, metabolic transformations, and target organ end point responses. However, PAHs are potent skin carcinogens. Current information on the contribution to cancer risk from dermal exposure to PAHs indicates the toxicity from the dermal pathway may be as toxic as from oral route of exposure. To estimate the risk contribution from PAHs via dermal exposure for all direct contact pathways, the risk posed for dermal exposure was assumed equal to the risk from oral exposure.

SOURCE: OU2 RI report (DOE 1994a)

As noted by EPA (1989f), the GI absorption of many metals from the GI tract is limited, and 0.05 is a reasonable default value for metals and inorganic substances. The EPA (1989f) did not recommend a separate default value for organic chemicals. A compilation of data for 19 organic chemicals presented GI absorption efficiencies of at least 0.9, indicating that organic chemicals generally are readily absorbed. The arithmetic average of the efficiencies for the 19 organic chemicals, 0.91368 (equivalent to 0.9 when rounded to one significant figure), appears to be a reasonable default GI absorption efficiency factor for organic chemicals. The default value of 0.9 was used for organic chemicals for which quantitative data were not adequate.

C.4.3 RADIONUCLIDES

Radionuclides found at contaminated sites interact in the environment in the same manner as their nonradioactive isotopes. Consequently, the types of data needed for a radiation risk assessment are similar to those required for a chemical risk assessment. The primary differences lie in the procedures used to characterize the radionuclide contaminants. Exposure pathways for radionuclides include both internal and external pathways. Intakes by inhalation, ingestion, and dermal absorption are the important internal pathways.

The qualification of the amount of energy deposited in living tissue due to internal and external exposure to ionizing radiation is termed "radiation dosimetry." The amount of energy deposited in living tissue is of concern because the potential adverse effects of radiation are proportional to energy deposition. Therefore, the term "dose," used regarding radiation exposure, is defined as the energy imparted to a unit mass of tissue, whereas chemical dose means the mass of a chemical absorbed into an organism.

Despite the fundamental difference between the way exposures are expressed for radionuclides and chemicals, the approach to exposure assessment is the same. An exposure assessment for radionuclides involves three steps: 1) characterization of the exposure setting, 2) identification of the exposure pathways, and 3) quantification of exposure. The primary differences in conducting exposure assessments for radionuclides as compared to chemicals are: 1) consideration of external exposures, 2) conversion of radiation exposures to dose equivalents, and 3) modification of fate and transport models for radiation exposure.

Toxicity assessment for radionuclides generally follows a two-step process. The first step, hazard identification, is used to determine whether exposure can increase the incidence of an adverse health effect. The second step, dose response assessment, is used to quantify the toxicity information and characterize the relationship between the dose of the contaminant administered or received and the incidence of adverse health effects in the exposed population.

Estimates of human health effects are based primarily on single, acute, high doses of radiation. The current model used to describe these effects as a function of dose is called the linear quadratic model. This model assumes that there is no threshold for the induction of cancer or genetic effects. It is assumed that any radiation dose could give rise to a cancer or genetic effect. This is a conservative assumption and a conservative model. There is very little data on the effects of radiation at low doses or on the effects of chronic, long-term exposure in humans.

Two major international groups have been responsible for collecting and evaluating data on the human health effects of ionizing radiation, the Committee on the Biological Effects of Ionizing Radiations (BEIR) of the National Research Council, and the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR). These groups have issued a series of reports presenting the data and recommendations on risk values. The EPA is responsible for developing guidelines for radiation risk assessment in the United States and has relied on the published evaluations of these groups, along with those of the International Commission on Radiological Protection (ICRP) and the National Council on Radiation Protection and Measurements (NCRP). The following discussion contains a brief overview of effects of ionizing radiation on human health, and the relative risks associated with these effects.

The principal adverse biological effects associated with ionizing radiation from radioactive substances in the environment are mutagenicity, teratogenicity, and carcinogenicity:

- Mutagenicity is the ability to induce genetic mutations in the nuclei of either somatic or reproductive cells.

- Teratogenicity is the ability to induce or increase the incidence of congenital malformations, which are permanent structural or functional deviations produced during embryonic growth and development.

- Carcinogenicity is the ability to produce neoplastic changes which result in tumors.

Carcinogenic Effects

The guidance for EPA Superfund risk assessments clearly states that carcinogenicity is considered to be the limiting deleterious effect at the radiation dose levels expected at the remediated FEMP. The carcinogenic effects may then be used as the sole basis for assessing the radiation-related human health risks of a site contaminated with radionuclides (RAGS).

Each radionuclide produces a unique radiation spectrum and can affect different organs in the human body. The EPA has calculated the annual radiation dose equivalent from each radionuclide to each organ in each year of life, per unit intake or external exposure, over a lifetime. The average excess number of all types of radiation-induced fatal cancers that occur in a year can then be estimated for the corresponding dose equivalents received during that year and relevant preceding years. The excess number of radiation-induced fatal cancers is derived from epidemiological data, extrapolation from high radiation doses to low doses, and mathematical models for projecting risk over a lifetime. Because the EPA is concerned with assessing cancer incidence, each radionuclide slope factor has been calculated by dividing the excess fatal cancer risk for that radionuclide by the mortality-to-incidence risk ratio (RAGS) for the types of cancer induced by that radionuclide. This mortality-to-incidence risk ratio is not incorporated into the cancer potency factors derived by EPA for chemical carcinogens; therefore, the basis for cancer risk estimates for radionuclides and chemical carcinogens is not the same.

The relationship between cancer incidence and exposure to radioactive materials is quantified by using mathematical extrapolation models, which estimate the largest possible linear slope (within the 95 percent UCL) at low extrapolated doses consistent with the data. This "radiocarcinogenicity slope factor" is characterized as the "maximum likelihood estimate of the age-averaged lifetime total excess cancer risk per unit intake or exposure" (EPA 1991b). For this reason, the true risk to humans, although not identifiable, is not likely to be the upper-bound estimate. It may be lower.

The EPA Office of Radiation Programs (ORP) has calculated cancer slope factors for radionuclides of potential concern at Superfund sites. These values are listed in the HEAST (not IRIS) and are subject to revision. The slope factors are presented in Table C.4-5.

TABLE C.4-5

CANCER SLOPE FACTORS FOR RADIONUCLIDES

Radionuclide	ICRP Lung Class[a]	Inhalation Risk/(pCi)	Ingestion Risk/(pCi)	External Exposure (Risk/year per pCi/g soil)
Cs-137 + Progeny	D	1.9×10^{-11}	2.8×10^{-11}	2.0×10^{-6}
Np-237 + Progeny	W	2.9×10^{-8}	2.2×10^{-10}	4.3×10^{-7}
Pu-238	Y	3.9×10^{-8}	2.2×10^{-10}	2.8×10^{-11}
Ra-226	W	3.0×10^{-9}	1.2×10^{-10}	1.2×10^{-8}
Ra-226 + Progeny[b]	W	3×10^{-9}	1.2×10^{-10}	6.0×10^{-6}
Ra-228 + Progeny	W	6.9×10^{-10}	1.0×10^{-10}	2.9×10^{-6}
Rn-222 + Progeny[b]	Gas	7.7×10^{-12}	1.7×10^{-12}	5.9×10^{-6}
Sr-90 + Progeny	D	6.2×10^{-11}	3.6×10^{-11}	0.0×10^{0}
Tc-99	W	8.3×10^{-12}	1.3×10^{-12}	6.0×10^{-13}
Th-228 + Progeny	Y	7.8×10^{-8}	5.5×10^{-11}	5.6×10^{-6}
Th-230	Y	2.9×10^{-8}	1.3×10^{-11}	5.4×10^{-11}
Th-232	Y	2.8×10^{-8}	1.2×10^{-11}	2.6×10^{-11}
U-234	Y	2.6×10^{-8}	1.6×10^{-11}	3.0×10^{-11}
U-235 + Progeny	Y	2.5×10^{-8}	1.6×10^{-11}	2.4×10^{-7}
U-238 + Progeny	Y	2.4×10^{-8}	2.0×10^{-11}	5.1×10^{-8}

[a]Classification recommended by the ICRP for half-time of clearance from the lung:
Y = years, W = weeks, D = days.
[b]A Ra-222 decay subchain, Rn-222+D, is also included in the HEAST tables, comprised of ingestion, inhalation and external exposure slope factors for Rn-222 plus the corresponding slope factors for each of its decay products (Po-218, Pb-214, Bi-214 and Po-214). For the ingestion and external exposure slope factors for Rn-222+D, decay products are assumed to be in secular equilibrium. For the inhalation slope factor, decay products are assumed to be in 50% equilibrium.

SOURCE: HEAST (EPA 1994c)

Genetic Effects. Genetic effects have been studied extensively using animal models and in the Japanese atomic-bomb survivors. A comparison of the survivor data has consistently led to estimates of genetic effects that imply lower risks in humans than in animals (NAS 1990). Taking into account the confidence intervals associated with the various data, the difference between humans and animals remains, indicating that humans are less sensitive to radiation induction of

mutations in germ cells, and that risks derived from animal data will be conservative if applied to humans. Therefore, BEIR V and UNSCEAR have based their evaluation of genetic risk on the lower 95 percent confidence limit for Japanese atomic-bomb survivor data, which is also consistent with the range of doubling doses observed in mice. A doubling dose is the dose required to double the incidence of genetic defects in a population.

The doubling dose for humans is currently estimated to be 100 rem (NAS 1990). Genetic effects expected per rem per 30-year generation, based on this doubling dose, fall into the range of less than 1 to about 100 per million liveborn offspring for multi-generations. The natural incidence for genetic anomalies ranges from 400 to 30,000 per million liveborn offspring (AS 1990).

The EPA has recommended (1989d) a genetic risk of 2600 effects per rad per 30-year generation for low Linear Energy Transfer (LET) radiation where 1 rad equals approximately 1 rem, and 6900 per rad per 30-year generation for high LET radiation (alpha and beta radiation) where 1 rad equals approximately 0.05 to 1 rem (depending on energy, LET, etc). These risks are based on the older BEIR III report. This approach is slightly more restrictive than the current BEIR V estimates.

Teratogenic Effects. Teratogenic effects are somatic effects resulting from exposure in utero to ionizing radiation. These effects, which are not passed on to other generations, can include severe mental retardation, microcephaly, and structural or limb abnormalities. Extrapolating the results of animal studies to humans has proved difficult because of the significant differences in fetal development rates. The EPA (1989d) uses an estimate of 4000 effects per rad of exposure during weeks 8 to 15 of gestation for low LET radiation (primarily gamma radiation).

C.4.4 TOXICITY PROFILES: RADIONUCLIDES

This section presents toxicity information for radionuclide compounds. It was assumed that all radionuclides are present in the soils as oxides or carbonates. This represents a conservative assumption because radionuclides clear slowly from environmental media.

The varying level of discussion among the contaminant profiles reflects both the amount of information accessible in the literature about these substances and professional judgement concerning the appropriate level of detail necessary to adequately discuss the toxicity of each substance.

C.4.4.1 Cesium-137

Biological Distribution and Retention/Pharmacokinetics

The GI uptake of cesium is rapid, and its absorption coefficient is approximately 85 percent in mammals. The cesium body burden decreases with a half-life of approximately 80 days. The EPA (1993b) has derived a GI absorption factor for cesium of 1.0, equivalent to 100 percent.

The physiological properties of cesium resemble those of potassium, although quantitative differences arise in transport by cell membranes; cesium can displace potassium from muscle and red blood cells. Potassium enters the cells via sodium-potassium-dependent ATPase. Cesium ions are effective in activating this enzyme and compete with potassium for carrier sites (Davie and Coleman 1988).

Noncarcinogenic Toxicity

Cesium salts can be regarded as being virtually nontoxic. Acute toxicity, which was observed only at very high cesium concentrations (10 to 20 mmol Cs/kg) in mice, is characterized by dysautonomic upset with parasympathetic predominance and a multi-phasic excitation/depression action on the central nervous system. The organs most affected appear to be the liver, intestine, heart, and kidneys.

In beagles injected with massive doses of Cs-137, early deaths occurred as a result of bone marrow destruction (Davie and Coleman 1988).

Carcinogenicity

In beagles injected with massive doses of Cs-137, neurofibrosarcomas occurred in the survivors (Davie and Coleman 1988). The EPA has derived cancer slope factors for cesium and its progeny, and were previously presented in Table C.4-5.

C.4.4.2 Neptunium-237

Biological Distribution and Retention/Pharmacokinetics

The fraction of ingested neptunium absorbed from the GI tract into blood (f_1) is assumed to be approximately 1 percent. This value was based on experimental data involving a large group of rats fed with doses of neptunium exceeding 1 mg/kg. When the dietary dose was lower than 1 mg/kg, the fraction F_1 was 0.1 percent or less. Data on distribution and retention of neptunium in rats indicate that its metabolic behavior is similar to that of plutonium. However, there are some indications that neptunium may distribute more like calcium than plutonium in the skeleton. Forty-five percent of the neptunium leaving the transfer compartment will be translocated to mineral bone. Another 45 percent will be transported to the liver, and 0.035 percent to the testes or 0.011 percent to the ovaries. The remaining neptunium leaving the transfer compartment is assumed to directly enter the excreta. The biological half-life of neptunium is about 100 years in mineral bone, about 40 years in the liver, and it is assumed that neptunium is permanently retained in the gonads. These retention and translocation data were based on the ICRP common model for systemic distribution and retention of all transuranic elements. The model was largely based on plutonium data.

Noncarcinogenic Toxicity

The presence of neptunium in high-level nuclear waste and its presumed environmental mobility have made it an isotope of special environmental concern. It has been estimated that Np-237 may be the most hazardous remaining constituent of high-level nuclear waste during the interval from 10,000 to 30,000 years following disposal.

All animal toxicity studies with neptunium have employed Np-237. Because of its low specific activity (0.76 mCi/g), the chemical toxicity effects of Np-237 are often observed to the exclusion of radiation effects. Soviet data in this area were studied by Moskalev et al. (NCRP 1988). Although the chemical toxicity effects might be a controlling factor in an acute exposure to

Np-237, they would not be an important factor at the usual levels concerning radiation protection, and certainly not at the very low levels of potential environmental exposure. In this presentation, therefore, the health effects of Np-237 are assessed only with respect to carcinogenicity, as described below.

Carcinogenicity

The effects of neptunium exposure have not been studied in humans. For radiation protection purposes, it has been assumed that radiation doses resulting from neptunium deposition in organs and tissues will result in biomedical effects similar to those observed following the exposure of humans to other sources of ionizing radiation. The very limited data on neptunium effects in animals provide no direct useful estimates of risk to humans. Although these data play no direct role in establishing neptunium standards, they can nevertheless help to validate these standards through comparisons with other animal studies employing other radionuclides.

The long-term radiation effects of Np-237 have been studied only in rats. Genetic effects have not been studied. Bone cancer has been the predominant long-term effect of low-level injections of Np-237. Both lung and bone cancer incidences are elevated following inhalation exposure. There is no indication that neptunium at low exposure levels constitutes a unique health risk unpredictable from its general radiological characteristics.

The 1987 NCRP recommendations for annual limits on Np-237 intake are as follows:

• Oral ingestion	0.6 μCi	Based on nonstochastic limits
	2.0 μCi	Based on stochastic limits
• Inhalation	0.005 μCi	Based on nonstochastic limits
	0.010 μCi	Based on stochastic limits

The nonstochastic limit or dose equivalent applies to bone surface.

The EPA has derived cancer slope factors for neptunium, and they are presented in Table C.4-5.

C.4.4.3 Plutonium

Biological Distribution and Retention/Pharmacokinetics

Regarding distribution and retention, inhaled plutonium is retained in the lungs with an effective half-life that varies from hundreds of days for plutonium oxides to tens of days for more soluble forms. A significant portion of the plutonium oxide that leaves the lungs is translocated to the tracheobronchial lymph nodes. Plutonium solubilized within the lungs is translocated to the liver and skeleton where it is tenaciously retained (Klaassen 1986).

Noncarcinogenic Toxicity

Among the plutonium isotopes, the short-lived Pu-241 is especially toxic because of its short half-life. The toxicity of plutonium compounds is based primarily on the very high radiotoxicity of the plutonium atom and secondarily upon the atoms or combinations of atoms contained (Sax 1984). There are no reports on the chemical toxicity of plutonium; however, the fibrosis observed in the lungs of exposed animals and humans could be due to chemical interactions. The radiologic toxicity of plutonium involves bone necrosis, bone and lung cancer, and detrimental effects on the reproductive system. Also, toxic effects are observed in offspring of pregnant animals exposed to plutonium. No ingestion data specific to plutonium are available.

In a classic long-term toxicity study performed by Bair et al., the effects of inhaled plutonium oxide were studied in beagles for up to 10 years following inhalation exposure. At the highest levels of deposited activity, the dogs died within several hundred days with radiation pneumonitis and pulmonary fibrosis. At later times, death was related to severe pulmonary fibrosis. Beyond 1000 days, although pulmonary fibrosis was still prominent, death was due to primary pulmonary neoplasia. The most common neoplasm was bronchioloalveolar carcinoma (Klaassen 1986). Hahn et al. (1983), using data reported by Bair and Thomas (1976), calculated the risk factor for Pu-239 alpha irradiation of the lungs to be 600 lung tumors per million rad to lung, or, assuming an RBE of 20, 30 lung tumors per millirem to lung.

Human data for plutonium exposure are available. Among workers contaminated, the case histories have been documented of 26 men who worked with plutonium during World War II. The initial body burden of these workers was between 540 and 229,500 pCi (reported as between 20 and 8500 Becquerel), and 11 of them received doses exceeding the maximum allowed by the

International Commission for Radiological Protection. After a medical follow-up of 37 years, 2 members of this group died of myocardial infarction and accidental trauma, respectively, compared to the 6.6 deaths expected on the basis of the adjusted rates for white males. Their 1982 exam provided no evidence that 37 years of exposure to internally deposited plutonium had adverse effects on their health (Seiler 1988).

Less toxicity data are available on trans-plutonium radionuclides such as americium and curium; however, the data that are available indicate a qualitative similarity to the toxicity of plutonium. McClellan, et al. (1972) noted that inhaled americium and curium, even as oxides, appeared more soluble than inhaled plutonium and rapidly translocated to the liver and skeleton. (Klaassen 1986)

Carcinogenicity

The EPA classifies all radionuclides as weight-of-evidence Group A substances (human carcinogens), based on their characteristic of emitting ionizing radiation and on the extensive epidemiologic data associating exposure with radiogenic cancers in humans (EPA 1992d). The carcinogenicity of Pu-238 (the predominant plutonium isotope at the FEMP) from internal exposure is due to alpha particles. The EPA (1992d) has reported cancer potency slope factors for the plutonium isotopes, and these are presented in Table C.4-5.

C.4.4.4 Radium

Biological Distribution and Retention/Pharmacokinetics

Four isotopes of radium occur naturally, Ra-223 (actinium series), Ra-224 and Ra-228 (thorium series), and Ra-226 (uranium series); radium is ubiquitous in the earth's crust and common in groundwater, mineral deposits, soil, food products, and common building materials. Ra-226 has the longest half-life (1600 years) of the radium isotopes and decays by alpha particle emission. Ra-223 and Ra-224 are also alpha-particle emitters, and Ra-228 is a beta-particle emitter. The primary uses of radium are for manufacturing luminous dials and instrument faces and for internal radiation therapy; thus, the bulk of human data on the effects of radium intake are available from studies of radium-dial painters and medical patients who have been administered therapeutic doses of radium.

Radium introduced into the body generates decay products, including gaseous isotopes of radon. Rn-222 generated in the body persists long enough that it easily diffuses into the bloodstream and accumulates in the sinuses, significantly reducing the alpha dose to the radium accumulating tissues but increasing the dose in the sinuses. Ultimately, the bone tissues are the principal site of radium accumulation because of the similar chemistry of radium and calcium (NAS 1988). In the bone tissues, radium is initially deposited in endosteal bone surface tissue. There is, then, a redistribution to the bone volume, where the radium resides with a long retention time.

Noncarcinogenic Toxicity

No chemical toxic effects of exposure to radium have been documented, and the EPA has not developed an RfD for radium; therefore, the health hazard for radium is associated with potential radiocarcinogenic effects.

Carcinogenicity

Although epidemiological investigations have documented the association between radium exposure and carcinogenic effects, there has been considerable debate over the dose-response relationship involved. Bone cancer incidence has been evaluated as a function of a variety of parameters that represent a measure of radium exposure, such as absorbed dose to the skeleton, pure radium equivalents, and cumulative rad-years (Evans 1966).

Cancers of the paranasal sinuses and the mastoid air cells have been associated with exposure to Ra-226 and Ra-228 since the 1930s (Martland 1939). These effects were initially seen in radium-dial painters, who received high absorbed doses from the quantities of radium they ingested. Excess incidence is evident when compared to the natural incidence, which is very low. After exposure to radium, these types of cancers were expressed later than bone cancers (Evans et al. 1969; Finkel et al. 1969; Rowland et al. 1971; Rundo et al. 1986).

As discussed above, Rn-222 generated in the body persists long enough that it easily diffuses into the bloodstream and accumulates in the sinuses, significantly increasing the dose in the sinuses. Studies of cancers of the sinuses and mastoid cells conducted in beagles injected with a variety of alpha-emitting radionuclides revealed excess incidence of these cancers (Schlenker 1980). Not all of the tumors were induced by alpha emitters that produce a gaseous decay product; therefore, a

gaseous decay product was not essential to induction. Nevertheless, the risk of these cancers from Ra-226 and its decay products (including Rn-222) is considered significantly greater than from other alpha-emitting radionuclides.

The accumulation of very high levels of radium is associated with severe anemias and leukemia (NAS 1988). However, at lower levels of accumulation (such as those experienced by the majority of U.S. radium-dial painters, especially in later years) the accumulated radium does not appear to significantly increase the risk of leukemia (NAS 1988). The BEIR IV Committee presented a cancer risk factor of 200 x 10^{-6} per rad for bone sarcomas from protracted exposure to radium in its report on radon and other alpha emitters (NAS 1988). The HEAST has reported cancer slope factors for the radium isotopes, and these are presented in Table C.4-5.

C.4.4.5 Radon and Progeny

Biological Distribution and Retention/Pharmacokinetics

The health risk accompanying radon exposure can be attributed to inhalation of the short-lived progeny of radon. The daughter atoms of concern are attached to particulates which then lodge in the lung passages and produce a radiation dose which may causes lung cancer. Radon progeny that do not lodge in the lung passages are exhaled, and do not deliver a radiation dose. Lung cancer results when the bronchial epithelium of the lung passages is exposed to alpha particles emitted from decaying radon progeny (i.e., Po-214 and Po-218) lodged in the lung passages.

Short-lived radon progeny will decay to lead. Because lead is a chemical toxicant, significant accumulations of radon pose a potential source of lead exposure.

Noncarcinogenic Toxicity

There are no known toxic effects of direct exposure to radon gas or its short-lived progeny.

Carcinogenicity

Radon gas and associated progeny have been linked to an increase in incidence of lung cancer in individuals exposed via inhalation.

The following discussion regarding the health effects of exposure to radon and radon progeny is summarized from the report of the BEIR IV Committee on radon and other alpha emitters (NAS 1988). The radiological effect of concern from exposure to radon and radon progeny is lung cancer.

The lung cancer mortality risk estimates for radon progeny exposure published by the BEIR IV Committee (NAS 1988) were based on an epidemiological study of underground miner populations. The assessment of the risk from exposure to radon progeny by the BEIR IV Committee represents the most recent comprehensive examination of estimated health risks associated with exposure.

In its study of the human epidemiological data, the BEIR IV Committee reevaluated the primary data (i.e., exposure histories and mortality) for the four principal epidemiological study groups of underground miners exposed to radon progeny. From this reevaluation, the committee estimated the risk of developing fatal lung cancer. The risk from lifetime exposure to radon progeny was estimated at 350×10^{-6} excess fatal lung cancers per cumulative working level month (WLM) as exposure. The WLM is defined as the cumulative exposure to an airborne concentration of short-lived radon progeny (equal to one working level) for a period of one working month. It must be noted that this estimate, quantified as fatal lung cancer risk, was based primarily on epidemiological studies of humans and is expressed per unit cumulative exposure to progeny (WLM^{-1}). The EPA slope factors addressing cancer incidence were based on calculated radiation doses to organs and tissues and are expressed per unit radioactivity intake (pCi^{-1}). Thus, the EPA and BEIR IV risk estimates are not directly comparable. The EPA cancer slope factors were used to assess risk attributable to radon and radon progeny exposure. It is also noted that EPA has adopted a nominal risk estimate of 360×10^{-6} per WLM for use in NESHAPS (RAGS). This estimate was based primarily on EPA's consideration of the BEIR IV assessment; however, EPA did average radon risk estimates derived from BEIR IV and ICRP models to calculate the estimate of 360×10^{-6} per WLM.

Although the carcinogenicity of radon progeny is established and the hazards of exposure during mining are well recognized, the hazards of exposure in other environments have not yet been adequately quantified (NAS 1988).

Using the BEIR IV risk factor (NAS 1988) of 350 x 10^{-6} WLM^{-1} for lung cancer mortality from inhalation of Rn-222 and progeny, and by assuming 51.5 working months per year (8760 hours per year divided by 170 hours worked per month), 100 pCi Rn/liter air, short-lived Rn-222 progeny present in 50 percent equilibrium, and an inhalation rate of 20 m^3/day for 365 days/year, one can derive a lung cancer mortality risk factor of 1.2 x 10^{-11} per pCi. The EPA cancer slope factor from HEAST for inhalation of Rn-222 plus progeny is 7.7 x 10^{-12} per pCi. The cancer slope factors for radon plus progeny are presented in Table C.4-5. It must be noted that the BEIR IV risk estimate pertains to lung cancer mortality, while the EPA cancer slope factors all pertain to cancer induction rather than cancer fatality.

C.4.4.6 Strontium

Biological Distribution and Retention/Pharmacokinetics

Wenning and Kirsch (1988) reported that the GI absorption of soluble strontium compounds ranges from 5 to 25 percent of the ingested dose and the EPA (1992d) has derived a GI absorption efficiency factor of 0.3. Insoluble strontium compounds are absorbed to about 5 percent. Data regarding inhalation or dermal absorption have not been located.

Strontium is an alkaline earth metal similar in chemical behavior to calcium (Wenning and Kirsch 1988). About 99 percent of the body burden is in the skeleton. Excretion is principally in the urine.

Noncarcinogenic Toxicity

Stable strontium has induced rachitic changes in the bones, particularly of the young (EPA 1992d). Presumably, Sr-90 would also induce rachitic changes in bone. The concern at the FEMP, however, is with the radiological effects (carcinogenicity) of Sr-90, rather than the noncarcinogenic toxicity.

Carcinogenicity

The EPA (1992d) has assigned stable strontium to cancer weight-of-evidence Group D, indicating it is not classifiable as to human carcinogenicity. Quantitative cancer risk estimates were not derived for Group D substances. The EPA classifies all radionuclides as Group A substances (human carcinogens), based on their characteristic of emitting ionizing radiation and on the

extensive epidemiologic data associating exposure with radiogenic cancers in humans (EPA 1992d). The EPA (1992d) has derived cancer potency slope factors for Sr-90, and its radioactive decay product of 3.6 x 10^{-11} per pCi for ingestion and 6.2 x 10^{-11} per pCi for inhalation exposure, and these are presented in Table C.4-5. There is no slope factor for external exposure to Sr-90, which does not emit penetrating radiation (gamma- or x-rays).

C.4.4.7 Technetium

Biological Distribution and Retention/Pharmacokinetics

No isotopes of technetium are stable (Clarke and Podbielski 1988). Lethality due to radiation toxicity usually occurs before the nonradiologic effects of technetium become manifest; hence, little is known of the absorption, distribution or pharmacokinetics of the element.

Noncarcinogenic Toxicity

No isotopes of technetium are stable (Clarke and Podbielski 1988). Lethality due to radiation toxicity usually occurs before the nonradiologic effects of technetium become manifest; hence, little is known of the metabolic effects of the element.

Carcinogenicity

The EPA classifies all radionuclides as weight-of-evidence Group A substances (human carcinogens), based on their characteristic of emitting ionizing radiation and on the extensive epidemiologic data associating exposure with radiogenic cancers in humans (EPA 1992d). The internal carcinogenicity of Tc-99 is due to its emission of beta particles (Clarke and Podbielski 1988). The EPA (1992d) has derived cancer potency slope factors for Tc-99 of 1.3 x 10^{-12} per pCi for ingestion, 8.3 x 10^{-12} per pCi for inhalation, and 6.0 x 10^{-13} per pCi yr/g for external exposure, and these are presented in Table C.4-5.

C.4.4.8 Thorium

Biological Distribution and Retention/Pharmacokinetics

Thorium is a naturally occurring radionuclide. Oxides and hydroxides of thorium are assigned to inhalation Class Y, while all other chemical forms are assigned Class W. It is deposited primarily in bone with a very long half-life (8000 days), and to a lesser extent in the liver and other soft tissues (ICRP 1978).

Noncarcinogenic Toxicity

No toxic effects of exposure to thorium have been documented, and the EPA has not developed an RfD for thorium; therefore, the health hazard for thorium is associated with its potential radiocarcinogenic effects.

Carcinogenicity

The half-life of Th-232 is approximately 10 billion years; thus, the specific activity is relatively low and the rate of decay is slow. Th-232 decays by alpha particle emission, as do most of the progeny in the thorium natural decay series.

Thorium has historically been used as a medical imaging agent, because it is a heavy atom that provides contrast in radiographic imaging. In this role, thorium has been used commercially as Thorotrast, a 25-percent colloidal solution of thorium dioxide. The following discussion of the health effects from thorium exposure is summarized from the report of the BEIR IV Committee on radon and other alpha emitters (NAS 1988).

Thorotrast has been used extensively in the United States, Europe, and Japan as an intravascular contrast agent for cerebral and limb angiography. The human epidemiological evidence from the studies of Thorotrast patients represents the primary source of data from which estimates of risk have been derived (NAS 1988). These data can be used to derive estimates of risk for liver cancer and leukemia; however, such estimates strictly apply only to conditions of intravascular Thorotrast injection. The BEIR IV committee derived a risk estimate of up to 300×10^{-6} per rad of alpha particle radiation to the liver. They emphasized that these estimates are for Thorotrast, not thorium, because the dosimetry of other isotopes of thorium differs from that of Th-232 in the Thorotrast colloid form. BEIR IV also derived a risk estimate of up to 60×10^{-6} per rad of alpha radiation to bone marrow for leukemia, and a value of up to 120×10^{-6} per rad of alpha radiation to the skeleton without marrow for bone cancer (NAS 1988).

In summary, the animal experimental evidence indicates that Thorotrast induces cancers as a result of the radiation dose delivered by the solution. The physical presence of particles in the colloid solution and the chemical effect of the thorium are not likely to influence the induction of cancer (NAS 1988). The EPA derived slope factors are presented in Table C.4-5.

C.4.4.9 Uranium

Biological Distribution and Retention/Pharmacokinetics

In general, uranium compounds are not easily absorbed across the human GI tract. Soluble uranium compounds demonstrate the best absorption. In a study in which patients drank a solution of uranyl nitrate hexahydrate, a water-soluble compound, only 0.5 to 5 percent of the dose was absorbed (Hursh et al. 1969). Recent uranium metabolic models estimated absorption from the GI tract to the blood to be 0.6 percent (Wrenn et al. 1987). Although human data concerning absorption by dermal exposure are sparse, water-insoluble uranium compounds were not absorbed in significant quantities across the skin (Yuile 1973) and are not believed to pose a significant risk to humans by this exposure route.

Once absorbed into the bloodstream, uranium compounds are metabolically converted to uranyl ions. The uranyl ion acts as a ligand in the systemic circulation, binding to the plasma proteins and bicarbonate. Although this uranyl-bicarbonate complex is stable at the pH of the plasma, the pH of urine favors dissociation of the complex. This leaves the uranyl ion free to bind to the tissues in the proximal tubule wall of the nephrons of the kidneys, resulting in cellular necrosis (Leggett 1989).

The kidneys are the only soft tissue that stores uranium in any appreciable quantity and are the main organs of excretion (Hursh and Spoor 1973). Approximately 70 percent of an intake of uranium has been estimated to be excreted by the kidneys within 24 hours of intake (Berlin and Rudell 1979). Uranium that is not excreted is stored in the kidneys and bones. Binding to the bone is believed to be caused by the affinity of uranium for the phosphate groups in the bone structure. The bone surface is the most probable target tissue for exposure to uranium, and bone sarcoma as the carcinogenic effect of concern. Radiocarcinogenic effects, including bone sarcoma and head carcinoma, have also been observed in animals and humans from exposure to isotopes of radium, and studies involving exposure of mice to high specific activity U-232 and U-233 have also revealed an increase in bone sarcomas.

Noncarcinogenic Toxicity

In humans, exposure to uranium leads to nephritis in the kidneys. Data on human exposure to uranium compounds were collected from 1940 to 1960 in acute studies on terminal and volunteer

patients. Single injections of 70 to 100 μg/kg of uranium nitrate to terminally ill patients resulted in proteinuria and increased levels of catalase in the urine (Berlin and Rudell 1979; Luessenhop et al. 1958). In another study, patients were given uranyl nitrate injections ranging from 6.3 to 71 μg/kg. One of the early signs of renal damage, the appearance of the enzyme catalase in the urine, occurred in patients receiving 55 to 71 μg/kg (Hursh and Spoor 1973; Leggett 1989).

The EPA (1991b) has established an RfD for uranium of 3×10^{-3} mg/kg/day. In lieu of a NOAEL, the RfD was based on the LOAEL of 2.8 mg/kg/day (Maynard and Hodge 1949) and an uncertainty factor of 1000. The uncertainty factor accounts for intraspecies and interspecies variability in toxicological response and for the use of the LOAEL rather than an NOAEL. No factor was included for the short duration of the exposure (30 days), because it has been shown that chronic nephrotoxic effects can be adequately characterized with experiments of acute/subacute duration (RAGS Part B). The RfD for uranium is presented in Table C.4-1.

Carcinogenicity

Uranium can induce cancer as a result of intake into the body through inhalation or ingestion pathways. The induction of cancer results when organs and tissues of the body are exposed to alpha particles emitted from decaying uranium atoms. Alpha particles are energetic emissions that cause molecular ionizations in a very dense pattern along a short path through matter. The effect of an alpha particle is highly localized due to the short path length traveled (low penetrability) and the ability of the particle to produce many ionizations. The ionization events cause biological damage believed to be responsible for inducing cells to become cancerous. Although other energetic emissions from radioactive decay of atoms (such as beta particles and gamma rays) also cause molecular ionizations, these radiations do not produce the density of ionizations that alpha particles produce. The dense pattern of ionizations caused by alpha particles and the low penetrability of alpha particles are the factors that determine uranium to be an internal exposure hazard. Alpha particles are not an external exposure hazard because they do not penetrate sensitive tissues from outside the body. The outer layers of the skin stop the alpha particles before they can penetrate and damage sensitive tissues of inner layers.

The type of uranium (i.e., natural, enriched, or depleted) under consideration is important because different types of uranium have different specific activities (the amount of radioactivity

per unit mass). The value of the specific activity of the uranium reflects the number of alpha particles emitted per unit mass. This has a direct impact on the magnitude of the radiological dose delivered internally after the uranium enters the body. Naturally occurring uranium and uranium processed from natural uranium is a mixture of U-234, U-235, and U-238. The difference between natural, enriched, and depleted uranium is defined by the percent U-235 mass enrichment: the higher the U-235 enrichment, the higher the specific activity of the mixture.

Convincing epidemiological evidence of uranium-induced radiocarcinogenic effects in humans is difficult to obtain. Available epidemiological evidence has come from studies of workers involved in uranium mining and milling operations. It has been noted for some time that uranium workers are at risk of increased cancer mortality; however, inhalation of airborne radon progeny rather than uranium particulates is considered the predominant source of radiation damage to the respiratory tract in uranium miners. Simultaneous exposures to radon progeny and other elements present in uranium ore are considered confounding factors in those studies of uranium miners intended specifically to examine the radiological effects of exposure to uranium.

Risk estimation for exposure to uranium is based heavily on the carcinogenic effects of other alpha-emitting radionuclides and on animal experiments involving exposure to uranium. Chronic exposure to uranium should be controlled on the basis of nephrotoxicity more than by radiocarcinogenicity from alpha particle emissions (NAS 1988). Quantification of the risk from chronic exposure to uranium alpha particles cannot be determined from published epidemiological studies because of confounding factors and the limited power of the studies to detect increased rates of cancer incidence or mortality (NAS 1988). Therefore, the BEIR IV Committee's risk estimate for uranium was based on the carcinogenic effects of other alpha emitting radionuclides and animal experiments involving exposure to uranium. The most probable radiogenic effect is an increase in bone sarcomas. The likelihood of sarcomas from exposure to naturally occurring uranium is considered low and demonstrable only if a linear dose-response relationship is assumed (Mays et al. 1985). If the dose-response relationship is quadratic, then virtually no effect would be expected from naturally occurring uranium. Assuming a linear dose-response relationship and a constant nonoccupational uranium intake of 1 pCi/day, then the risk of bone sarcoma induction over a lifetime is estimated to be 1.5×10^{-6} or 1.5 bone sarcomas per million persons (Mays et al.

1985). This is compared to a natural incidence of 750 bone sarcomas in the absence of excess exposure.

Assuming a constant nonoccupational uranium intake rate of 1 pCi/day, an exposure frequency of 365 days/year, and a lifetime of 70 years, then a lifetime uranium intake of nearly 26,000 pCi is calculated. Using the risk factor from Mays (Mays et al. 1985) and dividing by the calculated lifetime intake, a risk factor of 5.9×10^{-11} per pCi can be derived. A comparison of this risk factor with the cancer slope factors from HEAST for ingestion of U-234, U-235, and U-238 indicates that the ratios of the HEAST values to the former value are 2.4, 2.2, and 2.2, respectively. The EPA derived cancer slope factors for uranium isotopes are presented in Table C.4-5.

C.4.5 TOXICITY PROFILES: CHEMICALS

The following is a presentation of toxicity information for chemical COCs. The varying level of discussion among the contaminant profiles reflects both the amount of information accessible in the literature about these substances and professional judgement concerning the appropriate level of detail necessary to adequately discuss the toxicity of each substance.

C.4.5.1 Antimony

Pharmacokinetics

Antimony exists in the tri- and pentavalent states (Budavari 1989). The pharmacokinetics of antimony appear to be strongly valence- and species-dependent. Elinger and Friberg (1986a) estimated GI absorption to be at least 15 percent in mice given a single oral dose of labeled trivalent antimony potassium tartrate. This estimate was based on the recovery of labeled antimony in urine and tissues. Actual absorption may have been considerably higher, because GI excretion starts immediately after absorption following an oral dose. The 15 percent absorption efficiency is considered sufficiently conservative and well documented for use in estimating a dermal RfD from the oral RfD.

Although quantitative data were not provided, Elinger and Friberg (1986a) stated that the pulmonary absorption of inhaled trivalent antimony is substantial.

Patterns of tissue distribution of absorbed antimony appear to be largely species-dependent. In humans injected with labeled sodium antimony dimercaptosuccinate, highest amounts of antimony are located in the liver, thyroid, and heart (Elinger and Friberg 1986a). Smelter workers exposed to inhaled antimony compounds retain antimony in their lungs for several years. Single or repeated injections of trivalent or pentavalent antimony in monkeys, dogs, and mice result in highest levels in the kidney, liver, and thyroid. Rats appear to retain higher levels in the blood than do other laboratory animals. In rats, trivalent antimony is retained principally in the erythrocytes (at least 95 percent), but pentavalent antimony is retained principally in the plasma (about 90 percent).

In humans, pentavalent antimony appears to be cleared from the body more efficiently than trivalent antimony (Elinger and Friberg 1986a). Urinary excretion predominates over fecal excretion for both penta- and trivalent antimony, but particularly for pentavalent antimony. In rats and hamsters, urinary excretion predominates for pentavalent antimony and fecal excretion predominates for trivalent antimony.

Noncarcinogenic Toxicity

Chronic oral exposure studies in animal models include two briefly reported lifetime drinking water studies with potassium antimony tartrate in rats and mice that reported reduced longevity in both species and reduced mean heart weight and altered blood chemistry in the rats (EPA 1992d). A verified chronic oral RfD of 0.0004 mg/kg/day was based on the rat study and an uncertainty factor of 1000 (Table C.4-1).

Chronic effects from occupational exposure include irritation of the respiratory tract, pneumoconiosis, pustular eruptions of the skin called "antimony spots," allergic contact dermatitis, and cardiac effects, including abnormalities of the ECG and myocardial changes (Elinger and Friberg 1986a). Cardiac effects were also observed in rats and rabbits exposed by inhalation for six weeks, and in animals (dogs and possibly other species) treated by intravenous injection. Inhalation RfC values are not available from the EPA. The heart, respiratory tract, and skin are the principal target organs for antimony.

Carcinogenicity

Data were not located regarding the human carcinogenicity of antimony. Antimony fed to rats did not produce excess tumors (Goyer 1991), but a high frequency of lung tumors was observed in rats exposed by inhalation to antimony trioxide for one year (Elinger and Friberg 1986a). The EPA (1991c) has not evaluated the carcinogenicity of antimony.

C.4.5.2 Aroclors

Pharmacokinetics

Aroclor-1016, -1221, -1242, -1248, -1254, and -1260 are marketed commercially as PCBs. PCBs were detected in the serum and breast milk of women who consumed PCB-contaminated fish from Lake Michigan, and in the blood of volunteers who ingested PCB mixtures. These detections provide qualitative evidence of GI absorption in humans (ATSDR 1991). In volunteers who ingested PCBs in fish, blood levels peaked in approximately 5 hours after the meal and returned to baseline levels 17 hours later, suggesting that absorption is rapid. Quantitative GI absorption studies with rats, monkeys, and ferrets dosed with individual PCB congeners revealed retention of 75 to 95 percent of the administered dose, with some evidence that absorption efficiency may be inversely related to the extent of chlorination. The 75 percent GI absorption efficiency is considered sufficiently conservative and well documented for use in estimating a dermal RfD and cancer slope factor from the respective oral values.

Quantitative inhalation absorption data were not located for humans or animals. ATSDR (1991) reviewed the occupational exposure data presented by Wolff (1985) and concluded that inhalation uptake contributed up to 80 percent of the concentration measured in the adipose tissue of exposed workers. Dermal uptake accounted for the remainder of the concentration. Dermal application studies with PCBs containing 42 and 54 percent chlorine in animals revealed uptakes of 15 to 34 percent of the applied dose in monkeys and 56 percent in guinea pigs (ATSDR 1991). The dosing vehicle appeared to influence absorption; uptake in monkeys was 29 percent from mineral oil and 15 percent from trichlorobenzene.

In humans, PCBs distribute preferentially to adipose tissue (ATSDR 1991). In occupationally exposed workers, the adipose/plasma partition ratio ranged from 185/1 to 210/1. Inhalation and oral exposure data in animals revealed that distribution is biphasic, first to liver and muscle

followed by redistribution to adipose tissue. PCB residues were detected in human breast milk and in umbilical cord blood, indicating transfer to the fetus and offspring. Studies conducted on several species suggested that transfer to the offspring is greater through nursing than through placental transfer (ATSDR 1991).

PCB residues in human fat consisted largely of the more highly chlorinated congeners that were substituted in the meta-para vicinal positions, probably because these congeners are relatively more resistant to metabolism (ATSDR 1991). In vitro studies with human microsomes and animal studies indicate that metabolism involves hydroxylation, preferentially at the para position in the least chlorinated phenyl ring. Some PCB congeners were transformed to dihydrodiols, probably through a pathway involving formation of an arene oxide intermediate. The hydroxy derivatives may be conjugated with glucuronide or sulfate for excretion. Considerable interspecies variation was noted in the rate of metabolism of specific PCB congeners.

Animal studies indicate that both fecal and urinary excretion are important in the elimination of PCBs and their metabolites (ATSDR 1991). Lactation represented a major excretory pathway in nursing women, resulting in higher concentrations of PCB residues in infant's blood than in maternal blood. In humans who had consumed PCB-contaminated rice, elimination half-lives from blood for individual PCB congeners ranged from 4 to 24 months, with longer half-lives estimated for those congeners that were more resistant to metabolism.

Noncarcinogenic Toxicity

Targets for PCBs include the skin, liver, fetus, and neonate. Epidemiologic studies of women in the United States have associated oral PCB exposure with low birth weight or retarded musculoskeletal or neurobehavioral development of their infants (ATSDR 1991). Occupational exposure to PCBs has been associated with upper respiratory tract and ocular irritation, loss of appetite, liver enlargement, increased serum concentrations of liver enzymes, skin irritation, rashes and chloracne, and in heavily exposed female workers, decreased birth weight of their infants (ATSDR 1991). However, concurrent exposure to contaminants has confounded the interpretation of the occupational exposure studies. Animal models exposed to Aroclor-1254 vapors by inhalation exhibited moderate liver degeneration, decreased body weight gain, and slight

renal tubular degeneration. Neither verified nor provisional chronic inhalation RfC values are available.

Oral studies in animals have established the liver as the target organ in all species, and the thyroid as an additional target organ in the rat. Effects observed in monkeys included gastritis, anemia, chloracne-like dermatitis, and immunosuppression. Oral exposure in animal models induced developmental effects, including retarded neurobehavioral and learning development in monkeys. Neither verified nor provisional chronic oral RfD values were located for any of the Aroclors.

Carcinogenicity

The EPA (1991c) has classified the PCBs as cancer weight-of-evidence Group B2 substances (probable human carcinogens), based on inadequate data for humans but sufficient data for animals. The human data consist of several epidemiologic occupational and accidental oral exposure studies with serious limitations, including poorly quantified concentrations of PCBs and durations of exposure, and probable exposures to other potential carcinogens (EPA 1992d).

PCB congeners vary greatly as to their potency in producing biological effects. There is some evidence that mixtures containing more highly chlorinated biphenyls are more potent inducers of hepatocellular carcinoma in rats than mixtures containing less chlorine by weight (EPA 1993a).

The animal data consist of several oral studies in rats and mice with various Aroclors, Kanechlors or Clophens (commercial PCB mixtures manufactured in the United States, Japan, and Germany, respectively) that reported increased incidence of liver tumors in both species (EPA 1992d). The EPA (1991c) has presented a verified oral slope factor of 7.7 per mg/kg/day for all PCBs, based on liver tumors in rats treated with Aroclor-1260 (Table C.4-2).

C.4.5.3 Arsenic

Pharmacokinetics

Arsenic occurs in compounds in the trivalent and pentavalent forms (Budavari 1989). The extent of the GI absorption of arsenic depends on the particular arsenic compound ingested. Several studies with humans and laboratory animals indicate that the GI absorption of dissolved trivalent or pentavalent arsenic exceeds 90 percent (Ishinishi et al. 1986). Hamsters appear to have

somewhat lower (50 to 75 percent) GI absorption of soluble arsenic compounds (ATSDR 1989d). Organic arsenic compounds, which may occur in seafood, are also readily absorbed (70 to 99.7 percent). The GI absorption of less soluble compounds (e.g., arsanilic acid, arsenic trioxide) is determined by particle size, and pH of the gastric juice. An estimate of 95 percent GI absorption efficiency is considered to be sufficiently conservative and well documented for use in estimating a dermal RfD and cancer slope factor from the respective oral values (EPA 1993d).

The extent of absorption of arsenic from the lungs depends on the solubility of the inhaled compound and particle size (ATSDR 1989d; Ishinishi et al. 1986). In a study with arsenite in cigarettes and with arsenic aerosols in lung cancer patients, deposition was estimated at approximately 40 percent, and 75 to 85 percent of the deposited arsenic was absorbed from the lungs within 4 days.

The occurrence of systemic toxic effects following dermal exposure to arsenic acid or arsenic trichloride (Ishinishi et al. 1986) indicates qualitatively that dermal absorption of some arsenic compounds occurs.

In most animals, all but a small fraction of systemic arsenic is rapidly cleared from the blood and other tissues (ATSDR 1989d). Residual arsenic is located in tissues (liver, kidney, spleen, heart, skin, hair, epithelium of the upper GI tract) containing a high concentration of sulfhydryl groups, to which arsenic preferentially binds (Arnold 1988; Ishinishi et al. 1986). In rats, more than in the other laboratory animals and in humans, arsenic binds to the erythrocytes with high affinity and clearance from the blood is slow (ATSDR 1989d).

Arsenic is extensively metabolized, principally in the liver, in humans and animals (ATSDR 1989d). Metabolism involves methylation of trivalent arsenic (arsenite) to dimethylarsinic acid, or, to a lesser extent, to monomethylarsonic acid. Both methylation products, as well as inorganic arsenic, are excreted principally and rapidly through the urine.

Noncarcinogenic Toxicity

The only noncarcinogenic effects in humans clearly attributable to chronic oral exposure to arsenic are dermal hyperpigmentation and keratosis, as revealed by studies of several hundred

Chinese exposed to naturally occurring arsenic in well water (EPA 1992d). Similar effects were observed in persons exposed to high levels of arsenic in water in the western hemisphere. Occupational (predominantly inhalation) exposure was also associated with neurological deficits, anemia, and cardiovascular effects (Ishinishi et al. 1986). The EPA (1991c) has presented an RfD of 0.0003 mg/kg/day for chronic oral exposure, based on a NOAEL from the Chinese data and an uncertainty factor of 1 (Table C.4-1). The principal target organs for arsenic are the skin, nervous system, blood and cardiovascular system.

Carcinogenicity

Inorganic arsenic is clearly a carcinogen in humans (EPA 1992d). Inhalation exposure was associated with increased risk of lung cancer in persons employed as smelter workers, in arsenical pesticide applicators, and in a population residing near a pesticide manufacturing plant. Oral exposure to high levels in well water was associated with increased risk of skin cancer. The EPA (1991c) has classified inorganic arsenic in cancer weight-of-evidence Group A (human carcinogen). An inhalation slope factor of 50 per mg/kg/day, based on absorbed arsenic, was derived from occupational data. Applying an absorption factor of 0.3 yielded an inhalation slope factor of 15 per mg/kg/day, based on an ambient or inhaled dose. The slope factor based on the inhaled, rather than absorbed, dose is the correct parameter to use in risk assessments. Assuming a human inhales 20 m^3 of air per day and weighs 70 kilograms, the EPA (1991c) estimated an inhalation unit risk of 0.0043 $\mu g/m^3$. EPA (1993c) proposed an inorganic arsenic ingestion unit risk of 5.0×10^{-5} per mg/l. The equivalent oral slope factor is 1.8 per mg/kg/day assuming a 70 kg adult ingests 2 liters per day (Table C.4-2). "The uncertainties associated with ingested inorganic arsenic are such that estimates could be revised downward as much as an order of magnitude, relative to the risk estimates associated with most other carcinogens" (EPA 1993c).

C.4.5.4 Beryllium

Pharmacokinetics

Absorption of beryllium from the GI tract is low, probably not exceeding 20 percent of an ingested dose, because the metal forms insoluble precipitates with phosphate and is eliminated in the feces (Reeves 1986). EPA Region V guidance is to use a GI absorption factor of 1.00 (Saunders 1994).

Clearance of inhaled beryllium is multiphasic; small quantities of beryllium compounds may remain encapsulated in the lung parenchyma for several years (Reeves 1986). Water-soluble forms of beryllium with a pH of 3 are absorbed through the skin of animals (Zorn et al. 1988), but the extent of absorption is probably minimal, because most beryllium salts are insoluble at physiologic pH, and ionized beryllium is readily bound to epidermal contaminants (Reeves 1986).

Most beryllium in the circulation probably exists as a colloidal phosphate adsorbed to serum protein; minor amounts exist as the citrate or hydroxide (Reeves 1986). Distribution of small doses is primarily to the skeleton; for larger doses, distribution is primarily to the liver. Secondary distribution results in movement of beryllium from the liver to the skeleton. The primary route of excretion is through the urine.

Noncarcinogenic Toxicity

Beryllium has a low order of toxicity when ingested because it is poorly absorbed from the GI tract (Reeves 1986). Occupational exposure has induced dermatitis, acute pneumonitis, and chronic pulmonary granulomatosis (berylliosis). Berylliosis was also observed in humans living in the vicinity of a beryllium plant. Pulmonary effects also occurred in laboratory animals subjected to inhalation exposure. A verified chronic oral RfD value of 0.005 mg/kg/day (Table C.4-1) was based on a NOAEL of 0.54 mg/kg/day in a lifetime drinking water study with beryllium sulfate in the rat, and on an uncertainty factor of 100 (EPA 1991c). The target organs for inhalation exposure appear to be the lungs; target organs for oral exposure are not identified.

Carcinogenicity

The EPA (1991c) has classified beryllium in cancer weight-of-evidence Group B2 (probable human carcinogen), based on inadequate human data but sufficient animal data. The human data consist of occupational studies that weakly associate exposure with increased risk of lung cancer, but confounding variables were not controlled and the studies lacked sensitivity. A significant increase in lung tumors occurred in three strains of rats and in rhesus monkeys subjected to inhalation exposure or intratracheal instillation of a variety of beryllium compounds. Osteogenic sarcomas were induced in rabbits and mice, but not in rats or guinea pigs injected intravenously with various beryllium compounds. Oral studies in animal models yielded inconclusive results. The EPA (1991c) derived an oral slope factor of 4.3 per mg/kg/day from a slight but statistically

nonsignificant increase in total tumors in a lifetime drinking water study with beryllium sulfate in the rat. An inhalation unit risk of 0.0024 per $\mu g/m^3$, equivalent to 8.4 per mg/kg/day (assuming humans inhale 20 m^3 of air per day and weigh 70 kilograms), was derived from a human occupational study (Table C.4-2).

C.4.5.5 Carbazole

Noncarcinogenic Toxicity

Only the oral LD_{50} in rats for carbazole has been located. The oral LD_{50} in rats is reported to be greater than 5000 mg/kg (EPA 1993d).

The EPA has not derived chronic oral and chronic inhalation reference doses for carbazole.

Carcinogenicity

The EPA has classified carbazole as a cancer weight-of-evidence Group B2 substance (probable human carcinogen) based on the presence of liver tumors in mice that were administered carbazole in their diets. The EPA (1993c) has derived an oral cancer slope factor of 2.0×10^{-2} $(mg/kg/day)^{-1}$ (Table C.4-2).

C.4.5.6 Dieldrin

Toxicity

Dieldrin is toxic to both humans and animals. Clinical observations in humans indicate that the primary symptoms resulting from acute exposure to dieldrin are manifested as neurological and respiratory effects. Dieldrin exposures result in neurological effects which may include central nervous system excitation, convulsions, tremors, ataxia, agitation, nervousness and amnesia. Disturbances of sleep, memory and behavior may persist for several days or weeks after the acute phase of poisoning. In extreme overdoses, central nervous system depression may result in death which arises from respiratory depression. Repeated exposures to commercial dieldrin applicators resulted in a syndrome indistinguishable from idiopathic epilepsy which ceased when exposure was terminated (EPA 1994b). In addition, exposure via ingestion may cause nausea, vomiting, and diarrhea. Hematological changes include blood dyscrasia, anemia and leukemia. Dermal exposures result in irritation. Deaths associated with acute dieldrin toxic exposures were not reported. The EPA chronic oral RfD of 5×10^{-5} mg/kg/day is presented in Table C.4-1.

Carcinogenicity

Dieldrin has been classified as a probable human carcinogen (Weight-of-evidence Group B2) based on inadequate human carcinogenicity data and sufficient animal carcinogenicity data (EPA 1994a). Animal carcinogenicity data demonstrate that dieldrin is carcinogenic in both sexes of different strains of mice. Dose response data support these effects as ranging from being liver tumors, to hepatocarcinomas with transplantation confirmation, to pulmonary metastases. In studies in which tumors resulted, hepatocellular tumors were identified most frequently. Human carcinogenicity data are limited to one retrospective study which reported no statistically significant increases in cancer deaths among 1155 organochlorine pesticide manufacturing workers (EPA 1994a). In addition, two studies of workers exposed to aldrin and dieldrin reported no increase in the incidence of cancer. Van Raalte (EPA, 1994a) observed two cases of cancer (gastric and lymphosarcoma) among 166 pesticide manufacturing workers exposed between 4 and 19 years and with additional follow-up from 15 to 20 years. However, exposure was not quantified and workers were exposed to other pesticides (endrin and telodrin). In addition, the population of workers studied was small and the age of the cohort was young and the number of expected deaths was not calculated. Finally, the durations of exposure and latency were relatively short. The EPA oral and inhalation cancer slope factors for dieldrin are 1.6×10^{1} $(mg/kg/day)^{-1}$ and are presented in Table C.4-2.

C.4.5.7 Polycyclic Aromatic Hydrocarbons

Pharmacokinetics

Several rat studies indicate considerable chemical-specific variation in PAH pharmacokinetics (ATSDR 1989c). GI absorption is enhanced by solubilizing the chemical in a readily absorbed vehicle such as oil. Jones and Owen (1989) reported a range of 43 to 58 percent for the GI absorption of benzo(a)pyrene. The lower end of this range, 43 percent, is considered sufficiently conservative and well documented to use in estimating dermal RfDs and cancer slope factors from the respective oral values for all the EPA Group B PAHs.

The identification of metabolites of PAHs in the urine of occupationally exposed humans is qualitative evidence that respiratory tract uptake occurs, although quantitative uptake data were not located (ATSDR 1989c). Studies in rats indicate that pulmonary absorption of benzo(a)pyrene is rapid. PAHs carried by insoluble particulate matter, however, would be

retained in the lung longer than pure PAHs. Human and animal studies suggest considerable chemical-specific variation in dermal absorption. Quantitative estimates in animals treated with radiolabeled compounds range from 33 percent for dibenzo(a,h)anthracene to 93 percent for benzo(a)pyrene.

Inhalation and oral studies in animals with radiolabeled benzo(a)pyrene indicate that distribution of absorbed material is primarily to the lipid fractions of the liver, lung, kidney, and GI tract, with redistribution to the protein fractions of these organs (ATSDR 1989c). Once absorbed, benzo(a)anthracene, dibenzo(a,h)anthracene, and chrysene are rapidly and widely distributed in orally treated rats. There is considerable chemical-specific variability in the distribution of the PAHs to the fetuses of pregnant rats.

Studies of the metabolism of benzo(a)pyrene provide information relevant to other PAHs, because of the structural similarities of all members of the class. Metabolism involves microsomal mixed function oxidase hydroxylation of one or more of the phenyl rings with the formation of phenols and dihydrodiols, probably via formation of arene oxide intermediates (ATSDR 1989c). The dihydrodiols may be further oxidized to diol epoxides, which, for certain members of the class, are known to be the ultimate carcinogens (EPA 1992c). Conjugation with glutathione or glucuronic acid and reduction to tetrahydrotetrols are important detoxification pathways. Metabolism of naphthalene results in the formation of 1,2-naphthoquinone, which induces cataract formation and retinal damage in rats and rabbits.

Excretion of benzo(a)pyrene is principally through the bile, although there seems to be considerable species variation in the pattern (biliary versus urinary) and rate of excretion (ATSDR 1989c). Urinary excretion predominates slightly in rats treated dermally with anthracene.

Noncarcinogenic Toxicity

A single exposure to PAHs has been associated with a number of toxic effects. The acute lethal toxicity of PAHs ranges from 250 mg/kg for the most potent to 700 mg/kg for the least potent. However, most exposure situations will involve a mixture of PAHs; it is impossible to determine whether the acute lethal toxicity for a mixture will lie between these values of whether toxicity

will be additive. In addition, these data were obtained following parenteral administration, a step which bypasses metabolism in the liver; therefore, their relevance to human exposure is questionable.

Carboxylesterase activity of the intestinal mucosa was decreased in rats following intragastic administration of 50 or 150 mg/kg/day benzo(a)anthracene or benzo(a)pyrene for 4 days; enzyme activity was increased following oral exposure to 100 mg/kg/day of anthracene or phenanthrene (ATSDR 1990).

Bone marrow depression (aplastic anemia and pancytopenia) leading to death was observed in mice whose AHH enzyme was not inducible following oral administration of 120 mg benzo(a)pyrene/kg/day for 180 days (ATSDR 1990).

Several hepatic effects (enzyme and foci induction, liver regeneration and increased weights) have been observed in animals administered PAHs. These effects are not life-threatening but may precede the onset of more serious effects. A single intragastric administration of 200 mg/kg of benzo(a)pyrene, benzo(a)anthracene or dibenz(a,h)anthracene induced the formation of preneoplastic hepatocytes in a promotion/initiation bioassay in partially hepatectomized rats fed 2-acetylaminofluorene (ATSDR 1990). PAHs stimulate liver regeneration in partially hepatectomized rats following administration in the diet for 10 days. Noncarcinogenic PAHs required higher doses (ATSDR 1990).

Immunotoxic effects have been observed following dermal and parenteral administration in animals. PAHs that are carcinogenic are also immunosuppressive with the same rank order of potency (ATSDR 1990). Effects observed have included inhibition of t-cell dependent and independent antibody production and inhibition of lymphocyte mediated immunity (ATSDR 1990).

There is no information on the developmental effects of exposure to PAHs in humans (ATSDR 1990).

In animals, in utero exposure to benzo(a)pyrene (10, 40, or 160 mg/kg/day orally during gestation) was associated with reduced mean postnatal pup weight and increased incidence of sterility associated with alterations in gonadal morphology and germ-cell development in male mice (ATSDR 1990). An observed increased incidence of stillborns, resorptions and malformations following dietary administration of 120 mg benzo(a)pyrene/kg/day to the dam was associated with the metabolic responsiveness of the offspring and the dams (ATSDR 1990). Parental administration of a number of PAHs has been associated with a number of development effects: stillbirths, increased fetal resorptions, malformations, adverse gonadal histology, and decreased fetal survival.

There is no information on the effect of PAH on reproduction in humans (ATSDR 1990).

Benzo(a)pyrene decreased the percentage of pregnant females at parturition in pregnant CD-1 mice (ATSDR 1990) and reduced the incidence of pregnancy in rats (ATSDR 1990) but had no effect on fertility of Swiss mice (ATSDR 1990). Decreased numbers of corpora lutea, uterine weights and fetal survival and increased resorptions were observed following parenteral administration of benzo(a)pyrene (ATSDR 1990). The implications of the results obtained following parenteral administration, which bypasses first-pass metabolism of the liver, to human exposure are that adverse effects on reproduction are possible.

Numerous PAHs have been tested in numerous in vitro and in vivo genotoxicity studies (ATSDR 1990). In general, several PAHs demonstrated genotoxic potential that required metabolic activation. Benzo(a)pyrene produced several genotoxic effects: DNA binding/damage, sister chromatic exchange, chromosomal aberration, cell transformation; effects were observed in bacteria and mammalian (both somatic and germ) cells. DNA damage was also observed in human cells. Acenaphthene, acenaphtylene or fluorene were negative for genotoxic effects and anthracene, phenanthrene and pyrene were negative in all but one in vitro test.

Carcinogenicity

Dermal exposure to benzo(a)pyrene in humans was associated with epidermal changes indicative of neoplastic proliferation, chronic dermatitis and hyperkeratosis or exacerbation of pre-existing skin lesions (ATSDR 1990). Topical application of PAHs have been associated with adverse

effects in animals, including skin cancer, and on sebaceous glands, increased skin melanocytes, dermal inflammation, allergic contact hypersensitivity and photosensitization (ATSDR 1990).

Epidemiologic studies of humans exposed to coke-oven and roofing-tar emissions and cigarette smoke have demonstrated an increase in mortality due to lung cancer (ATSDR 1990). Skin tumors have been reported among individuals exposed to mixtures containing PAHs: scrotal cancer among chimney sweeps and skin cancer following exposure to shade oils (ATSDR 1990). These mixtures contain PAHs and several other potentially carcinogenic chemicals, tumor promoters, initiators and cocarcinogens. This concomitant exposure prevents a direct causal relationship to PAHs.

Inhalation, oral and dermal exposure to PAHs have been associated with carcinogenic effects in animals (ATSDR 1990). These studies suggest that the site of tumor induction is influenced by the route of administration. Following inhalation exposure, an increased incidence of respiratory tract tumors was observed. Benign and malignant tumors, adenomas, papillomas, neoplasms, and carcinomas of the lung, alimentary tract (particularly the forestomach), and mammary glands were observed following ingestion of benzo(a)pyrene, benzo(a)anthracene and dibenz(a,h)anthracene by rodents. A dose-responsive increase in the incidence of forestomach papillomas and carcinomas was observed in mice following dietary administration of 33.3 mg/kg/day benzo(a)pyrene for 30 to 197 days (ATSDR 1990). The overall evidence suggests that exposure to PAHs is associated with an increased risk of cancer.

Benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene have been demonstrated to induce skin tumors in mice following dermal exposure (ATSDR 1990). Benzo(a)pyrene, in particular, is a potent experimental skin carcinogen. It is often used as a positive control in carcinogenesis bioassays. The dose-response relationship of benzo(a)pyrene and skin tumors has been investigated in a number of studies (ATSDR 1990). Benzo(a)pyrene has been demonstrated to induce malignant skin tumor at exposures as low as 0.0054 mg/kg/day; however, the solvent and strain of mouse tested will influence the tumorigenic dose (ATSDR 1990).

Recent reevaluations of the carcinogenity and mutagenicity of the Group B2 PAHs suggest that there are large differences between individual PAHs in cancer potency (Krewski et al. 1989). A recent toxicity equivalency factor (TEF) approach for the weight-of-evidence Group B2 PAHs was based on the induction of lung epidermoid carcinomas in female Osborne-Mendel rats in lung-implantation experiments (Clement International 1990). The TEFs and the associated oral and inhalation slope factors are presented in Table C.4-3.

The following subsections present profiles of individual PAHs.

Benzo(k)fluoranthene

In a lifetime study in female rats, lung implants of 0.65, 3.4, or 17 mg/kg benzo(k)fluoranthene exhibited a dose-related increase in the incidence of epidermoid carcinomas in the lung and thorax. Equivocal incidences of lung adenomas and hepatic adenomas and hepatomas were reported in mice administered intraperitoneal injections of 120 μg benzo(k)fluoranthene/mouse on days 1, 8, 15 of age (EPA 1993a). Benzo(k)fluoranthene was positive in mouse skin-painting assays (EPA 1993a). Based on these data, the EPA has classified benzo(k)fluoranthene as a weight-of-evidence probable human carcinogen (Class B2).

Benzo(b)fluoranthene

In a lifetime study using female rats, lung implants of 0.4, 1.2, or 4.1 mg/kg benzo(b)fluoranthene exhibited a dose-related increase in the incidence of epidermoid carcinomas and pleomorphic sarcoma in the lung and thorax. Equivocal incidences of lung adenomas and hepatic adenomas and hepatomas were reported in mice administered intraperitoneal injections of 126 μg benzo(b)fluoranthene/mouse on days 1, 8 , 15 of age (EPA 1993a). Injection site sarcomas were observed in mice administered subcutaneous injections of benzo(b)fluoranthene (2.6 mg total dose) over 2 months (ATSDR 1990). Benzo(b)fluoranthene was positive for complete carcinogenesis and initiation in mouse skin-painting assays (EPA 1993a). Based on these data, EPA has classified benzo(k)fluoranthene as weight-of-evidence B2 probable human carcinogen.

Benzo(a)pyrene

There are multiple animal studies demonstrating increased incidence of carcinogenic effects following oral, intratracheal, inhalation and dermal administration of benzo(a)pyrene.

Benzo(a)pyrene has been shown to be an initiator and a complete carcinogen following dermal application (EPA 1993a). A dose-responsive increase in squamous cell papillomas and carcinomas of the forestomach was observed following oral administration of 1 to 250 ppm benzo(a)pyrene to rats and hamsters for 197 days (EPA 1993a). The incidences of respiratory tract and upper digestive tract tumors were increased following intratracheal instillation or inhalation of benzo(a)pyrene by guinea pigs, hamsters and rats (EPA 1993a). Inhalation exposure of hamsters to benzo(a)pyrene at 9.5 mg/m^3/day for 10 weeks was associated with development of tumors of the nasal cavity, larynx, trachea and pharynx. At the next highest dose, 45 mg/m^3/day, neoplasms were also observed in the upper digestive tract. The lowest dosed, 2.2 mg/m^3/day, animals did not develop tumors (EPA 1993a). Intraperitoneal and subcutaneous injection of benzo(a)pyrene is associated with injection site tumors (EPA 1993a). The EPA has classified benzo(a)pyrene as a probable human carcinogen, based on the existence of sufficient animal data, but the absence of human data. The EPA has calculated an oral slope factor of 7.3 $(mg/kg/day)^{-1}$ and an inhalation slope factor of 6.1 $(mg/kg/day)^{-1}$.

Benzo(a)anthracene

Increased incidence of pulmonary tumors and hepatomas was observed in mice following oral gavage with 500 mg/kg/day benzo(a)anthracene 3 times/week for 5 weeks (EPA 1993a). A single gavage dose of 0.5 mg benzo(a)anthracene was not tumorigenic while multiple gavage treatments (8 or 16 over 16 months) resulted in forestomach papillomas (EPA 1993a). Following intraperitoneal injection of benzo(a)anthracene on days 1, 8, and 15 of age (638 μg/mouse total dose), the incidence of liver adenomas or carcinomas was increased in treated male mice while the incidence of pulmonary adenomas or carcinomas was increased in treated females (EPA 1993a). Benzo(a)anthracene was positive as a complete carcinogen and as an initiator in mouse skin painting bioassays (EPA 1993a). Injection site sarcomas were observed following subcutaneous or intramuscular injection of benzo(a)anthracene (EPA 1993a). EPA has classified benzo(a)anthracene as a weight-of-evidence B2 probable human carcinogen.

C.5.0 FATE AND TRANSPORT MODELING

For this FS risk assessment, human-health risks were estimated for remedial action and postremedial action (residual) conditions. Prior to completing these risk estimates, the COC concentrations at receptor locations were predicted using computer models. These models begin with emission sources and then simulate the transport of COCs through the various environmental media, such as air, soil, and groundwater, to the receptor end points. The objective of these modeling efforts is to predict the concentrations of each COC during a specific activity and for a specified duration at selected receptor locations. The results are termed "exposure point concentrations" and are used in the risk equations shown in Section C.3.0 (risks are shown in Sections C.6.0 and C.7.0).

Section C.5.1 describes the modeling efforts conducted for COC transport during the implementation of remedial activities. Section C.5.2 discusses the postremediation modeling of Operable Unit 2 for residual sources.

C.5.1 REMEDIAL ACTION MODELING

The mechanisms modeled for COC transport during remedial activities include air dispersion, direct radiation from soil or waste material, and transportation scenarios for soil and waste. All steps (i.e., remedial activities) required for each remedial alternative were identified. Activities were evaluated for their potential to cause worker and/or public exposure. The activities involving the highest potential for risk were then selected to represent the bounding conditions to which receptors would be exposed. Activities not specifically evaluated represent risks that constitute only a small fraction of the risk represented by the evaluated activities. Figure C.5-1 presents the various potential health hazards by remedial activity and alternative. Shading indicates which emissions were quantified as part of this FS. The assumptions presented in Tables C.5-1 and C.5-2 were used as a basis for the modeling. Each activity was conservatively modeled to include reasonable variations. The computer codes used are all industry-standard models:

- MICROSHIELD, for direct radiation
- RADTRAN 4, for transportation
- ISCLT2, Dust Loading and Resuspension Rate Equation, RAECOM, Near Field Box Model, and a VOC model, for airborne concentrations

REMEDIAL ACTIVITY	ALTERNATIVE 1 No Action	ALTERNATIVE 2 Consolidation and Capping	ALTERNATIVE 3 Excavation and Off-site Disposal	ALTERNATIVE 6 Excavation and On-site Disposal with Off-site Disposal of Fraction Exceeding WAC
NO ACTION	R			
EXCAVATION		R	R	R
SHREDDING AND CRUSHING		R	R	R
DRYING			R	R
STAGING OF WASTE		R	R	R
WASTE STORAGE			R	R
RAIL TRANSPORT			R	R
ON-SITE TRANSPORT		R	R	R

R = Radon
VOCs
Particulates (PM_{10})
Emissions Quantified
Direct Radiation
Mechanical Injury for Construction/Operation

FIGURE C.5-1
POTENTIAL IMPACTS FROM REMEDIAL ACTIVITIES

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TABLE C.5-1

SUMMARY OF AIR MODELING ASSUMPTIONS

SCENARIO	ASSUMPTION/ASSUMED VALUE
Excavation	
Receptors	Remediation workers Nonremediation worker Public
Exposure Duration	10 hr/day (All receptors)
Exposure Pathways and Sources	
Direct Radiation	Remediation worker: immersion, direct
Airborne	Remediation worker: inhalation from air loading at 600 $\mu g/m^3$
Soil Composition	
Density	Source strength - 1.7 gm/cm^3 Self-shielding - 1.5 gm/cm^3
COC Concentration	Actual by subunit (see Table C.5-4)
Shielding for Receptors	
Remed. worker (Equip. operators	Equipment cab
Other workers, Public	NA
On-Site Transport (Truck)	
Receptor	Remediation worker
Exposure Duration	60% of 10 hr/day
Shielding for Receptor	None
Source Volume	Fully loaded truck 15.3 m^3 (540 ft^3)
Soil Composition, COC concentration	See excavation scenario (above)
Staging of Waste, Shredding and Crushing	
Exposure not quantified	Remediation worker would be exposed to COC concentration 2 orders of magnitude less than excavation air concentrations.
Drying	
Receptor	VOC exposure for the nonremediation worker and public
Source Volume	All vaccine feed material is released
Waste Storage	
Receptor	Remediation worker
Source volume	Maximum volume of single silo: 602m^3 (21260 ft^3)
Exposure pathways	Direct radiation
Shielding to receptor	None
Location of silos to receptor	Silo location 6.1m (20 ft) above work area
Source Term	To account for segregation, 2 x 95% UCL values (see Table C.5-4)
Exposure Duration	See excavation scenario (above)

TABLE C.5-2
SUMMARY OF ASSUMPTIONS
USED IN RAIL TRANSPORTATION MODELING

SCENARIO	ASSUMPTION/ASSUMED VALUE
Source Term	To account for segregation, 2 x 95% UCL values (see Table C.5-4)
Receptors	Remediation worker Railroad worker Public
Source Volume	100 tons, 54.3 m^3/Gondola
Number of Gondolas	159 Gondolas
Gondola Shielding	.64 cm (1/4") steel including covers
Miles Traveled	1913 miles

C.5.1.1 Air Fate and Transport Modeling

The primary mode of COC exposure during the implementation of remedial alternatives is through air. COCs are disturbed and/or emitted from various sources and transported through the air, eventually reaching the receptor. Airborne COCs can affect receptors through inhalation or radiation exposure from immersion in air. This section presents the major emission sources that would exist during remedial activities, the technical approach to quantifying the impact of these sources on the ambient air concentrations, and the subsequent exposure point concentrations for each receptor. Figure C.5-2 presents a sequential block diagram of the methodology used to calculate ambient air concentrations and receptor exposure concentrations. Table C.5-3 describes the air models used.

Air Modeling Technical Approach

Releases to the air include particulate emission (radionuclide, organics, and inorganics) and gaseous emissions (VOCs and radon). As shown in the remedial action conceptual models (Section C.2.2), airborne COCs would be generated during the remedial activities of soil excavation, soil drying, and staging-area soil handling and moving activities. The following discussion describes the models used to quantify receptor exposure concentrations.

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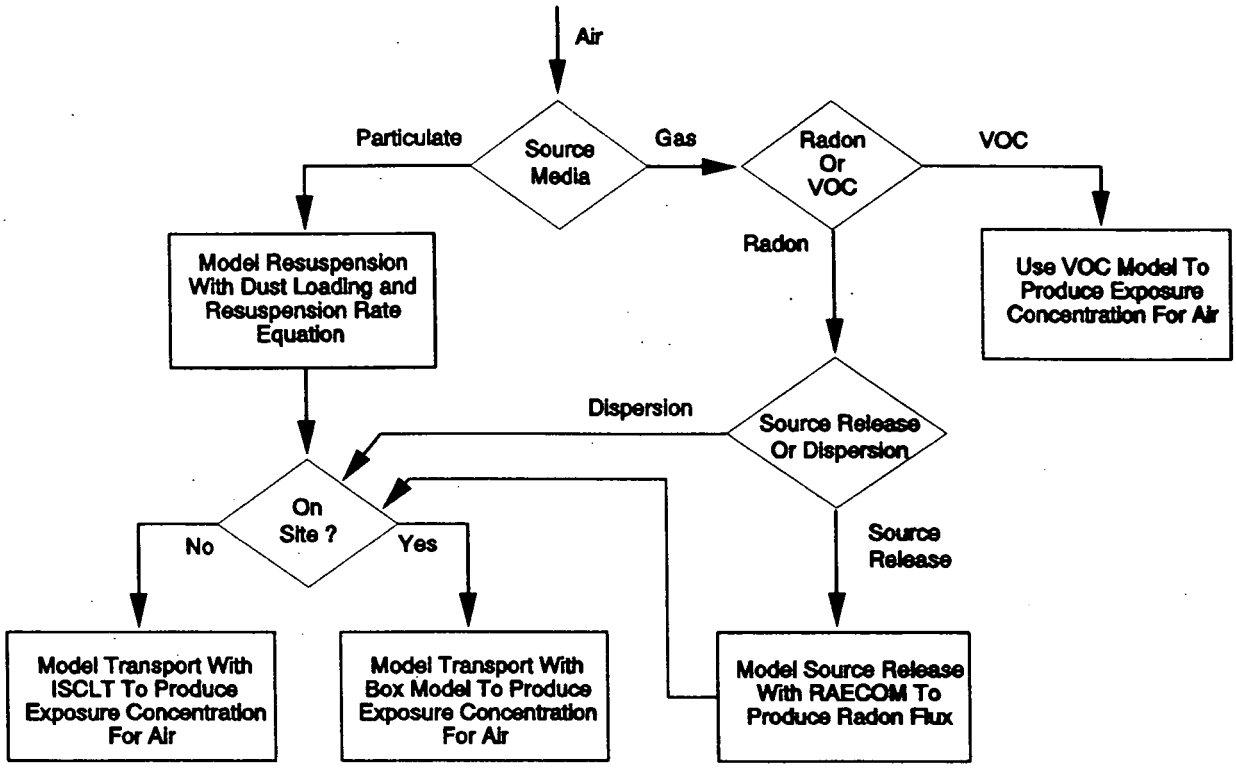

VOC = Volatile Organic Compound

FIGURE C.5-2
REMEDIAL RISK AIR MODELING METHODOLOGY

The air concentrations to which these receptors would be exposed were used in the equations presented in Section C.3.1 to determine the effective dose equivalent of radionuclides or chemical intake for the receptor. The calculated intakes and doses were then used to determine carcinogenic risk and noncarcinogenic HIs (see Section C.6.0).

TABLE C.5-3
SUMMARY OF AIR MODELS USED TO DETERMINE AIR CONCENTRATIONS AND RECEPTOR EXPOSURE CONCENTRATIONS

Model	Description
Dust Loading and Resuspension Rate Equation	Used to estimate exposure concentrations of COC in air for workers involved in remediation activities at the COC release point. A dust loading factor of 600 mg/m^3 was used for all OU2 excavation and soil moving/handling activities.
RAECOM	Computer model developed by the NRC (NRC 1984) to simulate the emission of Rn-222 gas from soil and material containing Ra-226. RAECOM was used in this modeling effort to estimate the Rn-222 emission rate.
ISCLT2	Computer model developed by the EPA (EPA 1992e) to simulate the dispersion of gas-phase and particulate-phase COCs emitted to the atmosphere. ISCLT2 was used in this modeling effort to predict the airborne concentrations of COCs emitted during remedial activities.
Near Field Box Model	Used to calculate air concentrations on site adjacent to the release point.
VOC Model	Used to estimate an average emission rate of a VOC based on the total mass of a given COC on site and the duration of the clean up.

SOURCES:

EPA 1992e for ISCLT2.
NRC 1984 for RAECOM.

PM_{10} Sources and Emission Rates

PM_{10} releases would be generated during soil excavation, and soil handling and moving at staging areas: Two staging areas would be operating simultaneously during the remediation of Operable Unit 2. This would result in PM_{10} emissions being generated from two excavation areas, and the dumping of excavated soil into two staging area piles (one pile for each staging area).

Using a dust loading factor, correlation can be made between the concentration of COCs in the soil to the concentration of COCs in the air. This factor is a measure of the mass of soil in a unit volume of air. Dust loading factors for various activities are presented in the RAWPA (DOE

1992). A dust loading factor of 600 $\mu g/m^3$ was used to calculate a COC concentration in air. Subunit-specific subsurface soil concentrations (as opposed to surface concentrations) were used in this analysis since a majority of excavated volumes would consist of subsurface soil. COC soil concentrations are based on the 95 percent UCL values. These concentrations are listed in Table C.5-4. Table C.5-5 lists the COC concentrations in air for each subunit.

The equations used to calculate a COC air concentration from its soil concentration are given below:

$$\text{(radionuclides)}\ C_a = (D_1)(C_S) \qquad \text{(C.5-1)}$$

$$\text{(chemicals)}\ C_a = (D_1)(C_S)(CF) \qquad \text{(C.5-2)}$$

where

C_a = COC concentration in air (pCi/m^3 or mg/m^3),
D_1 = dust load factor (g of soil/m^3 of air = 600 mg/m^3),
C_s = COC concentration in soil (pCi/g or $\mu g/g$), and
CF = conversion factor (10^{-3} $mg/\mu g$).

VOC Emission Rates

The following discussion and equations are taken from the *Air/Superfund National Technical Guidance Study Series: Estimation of Air Impacts for the Excavation of Contaminant Soil* (EPA 1992f).

Gaseous emissions from soil handling operations result from the exchange of COC-laden soil-pore gas with the atmosphere when soil is disturbed and from diffusion of COCs through the soil. There are multiple potential emission points for various soil handling operations. For excavation, the main emission points of concern would be emissions from:

- Exposed waste in the excavation pit
- Material as it is dumped from the excavation bucket
- Waste/soil in short-term storage piles

The average emission rate (ER) from excavation is equal to the sum of emission rates from the soil pore space (ER_{PS}) and from diffusion (ER_{DIFF}):

$$ER = ER_{PS} + ER_{diff} \qquad \text{(C.5-3)}$$

TABLE C.5-4
COCs SUBSURFACE SOIL CONCENTRATIONS
(95% UCL)

COC	Solid Waste Landfill	Lime Sludge Ponds[a]	South Field/ Inactive Flyash Pile[a]	Active Flyash Pile
Chemicals (mg/kg)				
Antimony	22.000	23.200	18.700	2.000
Aroclor-1254	0.048	0.043	0.430	NA
Aroclor-1260	0.077	NA	0.089	NA
Arsenic	13.800	6.777	12.060	64.27
Beryllium	1.075	1.267	1.438	3.375
Carbazole	4.200	NA	0.001	NA
Dieldrin	NA	NA	0.016	NA
Pyrene[b]	10.72	0.190	0.180	NA
Radionuclides (pCi/g)				
Cs-137	0.250	0.168	0.237	NA
Np-237	0.351	0.323	0.300	0.450
Pu-238	0.328	0.199	0.040	0.123
Ra-226	1.550	1.562	2.919	5.240
Ra-228	2.560	1.800	1.656	4.336
Sr-90	1.580	0.841	1.360	0.964
Tc-99	0.754	1.050	0.900	NA
Th-228	3.390	1.540	1.704	5.790
Th-230	12.300	8.381	4.263	5.717
Th-232	3.590	1.070	1.531	3.866
U-234	97.000	6.176	30.19	8.903
U-235	9.93	0.435	18.460	4.720
U-238	170.000	7.468	32.300	6.911
U-Total	446.000	22.198	104.400	29.960

NA = Not Applicable
[a]Values for South Field and Inactive Flyash Pile are identical.
[b]Combined concentration for all COC PAHs.

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TABLE C.5-5
COC AIR CONCENTRATIONS FOR EACH SUBUNIT

COC	Solid Waste Landfill	Lime Sludge Ponds	South Field/ Inactive Flyash Pile*	Active Flyash Pile
Chemicals ($\mu g/m^3$)				
Antimony	1.32×10^{-2}	1.39×10^{-2}	1.12×10^{-2}	1.20×10^{-3}
Aroclor-1254	2.88×10^{-5}	2.58×10^{-5}	2.58×10^{-5}	---
Aroclor-1260	4.62×10^{-5}	---	5.34×10^{-5}	---
Arsenic	8.28×10^{-3}	4.02×10^{-3}	7.24×10^{-3}	3.86×10^{-2}
Benzo(a)pyrene	6.43×10^{-3}	1.13×10^{-4}	1.10×10^{-4}	---
Beryllium	6.45×10^{-4}	7.60×10^{-4}	8.63×10^{-4}	2.03×10^{-3}
Carbazole	2.52×10^{-3}	0.00×10^{0}	6.00×10^{-7}	---
Dieldrin	---	---	9.60×10^{-6}	---
Radionuclides (pCi/m^3)				
Cs-137	1.50×10^{-4}	1.01×10^{-4}	1.42×10^{-4}	---
Np-237	2.11×10^{-4}	1.94×10^{-4}	1.80×10^{-4}	2.70×10^{-4}
Pu-238	1.97×10^{-4}	1.19×10^{-4}	2.40×10^{-5}	7.38×10^{-5}
Ra-226	9.30×10^{-4}	9.37×10^{-4}	1.75×10^{-3}	3.14×10^{-3}
Ra-228	1.54×10^{-3}	1.08×10^{-3}	9.94×10^{-4}	2.60×10^{-3}
Sr-90	9.48×10^{-4}	5.05×10^{-4}	8.16×10^{-4}	5.78×10^{-4}
Tc-99	4.52×10^{-4}	6.30×10^{-4}	5.40×10^{-4}	---
Th-228	2.03×10^{-3}	9.24×10^{-4}	1.02×10^{-3}	3.47×10^{-3}
Th-230	7.38×10^{-3}	5.03×10^{-3}	2.56×10^{-3}	3.43×10^{-3}
Th-232	2.15×10^{-3}	6.42×10^{-4}	9.19×10^{-4}	2.32×10^{-3}
U-234	5.82×10^{-2}	3.71×10^{-3}	1.81×10^{-2}	5.34×10^{-3}
U-235	5.96×10^{-3}	2.61×10^{-4}	1.11×10^{-2}	2.83×10^{-3}
U-238	1.02×10^{-1}	4.48×10^{-3}	1.94×10^{-2}	4.15×10^{-3}
U-Total	2.68×10^{-1}	1.33×10^{-2}	6.26×10^{-2}	1.80×10^{-2}

*Values for South Field and Inactive Flyash Pile are identical.

The variables ER_{PS} and ER_{DIFF} were calculated using the following equations:

$$ER_{PS} = \frac{(P)(MW)(10^6)(E_a)(Q)(ExC)}{(R)(T)} \quad \text{(C.5-4)}$$

$$E_a = 1 - \left[\frac{B-(B)(M_{FRAC})}{P}\right] \quad \text{(C.5-5)}$$

$$K_{eg} = \frac{1}{COC_T} \quad \text{(C.5-6)}$$

where

COC_T = number of VOCs + radon
= 4 Solid Waste Landfill
= 3 Lime Sludge Ponds
= 5 South Field/Inactive Flyash Pile

$$D_e = \frac{D_a(E_a)^{3.33}}{(E_T)^2} \quad \text{(C.5-7)}$$

The term ExC in Equation C.5-4 is the fraction of the VOC in the pore space that is emitted to the atmosphere during excavation. All variables are defined in Table C.5-6. Values of molecular weight, vapor pressure at 25°C, and diffusivity in air at 25°C are given in Table C.5-7. Equation C.5-4 is based on the assumption that the soil pore gas is saturated with the COC of interest.

The results of the calculations to determine VOC emissions are presented in Table C.5-8. After the total VOC emission rates due to excavation and soil handling were calculated, the Nearfield Box Model was used to estimate the air exposure concentration for the remedial worker. The calculation is shown in Table C.5-9.

Dryer VOC Emission Rates

Gaseous emissions from the dryer would be very low because of the high boiling temperatures and low vapor pressures of PAHs, Aroclors (PCBs), and the insecticide dieldrin. To quantify gaseous emissions from the dryer, it was assumed that soil agitation by the rotary kiln dryer (assumed operating temperature of 120 to 150°C) would release the contaminant-laden soil pore

gas to the off-gas system and then to the atmosphere. The off-gas system would have dust controls which reduce particulate emissions to an insignificant rate. Gaseous emissions would be released in a submit-specific ratio of pore space emissions to total quantity of COC available for release. This ratio was multiplied by the COC soil concentration and the dryer process rate to determine the gaseous emission rate of the COC. The maximum receptor unit concentrations (based on a unit emission rate of 1 g/s, from ISCLT2 modeling) for each dryer were added and multiplied by the COC gaseous emission rate to determine a maximum receptor exposure concentration for a COC. Table C.5-10 lists the calculations used to determine receptor concentrations. COC properties are listed below. Values were taken from the Hazardous Chemicals Desk Reference Lewis 1991).

COC	Boiling Point	Melting Point	Miscellaneous
Aroclor-1254, -1260	340-375°C	---	---
Benzo(a)pyrene	310-312°C @10mm Hg	179°C	Insoluble in water
Carbazole	354.8°C	244.8°C	Vapor pressure: 400 mm Hg @323.0°C
Dieldrin	---	150°C	Insoluble in water

Radon Emission Rates

The emission rate of Rn-222 from diffusion was determined from Ra-226 soil concentrations using the RAECOM model developed for the NRC (NRC 1984). The model accounts for the half-lives of Rn-222 and Ra-226 as well as the density, porosity, moisture content, and depth of contaminated layers and over layers in estimating a Rn-222 exit flux. Multiplying the exit flux by the diffusion area results in an emission rate. Calculated exit fluxes are summarized below. RAECOM input files and a sample output are presented in Attachment C.I. The diffusion area was assumed to be 150m^2. Table C.5-8 lists the Rn-222 diffusion emission rate for all subunits.

Subunit	RAECOM Exit Flux (pCi/m^2/s)
Solid Waste Landfill	.7209
Lime Sludge Ponds	.7209
South Field/Inactive Flyash Pile	1.352
Active Flyash Pile	2.433

TABLE C.5-6
INPUT VARIABLES FOR EMISSIONS EQUATIONS

Variable	Definition	Units	Value
P	Vapor pressure	mm Hg	COC-specific
MW	Molecular weight	g/g-mol	COC-specific
R	Gas constant	mm Hg-cm^3/g-mol °K	62,361
T	Temperature	°K	298
E_a	Air-filled porosity	Dimensionless	0.440
S_v	Volume of soil moved	m^3	Area-specific
Q	Excavation rate	m^3/sec	0.01
10^6	Conversion factor	cm^3/m^3	—
ExC	Soil-gas to atmosphere exchange constant	Dimensionless	0.1
C	Concentration in soil	g/cm^3	COC-specific
10,000	Conversion factor	cm^2/m^2	—
SA	Emitting surface area	m^2	Assumed 150 m^2
K_{eq}	Equilibrium coefficient	Dimensionless	COC-specific
k_g	Gas-phase mass transfer coefficient	cm/sec	0.15
π	Pi	Dimensionless	3.14
E_T	Total porosity	Dimensionless	0.43
t	Time[a]	sec	-
D_e	Effective diffusivity in air	cm^2/sec	COC-specific
M	Total mass of COC	g	COC-specific
Other Variables Required to Calculate Certain Variables Listed Above			
t_{sv}	Time to excavate a given volume of soil	sec	—
β	Bulk density	g/cm^3	1.5
ρ	Particle density	g/cm^3	2.65
D_a	Diffusivity in air	cm^2/sec	COC-specific
U	Wind speed	m/sec	2.0
μ_a	Viscosity of air	g/cm-sec	1.81×10^{-4}
d_e	Diameter of excavation	m	Area-specific

[a]See Page 11 of Appendix A for discussion of time term.

SOURCE: EPA (1992f), RAWPA, standard chemical reference manuals, and EPA review comments of other Operable Unit RAs.

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TABLE C.5-7
INPUT VARIABLES FOR EMISSIONS CALCULATIONS

COC[a]	Molecular Weight (g/g mole)	Vapor Pressure at 25°C (mm Hg)	Diffusivity In Air (cm^2/s)
Aroclor-1254	327.00	6.00×10^{-5}	1.04×-10^{-1}[b]
Aroclor-1260	370.00	4.05×10^{-5}	1.04×10^{-1}
Benzo(a)pyrene	252.32	5.68×10^{-4}	4.30×10^{-2}
Dieldrin	380.91	1.78×10^{-7}	1.04×10^{-1}[b]

[a]Since vapor pressure is 400mm Hg at 323.0°C, Carbazole is assumed to be nonvolatile during OU2 remedial activities.

[b]COC-specific value could not be found. The diffusivity of Aroclor (PCB), CAS No. 1336-36-3, was used.

TABLE C.5-8
EXCAVATION GASEOUS EMISSIONS[a]

	Solid Waste Landfill		Lime Sludge Ponds		Active Flyash Pile		South Field/Inactive Flyash Pile	
COC	Diffusion	Soil Pore Space	Diffusion	Soil Pore Space	Diffusion	Soil Pore Space	Diffusion	Soil Pore Space
Aroclor 1254 (g/s)	1.78×10^{-5}	1.5×10^{-11}	1.83×10^{-5}	1.47×10^{-7}	--	--	1.42×10^{-5}	1.47×10^{-7}
Aroclor 1260 (g/s)	2.78×10^{-5}	1.14×10^{-7}	--	--	--	--	3.06×10^{-5}	1.14×10^{-7}
Benzo(a)pyrene (g/s)	2.58×10^{-3}	9.4×10^{-12}	5.3×10^{-6}	9.4×10^{-12}	--	--	3.89×10^{-5}	9.44×10^{-12}
Dieldrin (g/s)	--	--	--	--	--	--	5.28×10^{-6}	5.0×10^{-10}
Radon (pCi/s)	108.1	1,278.8	108.1	1,701.0	365.0	17,292	202.8	1,926.5

[a]Since vapor pressure is 400 mm H_2O at 323.0°C, carbazole is assumed to be nonvolatile during OU2 remediation.

TABLE C.5-9

RADON AND VOC AIR CONCENTRATIONS (Ca) FOR THE REMEDIAL WORKER

Near Field Box Model (RAWPA Section 6.3.1.3):

$$Ca = Q/(Hb)(Wb)(Um) \quad \text{(C.5-8)}$$

Ca = concentration of COC in ambient air on site (pCi/m^3)(mg/m^3),
Q = emission rate of COC (pCi/s or mg/s),
H_b = downwind exposure height (1.83 m),
W_b = width of crosswind dimension of contaminated area (assumed to be 45m), and
U_m = average wind speed, 4.61 m/s (RAWPA Table 6-7).

COC/Subunit	Q (g/s)	Ca (g/m^3)
Solid Waste Landfill		
Benzo(a)pyrene	2.58×10^{-3}	6.80×10^{-6}
Aroclor-1254	1.78×10^{-5}	4.69×10^{-8}
Aroclor-1260	2.78×10^{-5}	7.32×10^{-8}
Carbazole	0.00×10^{0}	0.00×10^{0}
Dieldrin	---	---
Rn-222 (pCi/s)	1.39×10^{-3}	3.65×10^{0} pCi/m3
Lime Sludge Ponds		
Benzo(a)pyrene	5.28×10^{-6}	1.39×10^{-8}
Aroclor-1254	1.83×10^{-5}	4.82×10^{-8}
Aroclor-1260	---	---
Carbazole	---	---
Dieldrin	---	---
Rn-222 (pCi/s)	1.81×10^{3}	4.77×10^{0} pCi/m3
South Field/Inactive Flyash Pile		
Benzo(a)pyrene	3.89×10^{-5}	1.02×10^{-7}
Aroclor-1254	1.42×10^{-5}	3.74×10^{-8}
Aroclor-1260	3.06×10^{-5}	8.06×10^{-8}
Carbazole	0.00×10^{0}	0.00×10^{0}
Dieldrin	5.28×10^{-6}	1.39×10^{-8}
Rn-222 (pCi/s)	2.13×10^{3}	5.61×10^{0} pCi/m3
Active Flyash Pile		
Benzo(a)pyrene	---	---
Aroclor-1254	---	---
Aroclor-1260	---	---
Carbazole	---	---
Dieldrin	---	---
Rn-222 (pCi/s)	1.77×10^{4}	4.65×10^{1} pCi/m3

TABLE C.5-10

AIR EXPOSURE CONCENTRATIONS FOR THE OFF-PROPERTY RECEPTOR DUE TO DRYER EMISSIONS

Subunit	Volume (Dried-yd^3)	Volume (Dried-m^3)	Remedial Time (Months)	Dryer Operation (Months)	Dryer Operation (Sec)	Soil Density (g/cm^3)	Dryer Process Rate (g Soil/s)
Solid Waste Landfill	7000	5352.5	14	13	$8.05 \times 10^{+6}$	1.5	997.4
Lime Sludge Ponds	7100	5428.9	16	15	$9.29 \times 10^{+6}$	1.5	876.8
Inactive Flyash Pile	6900	5276.0	34	33	$2.04 \times 10^{+7}$	1.5	387.3
South Field	11000	8411.0	23	22	$1.36 \times 10^{+7}$	1.5	926.2
South Field/Inactive Flyash Pile	17900	13687.1	57	55	$3.41 \times 10^{+7}$	1.5	602.8
Active Flyash Pile	700	535.2	24	23	$1.42 \times 10^{+7}$	1.5	56.4

COC	Soil Conc (ug/g)	Max Stack Emission Rate (g/s)	Total Available (g/hr)	Pore Space Release (g/hr)	Fraction of (Pore Space/ Total Available)	Total Max Receptor Conc (g/m^3)
Solid Waste Landfill[b]						
Benzo(a)pyrene	10.72	$1.07 \times 10^{+2}$	7.30×10^{-2}	3.40×10^{-8}	4.66×10^{-11}	1.49×10^{-14}
Aroclor-1254	0.048	4.79×10^{-5}	3.30×10^{0}	5.30×10^{-4}	1.61×10^{-4}	2.31×10^{-10}
Aroclor-1260	0.077	7.68×10^{-5}	5.30×10^{0}	4.10×10^{-4}	7.74×10^{-5}	1.78×10^{-10}
Carbazole	4.2	---	---	---	---	---
Dieldrin	---	---	---	---	---	---
Lime Sludge Ponds[b]						
Benzo(a)pyrene	0.19	1.67×10^{-4}	1.30×10^{0}	3.40×10^{-8}	2.62×10^{-8}	1.31×10^{-13}
Aroclor-1254	0.043	3.77×10^{-5}	2.90×10^{0}	5.30×10^{-4}	1.83×10^{-4}	2.07×10^{-10}
Aroclor-1260	---	---	---	---	---	---
Carbazole	---	---	---	---	---	---
Dieldrin	---	---	---	---	---	---
South Field/Inactive Flyash Pile[b]						
Benzo(a)pyrene	0.18	1.09×10^{-4}	1.20×10^{0}	3.40×10^{-8}	2.83×10^{-8}	9.22×10^{-14}
Aroclor-1254	0.043	2.59×10^{-5}	2.90×10^{0}	5.30×10^{-4}	1.83×10^{-4}	1.42×10^{-10}
Aroclor-1260	0.089	5.37×10^{-5}	6.10×10^{0}	4.10×10^{-4}	6.72×10^{-5}	1.08×10^{-10}
Carbazole	0.001	---	---	---	---	---
Dieldrin	0.016	9.65×10^{-6}	1.10×10^{0}	1.80×10^{-6}	1.64×10^{-6}	4.73×10^{-13}

[a]AFP soil is not contaminated with any of the above listed COCs.
[b]Total maximum receptor unit concentration = 3.00×10^{-12} (g/m^3)/(g/s).

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The calculation of Rn-222 emissions due to soil pole space is based on the assumption that the soil concentration of Rn-222 is equal to the soil concentration of Ra-226. An emanation factor of one-fifth was used to quantify how much Rn-222 was present in the pore space. However, pore space is shared with VOCs. The presence of VOCs limits the pore space available to Rn-222 and it was assumed that Rn-222 and VOCs would occupy the pore space equally. It was also assumed that during excavation all pore space Rn-222 would be released when soil is dropped onto a storage pile. This emission rate was calculated using the following equation:

$$ER_{PSR} = (C_S)(E_F)(PS_F)(D_S)(Q)(CF) \qquad \text{(C.5-9)}$$

ER_{PSR}	=	pore space emission rate of Rn-222 (pCi/s),
C_S	=	Ra-226 soil concentration (see Table C.5-4),
E_F	=	Emanation factor (.2),
PS_F	=	pore space factor (1/[total number of gaseous COC present in soil including Rn-222),
D_S	=	soil density (1.5 g/cm^3),
Q	=	excavation rate (.01 m^3/s), and
CF	=	conversion factor (10^6 cm^3/m^3).

Table C.5-8 lists the Rn-222 pore space emission rate for all subunits. As with VOC emissions resulting from excavation and soil handling, the total Rn-222 emission rate was used in the Near Field Box Model to estimate the air exposure concentration for the remedial worker. The calculation is shown in Table C.5-9.

C.5.1.2 Direct Radiation Fate and Transport Modeling

Direct radiation exposure can be quantitatively modeled when measurement data are not available. This section describes the modeling used to estimate penetrating gamma radiation dose rates to remediation workers during phases of cleanup that involve excavation or removal of waste material that is a source of significant gamma radiation. Section C.5.1.3 discusses the dose rates received during remedial alternatives involving the transportation of waste to a disposal facility.

C.5.1.2.1 Direct Radiation Modeling Technical Approach

Remedial workers are receptors impacted by direct radiation. Direct exposure doses were calculated for an excavation-area remedial worker, an on-site dump truck driver, and a worker at the loading/staging area for gondola railcars. To model direct radiation exposure, the following

items were considered: source geometries, the presence of shielding between the radiation source and the receptor, and the distance between the source and receptor.

Radiation dose rates for planar source geometries (which may or may not involve shielding materials) and for nonplanar source geometries were modeled using the MICROSHIELD 4.1 code. MICROSHIELD was developed for use on personal computers by Grove Engineering (Grove 1988) and uses the same algorithms as ISOSHIELD, a mainframe code developed by Battelle Northwest Laboratories (Engle 1966). MICROSHIELD contains a variety of source geometries used in RI/FS risk assessments and is suitable for operable-unit-specific modeling.

MICROSHIELD presents the estimated dose rate from a given configuration in three forms: activity (photons/sec), gamma flux energy density (MeV/cm^2/sec), and dose rate (mrad/hr). Basic information requirements can be grouped into three categories: source term configuration, shielding arrangement, and receptor/detector placement.

The composition of the source is characterized by information on the types and densities of the source materials and the types and concentrations of nuclides in the source. Information on materials located between the source and the receptor (including air) allows the code to calculate the degree to which the gamma rays emitted by the source are attenuated. In addition, the code can use information on the chemical and physical properties of the shielding and source materials to estimate any additional exposure caused by scattering (buildup).

Receptor location determines the thickness of the air gap between the receptor and the source. The air gap provides additional shielding since gamma exposures decrease as a function of distance from the source.

C.5.1.2.2 Direct Radiation Modeling Results

Workers at the excavating and staging areas of the site may be exposed to direct radiation from contaminated soil and from resuspended dust resulting from remedial activities. The input parameters used in MICROSHIELD to calculate exposure are shown in Table C.5-11. MICROSHIELD results are summarized in Table C.5-12.

TABLE C.5-11
MICROSHIELD INPUT PARAMETERS

Source volume of direct exposure to remedial worker during excavation:
Diameter = 20 m; Depth = 2 m; Volume = 6.28×10^8 cc;
Mass = 1.07×10^9g (1.7 g/cc for source strength);
Density = 1.5 g/cc (for self shielding).

Roll-off Truck:
Length = 4.57 m; Width = 2.44 m; Height = 1.37 m;
Volume = 1.53×10^7 cc;
Mass = 2.60×10^7 g (1.7 g/cc for source strength);
Density = 1.5 g/cc (for self shielding).

Train Gondola Car:
Length = 16.0 m; Width = 2.90 m; Height = 1.37 m;
Volume = 6.36×10^7 cc;
Mass = 8.85×10^7 g;
Density = 1.5 g/cc (for self shielding only).

Remediation crews work 10 hours/day, 4 days/week.

Remedial activities produce mechanical suspension of soil particles in air at a concentration of 600 $\mu g/m^3$.

Note: COC soil concentrations are presented in Table C.5-4.

TABLE C.5-12
MICROSHIELD OUTPUT (mR/hr)

	Direct Exposure			Immersion
Subunit	**On-property Rail Remedial Worker**	**On-property Transportation**	**Excavation Remedial Worker**	**Excavation Remedial Worker**
Solid Waste Landfill	5.16×10^{-3}	1.11×10^{-2}	1.59×10^{-2}	7.10×10^{-10}
Lime Sludge Ponds	2.65×10^{-3}	5.66×10^{-3}	8.18×10^{-3}	3.52×10^{-10}
South Field/Inactive Flyash Pile	4.48×10^{-3}	9.63×10^{-3}	1.38×10^{-2}	6.51×10^{-10}
Active Flyash Pile	8.48×10^{-3}	1.82×10^{-2}	2.63×10^{-2}	1.13×10^{-9}

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C.5.1.3 Transportation Modeling

The analysis of potential impacts in this FS requires consideration of the radiation dose and risk to potential receptors as a result of transporting radioactive waste to an off-site disposal facility via gondola railcar. Potential receptors include on-property remediation workers, rail crewmen, and the public along the transportation route. The proposed off-site disposal facility is EnviroCare in Utah. Off-site disposal would be used for Alternative 3, under which all contaminated soils are transported off-site, or for Alternative 6, under which only the waste exceeding the WAC is transported off-site.

This transportation analysis includes two distinct cases: incident-free transportation and transportation involving vehicular accidents. One waste configuration was used in the analysis of both cases.

C.5.1.3.1 Transportation Modeling Technical Approach

Transportation of radioactive material involves a wide range of events with potential for environmental impact. For the remediation of Operable Unit 2, material to be disposed would be loaded into a gondola railcar and covered. The radiation exposure levels would be noted, railcars labeled with the appropriate information, and a shipping bill prepared. The railcar would then be put aside until transportation actually begins. After at least 159 railcars are accumulated, the covered gondolas would be taken to EnviroCare for final disposal of the radioactive material.

RADTRAN 4 (version 4.0.16, April 12, 1994) was used to evaluate the radiological consequences of both incident-free transportation and transportation involving vehicular accidents. Sandia National Laboratories developed the original RADTRAN code in 1977. The analytical capabilities of the code have been expanded and refined in subsequent versions.

The current version of RADTRAN 4 contains advances in the handling of route-related data and in the treatment of multiple-isotope materials. It can perform route-specific analysis, model the risk from transportation of multiple-isotope materials, analyze multiple-package shipments made up of dissimilar packages, and calculate the maximum individual in-transit dose. RADTRAN 4 contains idealized mathematical models of transportation environments; these models have been

formulated to yield conservative estimates of integrated population dose in a way that can be supported by available data. These models neglect features of the transportation environment that either do not affect the calculated risk values or reduce conservatism (e.g., the "divider width" of divided highways).

C.5.1.3.2 RADTRAN Incident-Free Transportation Model

In RADTRAN, the general population is divided into eight exposable population subgroups: crewmen, flight attendants, warehouse personnel (at EnviroCare), passengers on railcars, public along storage depots, public along transportation route, people in the vicinity of the transporting vehicle while it is stopped, people surrounding the transport link on which the vehicle is moving, and people sharing the transport link with the vehicle. Of these eight population subgroups, only six were computed for this analysis (Figure C.5-3). The dose to flight attendants was not computed because the method of transportation is railcar. The dose to passengers on railcars was not computed because the railcar will be restricted to transportation personnel only. Total doses (in person-rem) were computed for each of the six subgroups relevant to Operable Unit 2.

Table C.5-13 identifies the common input parameters used in the incident-free model. The amount of soil shipped to the disposal facility varies by alternative and final residual risk level. Table C.5-14 presents the results for the single shipment RADTRAN run.

C.5.1.3.3 Transportation Accident Model

Two factors were considered when evaluating impacts of accidents that involve vehicles carrying radioactive shipments: probability and consequence. The probability that an accident releasing radioactive material will occur can be described in terms of the expected number of accidents of a given severity for each transport mode, together with the package response to such an accident. The consequences of an accident are expressed in terms of the potential effects of the release of a specified quantity of radioactive material to the environment or the increased direct exposure of persons to ionizing radiation resulting from damaged package shielding.

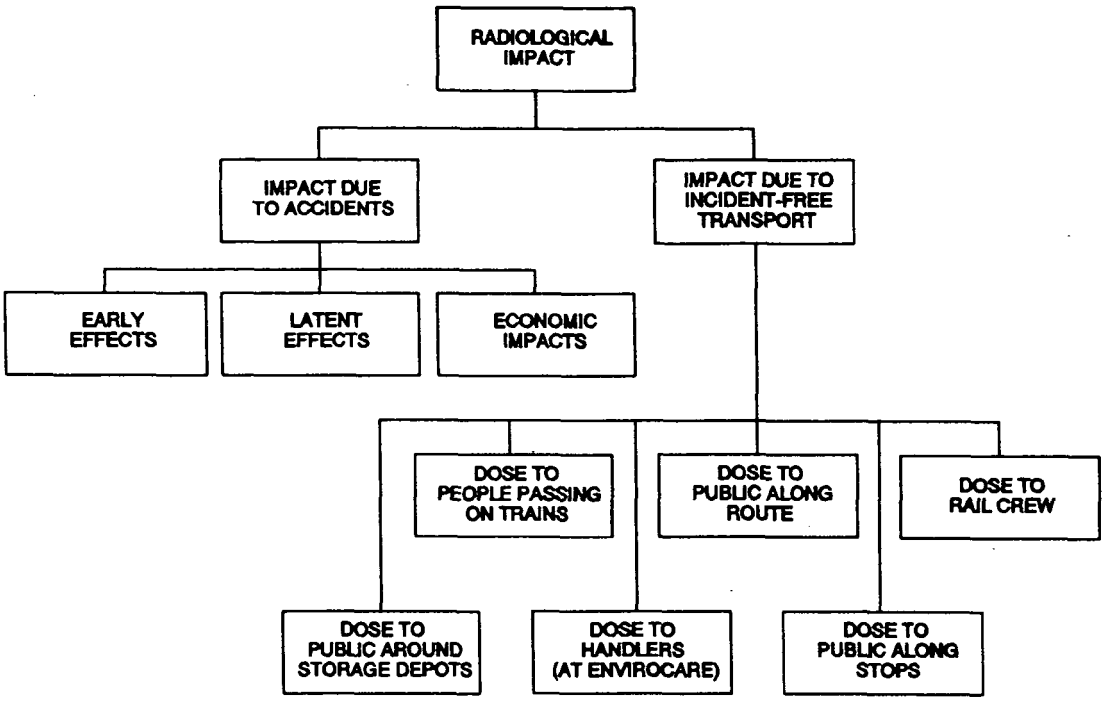

FIGURE C.5-3
COMPONENTS OF RADIOLOGICAL IMPACT EVALUATED BY RADTRAN FOR OU2 REMEDIAL ACTIVITIES

TABLE C.5-13
COMMON INPUT PARAMETERS FOR INCIDENT-FREE RADTRAN MODEL

Parameter	Value	Units
Gondola Rail Cars Per Shipment	159*	Rail Cars
Number of Shipments	1	Trains
Dose Rate at 1m (Transport Index)	8.5×10^{-3}	mrem/hr
Travel in Rural Population Zone	82	% of total
Travel in Suburban Population Zone	14	% of total
Travel in Urban Population Zone	4	% of total
Velocity in Rural Population Zone	64	km/hr
Velocity in Suburban Population Zone	40	km/hr
Velocity in Urban Population Zone	24	km/hr
Number of Crewmen	5	People
Distance from source to crew	64	m
Number of Handlings	1	Trains
Stop Time per Kilometer	3.3×10^{-2}	hr/km
Minimum Stop Time per Trip	10	hr
Zero Stop Time per Trip	60	hr
Minimum Number of Rail Inspections	2	Insp.
Persons Exposed While Stopped	100	People
Average Exposure Distance While Stopped	20	m
Storage Time per Shipment	8	hr
Number of Exposed Persons During Storage	20	hr
Average Exposure Distance While In Storage	100	m
Number of People per Vehicle on Link	3	People
Fraction of Urban Travel During Rush Hour	0	Unitless
Fraction of Urban Travel on City Streets	1	Unitless
Fraction of Rural-Suburban Travel on Freeways	0	Unitless
Traffic Count Passing a Specific Point-Rural Zone	1	Cars/Time
Traffic Count Passing a Specific Point-Suburban Zone	5	Cars/Time
Traffic Count Passing a Specific Point-Urban Zone	5	Cars/Time

*The number of packages for determining the dose to crew members was reduced to 1 rail car. The contribution from the trailing 158 cars would be negligible due to self-shielding. RADTRAN 4 does not take self-shielding into consideration in calculating dose.

TABLE C.5-14
RADTRAN INCIDENT-FREE SUMMARY FOR ONE SHIPMENT

Population Subgroup	Person-rem
Rail Crew	4.2×10^{-6}
Handlers (at EnviroCare)	2.22×10^{-2}
Public Along Route	4.94×10^{-3}
Public Passing On Trains	5.59×10^{-4}
Public Along Stops	8.16×10^{-3}
Public Around Storage Depots	9.3×10^{-4}
Total to Public	3.74×10^{-2}
Total for All Population Subgroups	3.74×10^{-2}

Accidents were assigned a severity category based upon the duration and temperature of fire occurring during the accident, and either impact speed (air transport), crush forces (for truck and van transport), or puncture impact speed (for rail transport). Eight severity categories were considered for this case (Table C.5-15).

RADTRAN uses four quantities which depend on severity category: accident severity fraction (n), release fraction (RF), aerosolization fraction (AER), and respirable fraction (RESP). The severity fraction is a three-dimensional array which defines the probability that transport accidents for each of the allowable-modes will occur in each of three population zones and each of the eight severity categories. Table C.5-15 identifies the default RADTRAN accident severity fractions used in the accident model. Table C.5-16 identifies the release fractions by severity group.

TABLE C.5-15
RADTRAN ACCIDENT SEVERITY FRACTIONS
BY POPULATION DISTRIBUTION AND SEVERITY GROUP

Severity Group	Rural	Suburban	Urban
1	3.56×10^{-1}	3.13×10^{-1}	5.72×10^{-1}
2	2.14×10^{-1}	1.88×10^{-1}	3.43×10^{-1}
3	3.85×10^{-1}	4.51×10^{-1}	7.72×10^{-2}
4	3.85×10^{-1}	4.51×10^{-1}	7.72×10^{-2}
5	6.41×10^{-3}	3.38×10^{-3}	5.14×10^{-4}
6	6.48×10^{-4}	1.63×10^{-4}	1.86×10^{-5}
7	3.42×10^{-4}	3.76×10^{-5}	8.57×10^{-6}
8	6.41×10^{-5}	3.13×10^{-6}	7.15×10^{-7}

TABLE C.5-16
RADTRAN RELEASE FRACTIONS BY SEVERITY GROUP

Severity Group	Release Fraction
1	0
2	0.1
3	0.2
4	0.3
5	0.4
6	0.5
7	0.6
8	1

Consideration of packaging strength of a train gondola car as a function of severity is included in the release fraction. This parameter varies from 0 to 1, depending on the relative damage done to the gondola car in the accident. If RF is 1, the gondola car is totally destroyed from a material containment point of view. If RF is 8, the gondola car is unbreached (although not necessarily undamaged) and the material is fully contained. Intermediate values describe conditions of increasing gondola car failure ranging from microfractures to catastrophic failure.

Transported materials are classified according to their dispersibility based on the shipment size and the chemical/physical properties of the material. The dispersion category in turn determines the fractions aerosolized and respirable. Figure C.5-4 shows the decision tree structure used to make this classification. The Operable Unit 2 soil was modeled as Category V, Small Loose Powder.

The aerosol fraction specifies the fraction of material released from a package in aerosol form. The aerosol fraction used in the accident model was 0.1 and was based on material dispersibility of 5 (small base powder). Only those particles less than approximately 10 microns in aerodynamic diameter pose an inhalation hazard. The respirable fraction was introduced to quantify this respirability fraction as a function of material dispersibility class and accident severity.

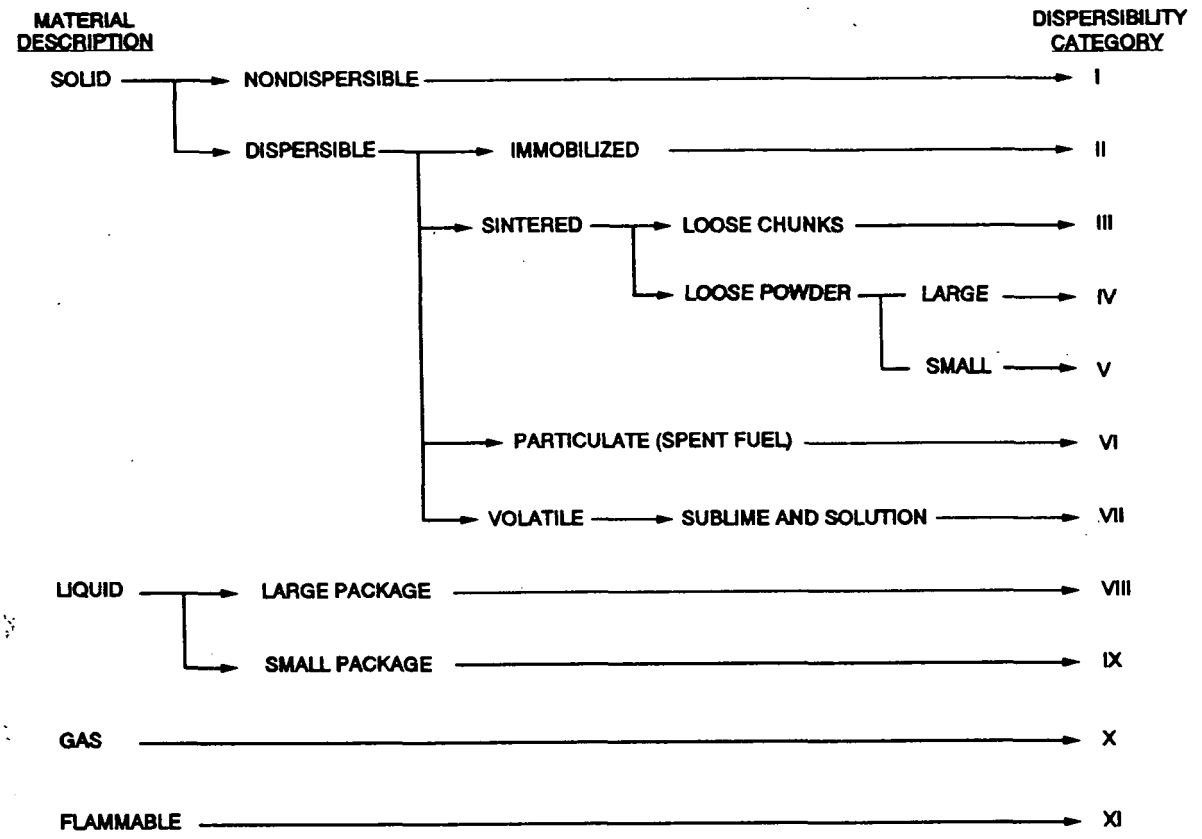

FIGURE C.5-4
MATERIAL DISPERSIBILITY CATEGORIES

The respirability fraction used in the accident model was 0.05 and based on the same material dispersibility of 5. In terms of ground contamination, all airborne particles are significant so the respirability fraction was not included. Table C.5-17 lists the accident results for one shipment.

TABLE C.5-17
RADTRAN ACCIDENT SUMMARY FOR ONE SHIPMENT

Population Density	Severity Group	Expected No. of Accidents Per Shipment	Consequences of One Shipment (person-rem)
Urban	1	1.07×10^{-3}	0×10^{0}
	2	6.41×10^{-4}	2.84×10^{1}
	3	1.44×10^{-4}	5.68×10^{1}
	4	1.44×10^{-4}	8.51×10^{1}
	5	9.61×10^{-7}	1.13×10^{2}
	6	3.48×10^{-8}	1.42×10^{2}
	7	1.6×10^{-8}	1.70×10^{2}
	8	1.34×10^{-9}	2.84×10^{2}
Urban Total		(2×10^{-3})	NA
Suburban	1	2.59×10^{-4}	0×10^{0}
	2	1.56×10^{-4}	6.60×10^{0}
	3	3.74×10^{-4}	1.32×10^{1}
	4	3.74×10^{-5}	1.98×10^{1}
	5	2.8×10^{-6}	2.6×10^{1}
	6	1.35×10^{-7}	3.29×10^{1}
	7	3.12×10^{-8}	3.95×10^{1}
	8	2.59×10^{-9}	6.59×10^{1}
Suburban Total		(8.29×10^{-4})	NA
Rural	1	9.1×10^{-5}	0×10^{0}
	2	5.47×10^{-5}	1.23×10^{-1}
	3	9.84×10^{-5}	2.46×10^{-1}
	4	9.184×10^{-6}	3.69×10^{-1}
	5	1.64×10^{-6}	4.92×10^{-1}
	6	1.66×10^{-7}	6.15×10^{-1}
	7	8.74×10^{-8}	7.38×10^{-1}
	8	1.64×10^{-8}	1.23×10^{0}
Rural Total		2.56×10^{-4}	(NA)
Overall Totals		3.1×10^{-3}	NA

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C.5.2 RESIDUAL RISK MODELING

Fate and transport modeling was conducted to determine the impacts from the movement of COCs remaining in residual (postremediation) soil. Transport mechanisms modeled include groundwater, air, and farm products. The objective of this effort is to predict the future concentrations of residual COCs at receptor locations, under assumed conditions. The following sections summarize the fate and transport modeling conducted for groundwater and air transport, as well as the transport of COCs through food products. For a detailed discussion of the groundwater and air modeling effort, see Appendix D of the FS report.

C.5.2.1 Groundwater Fate and Transport Modeling

Groundwater fate and transport modeling was used to simulate residual COC movement from the Operable Unit 2 subunits to potential human receptors. Different exposure scenarios were modeled, but all of the source terms can be identified as residual soils, in situ containment of waste with a cap, or waste deposited in an engineered disposal cell. Fate and transport models provide the only means of predicting potential groundwater concentrations at receptor locations in the future under assumed conditions. The following models were used:

- The Universal Soil Loss Equation (USLE) was used to estimate erosion potential in 1000 years
- Hydrological Evaluation of Landfill Performance (HELP) was used to estimate exfiltration and infiltration rates
- ODAST/SWIFTLOAD was used to predict COC movement through the vadose zone and prepare input files for the SWIFT III model
- SWIFT III was used to predict contaminant movement through the Great Miami Aquifer

Only a brief description of the methodology used to quantitatively predict COC concentrations is presented here. For a more complete description of the methods and parameters used for the Operable Unit 2 modeling, refer to Appendix A of the Operable Unit 2 RI report.

C.5.2.1.1 Groundwater Conceptual Model

The geology of the FEMP site is dominated by glacial sediments. Well sorted sand and gravel glacial outwash forms the regional Great Miami Aquifer. A sequence of fine-grained till deposits interbedded with sand and gravel glaciofluvial stringers (the glacial overburden) overlie the

glaciofluvial material of the Great Miami Aquifer. The migration of COCs from sources to the groundwater begins with the infiltration of rainwater (Figure C.5-5). Fluid and/or leachate entering from the waste areas migrates first through the glacial overburden (if present), then through the unsaturated outwash deposits, and finally into the Great Miami Aquifer.

Based on characteristics of the geology underlying the Operable Unit 2 subunits and the on-site disposal facility, a conceptual model was developed for the pathways between the disposal areas and receptor locations. Three active pathways for COC migration from the Operable Unit 2 source areas to the Great Miami Aquifer were identified for future conditions in Appendix D.1:

- Vadose zone pathway:
  Migration of COCs from the waste unit laterally and vertically through the vadose zone to the aquifer is designated as the vadose zone pathway.

- Perched water infiltration pathway:
  Vertical migration of perched water through the glacial till to the Great Miami Aquifer is designated as the perched water infiltration pathway.

- Perched water subsurface seep pathway:
  Lateral migration of COCs occurs when perched water in sand and gravel layers within the glacial overburden come in contact with waste material. Perched water moves laterally in the sand layer until it is intercepted at the sand/gravel and waste interface. At that point, perched water moves along the slope of waste and till interface until it comes in contact with the unsaturated Great Miami Aquifer. This water containing COCs then vertically infiltrates to the aquifer.

C.5.2.1.2 Groundwater Modeling Technical Approach

This section presents a summary of the modeling procedures and assumptions that were used for Operable Unit 2 risk assessment modeling. Additional information is provided in Appendix D of this FS report and Appendix B of the RI report.

The groundwater COCs identified in the Operable Unit 2 RI report are the uranium isotopes. Of these isotopes, only U-238 was modeled, to more efficiently use computation time. All of the uranium isotopes are assumed to have the same flow and transport properties; thus, modeling results for U-238 were used to predict concentrations of U-234, U-235/236, and total uranium.

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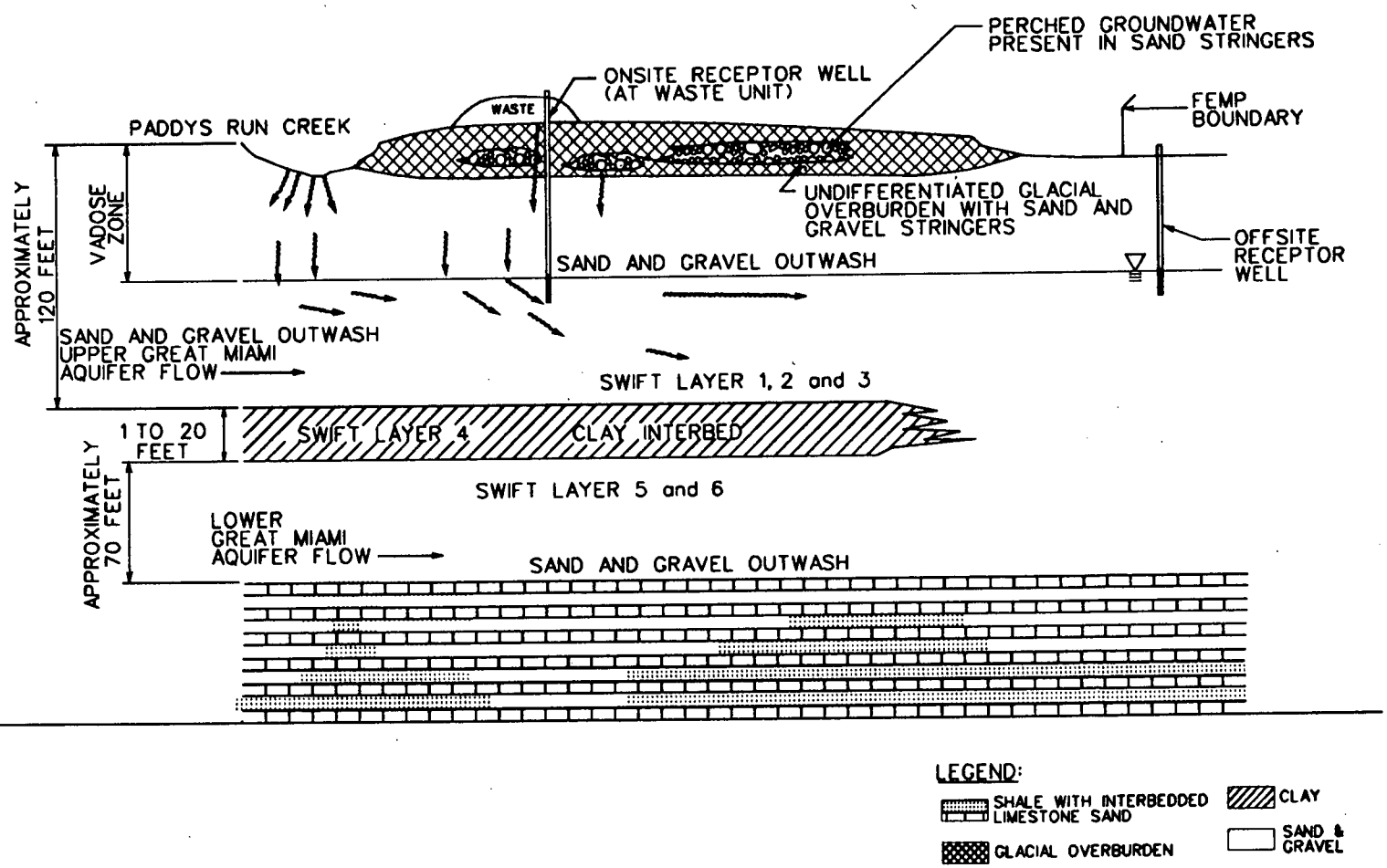

FIGURE C.5-5
CONCEPTUAL MODEL OF LOADING TO THE GREAT MIAMI AQUIFER AND CONTAMINANT TRANSPORT BY GROUNDWATER

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U-238 concentrations in 7.6 x 7.6 x 0.76 meter (25 x 25 x 2.5 foot) blocks were estimated using three-dimensional kriging for each media type. Average waste concentrations in each 38 x 38 meter (125 x 125 foot) SWIFT III grid cell were then calculated from all blocks within each cell. Source terms for residual soils were determined by evaluating the U-238 concentration isopleths on a block-by-block basis against the cleanup criteria selected for the alternative. The source term for fate and transport modeling for consolidation and placement under a cap was based on maximum detected U-238 concentration in each media type.

Vadose zone modeling was performed by using the leachate concentrations as input into a one-dimensional unsaturated flow model to simulate transport through the vadose zone to the Great Miami Aquifer. The One-Dimensional Analytical Solute Transport (ODAST) model was used to simulate dispersion, retardation, and decay through unsaturated materials. The HELP model was used to estimate infiltration rates.

The improved and calibrated SWIFT groundwater flow model was then used to simulate the solute transport of COCs in the Great Miami Aquifer. First, the vadose zone modeling results (for the vadose zone and perched water infiltration pathways) were incorporated into SWIFT as the loading rates to the Great Miami Aquifer from the subunits or disposal areas. The model then simulated the transport of COCs away from these source areas. Dispersion, retardation, and decay were factored into the COC transport process. SWIFT III simulations of COC transport in the Great Miami Aquifer were run for up to 1000 years.

The loading from each grid cell impacted by the subunit was entered into the SWIFT III model as a discrete source, making multiple sources for each COC. Due to the proximity of the Inactive Flyash Pile to the South Field (and their similar geologies), sources from these two subunits were combined in one SWIFT III run. The modeling runs produced simulations of the aggregate effects of loading from these two subunits for the COCs.

C.5.2.1.3 Results of Residual Groundwater Modeling

Groundwater modeling was used for this risk assessment to estimate the maximum groundwater concentrations at specific receptor locations. For the on-property resident farmer, receptor locations were selected at the points where the highest U-238 concentrations were predicted to occur in groundwater, beneath each subunit, over the 1000-year modeling period. The South

Field and Inactive Flyash Pile as previously stated, were modeled together and have a common receptor location.

The on-property resident farmer scenario also includes the use of perched water from beneath the Solid Waste Landfill and Lime Sludge Ponds. For these two subunits, the assumption was made that the current perched water contamination would be completely remediated by Operable Unit 5. For future contamination, the leachate concentrations from the residual waste were conservatively assumed to be representative of perched water concentrations. This approach does not incorporate the effects of dilution or dispersion in the perched zone. Therefore, the perched water receptor could be considered to be located at any point in the Solid Waste Landfill or Lime Sludge Ponds where perched water is directly beneath the subunit. The COCs for perched water are identified in the Operable Unit 2 RI report as carbazole, Tc-99, and the uranium isotopes for the Solid Waste Landfill, and Tc-99, Np-237, Sr-90, and the uranium isotopes for the Lime Sludge Ponds.

For the off-property farmer, the closest point to each area at which a hypothetical farmer could install a well would be along the FEMP fenceline. Groundwater modeling was used to identify the specific point along the fenceline at which the plume of contaminated groundwater from each area would reach the highest concentration over the 1000-year modeling period. This point was then used as the receptor location for its associated source area.

As with the on-property resident farmer, the South Field and Inactive Flyash Pile were modeled together, and also have a common off-property receptor. In addition, the Active Flyash Pile was modeled separately for most alternatives, but was combined with the South Field and Inactive Flyash Pile for Alternative 2 (Consolidation and Capping). This was done because wastes from all three areas will be consolidated together. The single location identified by the model at the fenceline that had the highest U-238 concentration over the 1000 years was selected as the receptor location for all three sources areas.

Additional information on the groundwater modeling procedures and assumptions is presented in Appendix D. The predicted maximum concentrations of the COCs in groundwater at each receptor location for the alternatives under each land-use scenario are listed in Table C.5-18.

TABLE C.5-18
RESULTS OF RESIDUAL GROUNDWATER MODELING: EXPOSURE POINT CONCENTRATIONS

	Alternative 2		Alternative 3&6 (Federal)		Alternative 3&6 (Private)	
COCs	On-Property	Off-Property	On-Property	Off-Property	On-Property	Off-Property
Lime Sludge Ponds						
GMA						
U-234	$1x10^{-4}$	$1x10^{-5}$	NA	$3.7x10^{-2}$	$1.9x10^{-3}$	$7.1x10^{-5}$
U-235	$1x10^{-4}$	$1x10^{-5}$	NA	$2.0x10^{-3}$	$1.0x10^{-4}$	$3.7x10^{-6}$
U-238	$1x10^{-4}$	$1x10^{-5}$	NA	$4.1x10^{-2}$	$2.0x10^{-3}$	$7.8x10^{-5}$
Uranium-Total	$1x10^{-7}$	$1x10^{-8}$	NA	$1.2x10^{-4}$	$6.0x10^{-6}$	$2.3x10^{-7}$
Perched Groundwater						
Np-237					$9.3x10^{-5}$	
Tc-99					$1.6x10^{-2}$	
Sr-90					$5.6x10^{-4}$	
U-234					$6.4x10^{-1}$	
U-235					$3.4x10^{-2}$	
U-238					$7.0x10^{-1}$	
Carbazole					NA	
Solid Waste Landfill						
GMA						
U-234	$7x10^{-4}$	$7x10^{-4}$	NA	$2.1x10^{-1}$	$2.4x10^{-2}$	$8.0x10^{-4}$
U-235	$7x10^{-4}$	$7x10^{-4}$	NA	$1.1x10^{-2}$	$1.2x10^{-3}$	$4.0x10^{-5}$
U-238	$7x10^{-4}$	$7x10^{-4}$	NA	$2.3x10^{-1}$	$2.6x10^{-2}$	$9.0x10^{-4}$
Uranium-Total	$2x10^{-6}$	$2x10^{-6}$	NA	$6.9x10^{-4}$	$8.0x10^{-2}$	$2.7x10^{-6}$
Perched Groundwater						
Np-237					NA	
Te-99					$1.6x10^{-2}$	
Sr-90					NA	
U-234					$6.1x10^{-1}$	
U-235					$3.2x10^{-2}$	
U-238					$6.7x10^{-1}$	
Carbazole					$4.7x10^{-4}$	
South Field Area						
GMA						
U-234	$3.2x10^{0}$	$4.5x10^{-}$	$5.6x10^{0}$	$6.6x10^{-1}$	$1.8x10^{-1}$	$3.1x10^{-2}$
U-235	$1.7x10^{-1}$	$2.4x10^{-2}$	$2.9x10^{-1}$	$3.5x10^{-2}$	$1.0x10^{-2}$	$2x10^{-3}$
U-238	$3.6x10^{0}$	$5.0x10^{-1}$	$6.1x10^{0}$	$7.2x10^{-1}$	$2.0x10^{-1}$	$3.4x10^{-2}$
Uranium-Total	$1.1x10^{-2}$	$1.5x10^{-3}$	$1.8x10^{-2}$	$2.2x10^{-3}$	$6.1x10^{-4}$	$1.0x10^{-1}$
Disposal Cell (Alternative 6 Only)						
GMA						
U-234				$6.3x10^{-1}$		$6.3x10^{-1}$
U-235				$3.3x10^{-2}$		$3.3x10^{-2}$
U-238				$7.0x10^{-1}$		$7.0x10^{-1}$
Uranium-Total				$2.1x10^{-3}$		$2.1x10^{-3}$

*Modeling results are presented in pCi/l for radionuclides and mg/l for all other COCs.
GMA = Great Miami Aquifer
NA = Not applicable

These exposure point concentrations are used in the risk assessment equations shown in Section C.3.2. Results from these calculations are presented in Section C.7.0. The uranium isotopes were not all modeled separately, but instead were calculated as a ratio of the U-238 modeling results. Appendix D provides a detailed description of this process.

C.5.2.2 Air Fate and Transport Modeling

The following discussion briefly describes the conceptual model and technical approach used to conduct air pathway fate and transport modeling for the FS residual risk assessment. The objective of this analysis was to determine the on and off-property annual average air-contaminant concentrations from the remediated Operable Unit 2.

C.5.2.2.1 Air Modeling Conceptual Model

Wind erosion and resuspension of particulate matter represents a viable transport pathway for all contaminated surface soil in Operable Unit 2. Under windy conditions, surface soil particles can be resuspended and dispersed in the atmosphere. The particulate matter emission rate from the surface depends on the ambient wind speed, representative size of surface soil particles, moisture content and crustiness of the soil, and quantity of vegetative cover on the surface.

Emission and dispersion of Rn-222 gas from surface soil containing Ra-226 represents another viable COC transport pathway. The emission rate of Rn-222 depends on the concentration of Ra-226 in the soil, the soil moisture content and porosity, the depth of Ra-226 contamination, and the presence or absence of cover layers over the contaminated soil layer.

The subsequent dispersion of contaminated particulate matter or Rn-222 gas was determined from statistical summaries of wind speed, wind direction, atmospheric stability, ambient temperature, and mixing height.

C.5.2.2.2 Air Modeling Technical Approach

Six major steps were required to achieve the objective of the air modeling:

1. Potential air quality impacts for each land use were qualitatively defined.
2. Sources of air emissions and COCs released were identified based on site-specific information.

3. The RAECOM model was used to determine the radon emission rates form each of the identified source areas.

4. The particulate emission model was used to determine particulate emission rates from Operable Unit 2 sources areas. Site-specific soil concentration data were used to determine the COC-specific emission rate from each identified source area.

5. Additional inputs to the air dispersion model, such as meteorological data and receptor locations, were obtained or developed.

6. The air dispersion model (ISCLT2) was used to determine COC air concentrations.

Figure C.5-6 presents the sequence and interactions of these steps. Table C.5-19 summarizes the major air pathway fate and transport modeling components. The results from this modeling were used as exposure point concentrations in the residual risk assessment (Section C.7.0).

Source Term Assumptions for Air Transport Analysis

The residual risks from Operable Unit 2 were evaluated for Alternatives 2, 3, and 6 (see Section C.2.1 for a summary of the alternatives). Air fate and transport analysis for Alternative 2 was conducted only for the federal ownership land-use scenario. Therefore, the PRGs for the expanded trespasser and/or off-property farmer were assumed to set the upper limit on residual surface soil contamination levels (see Section 2.0 of this FS for a discussion of PRGs). The air analysis for Alternatives 3 and 6 were conducted for both land-use scenarios. The PRGs for the expanded trespasser and/or off-property farmer were assumed to set the upper limit on residual surface soil contamination levels for the federal ownership scenario while the PRGs for the on-property resident farmer were assumed to set the upper limit on residual surface soil contamination levels for the private ownership scenario.

Air Emission Sources and Air Contaminants

A total of 373 areas sources were used to analyze Operable Unit 2 residual air concentrations. These sources were combined into 13 source groups such that each source group contained sources with identical emission rates. The COC concentrations in soil used to develop emission rates are presented in Appendix D.2 of this FS report.

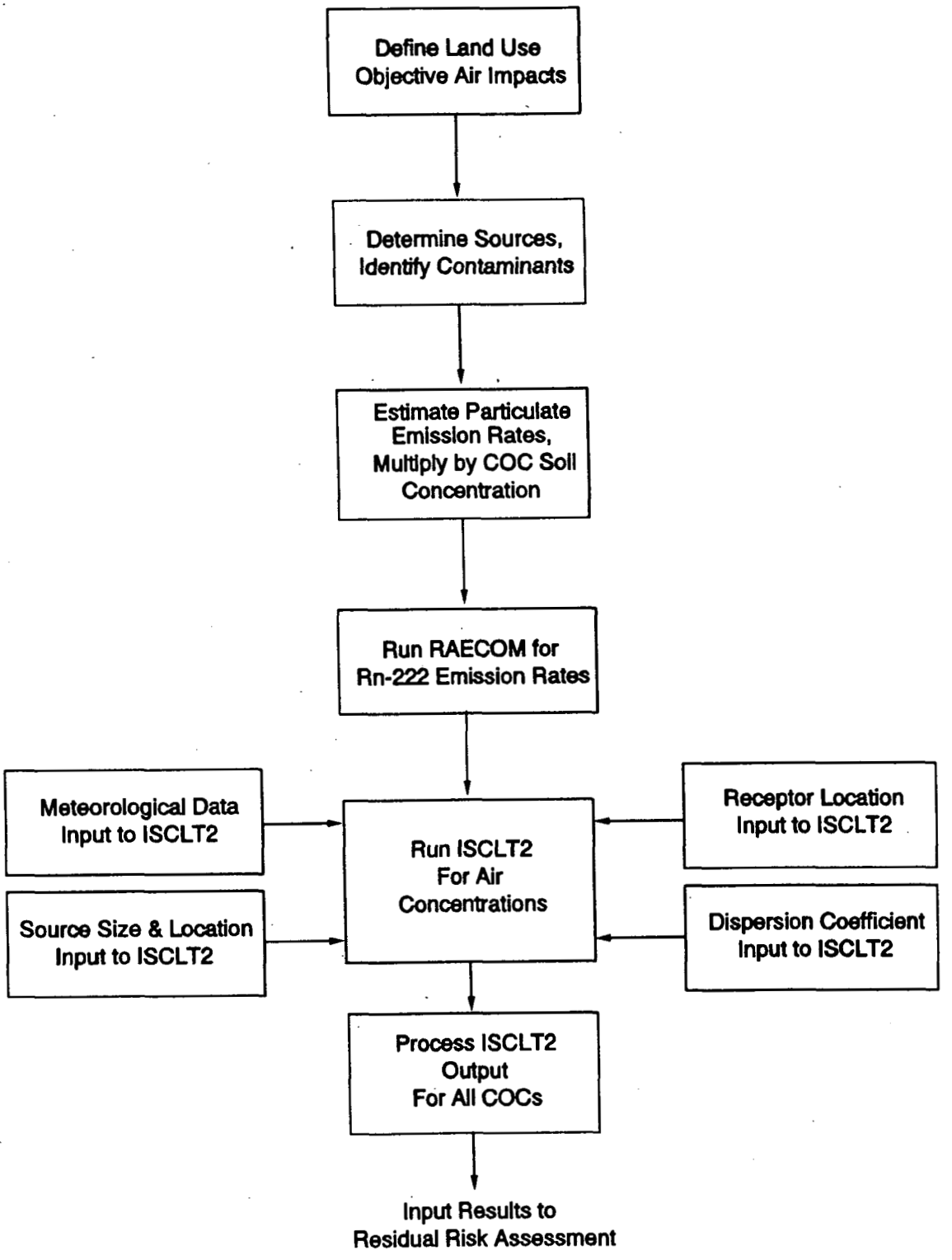

FIGURE C.5-6
SEQUENCE OF AIR FATE AND TRANSPORT MODELING TASKS

TABLE C.5-19

MAJOR COMPONENTS OF THE AIR EMISSION AND DISPERSION MODELS

Model	Description and Use
RAECOM	Computer model developed by the NRC (NRC 1984) to simulate the emission of Rn-222 gas from soil and material containing Ra-226. RAECOM was used in this modeling effort to estimate the Rn-222 emission rate from FEMP surface soils and through cover soils placed over on-property consolidation areas. The output from RAECOM was used as input to ISCLT2.
Particulate Matter Emission Equations	Presented in *Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination Sites* (EPA 1985), these equations were used in this modeling effort to estimate particulate matter emissions from surface soil caused by wind erosion. The results from these equations were used as input to ISCLT2.
ISCLT2	Computer model developed by the EPA (EPA 1992e) to simulate the dispersion of gas-phase and particulate-phase COCs emitted to the atmosphere. ISCLT2 was used in this modeling effort to predict the airborne concentrations and deposition rates of COCs emitted from the FEMP surface soils. The output from RAECOM and particulate matter emission models were used as input to ISCLT2.

SOURCES:
NRC 1984 for RAECOM.
EPA 1985 for emission equations.
EPA 1992e for ISCLT2.

Gaseous Contaminant Emission Rates

Emissions of Rn-222 were assumed to be the only gas-phase COC dispersed in the atmosphere. Volatile organics were assumed to have decayed to negligible levels prior to the time period studied by this residual risk analysis. Radionuclides, semivolatile and nonvolatile organics, and inorganics were assumed to be transported with the particulate emitted from the site.

Rn-222 emissions were determined from the Ra-226 concentrations in surface soil using the RAECOM model developed for the NRC (NRC 1984). The model accounts for the half-lives of Rn-222 and Ra-226 as well as the density, porosity, moisture content, and depth of contaminated layers and cover layers in estimating Rn-222 emission rates.

Particulate Matter Emission Rates

Radionuclide, inorganic, and organic COCs were assumed to be present in the suspended particulate matter emitted from the site. The emission rate for each COC in this particulate matter was calculated from the concentration of the COC in the exposed soil and from the estimated site-wide annual particulate matter emission rate. For concentration calculations, the emission rate of particulate matter less than 10 micrometers in diameter (PM_{10}) was used. For deposition rate calculations, the emission rate of total suspended particulate (TSP) was used. The modeled PM_{10} concentrations were multiplied by 2 to obtain the TSP concentrations (EPA 1993e).

The method used to estimate PM_{10} emission rates for the FEMP is based on EPA guidance for estimating wind erosion rates from flat soil surfaces at hazardous waste sites (EPA 1985). This guidance has been adopted by the EPA for Superfund sites (EPA 1992e). The EPA methodology assumes that a minimum wind speed is required for the suspension of respirable dust, and that the emission rate is a nonlinear function of the "threshold friction velocity" (TFV) and the erosion potential of the site, which depends on the modal diameter of the soil particles. Very fine soils (those with small modal diameters) have low TFVs and high potential for erosion by wind.

In addition to modal diameter, other factors such as the amount of nonerodible elements (gravel and pebbles with diameters greater than approximately 1 centimeter), the crustiness of the surface soil, and the amount of vegetative cover effect the quantity of soil that can be resuspended by the wind.

Meteorological Data

Meteorological data characterizing the transport and dispersion conditions of an area are needed as input to the ISCLT2 model. These data include wind speed, wind direction, atmospheric stability, ambient air temperature, and mixing height. Measurements for all of these meteorological parameters, except mixing height, have been recorded at the FEMP site as part of a comprehensive environmental monitoring program since August 1986. Mixing heights were determined from atmospheric soundings made twice daily by the National Weather Service. The nearest National Weather Service station is in Dayton, Ohio.

Receptor Locations

Two receptor grid systems were used in the ISCLT2 model to determine on-property air concentrations. Each grid system includes receptor points on 121 x 121 meter (400 x 400 foot) intervals. The second system is offset 60.5 meters (200 feet) north and 60.5 meters east from the first, resulting in an effective 83 x 83 meter (283 x 283 foot) grid system over the center of the FEMP. These grid systems include 985 points located across the FEMP. An additional 36 receptor points were located on the property line around the FEMP to determine the off-property air concentrations.

Dispersion Coefficients

U.S. Geological Survey (USGS) maps and a site survey of the area indicate that industrial, commercial, and compact residential land use comprise no more than 10 percent of the area within a 3-kilometer (1.9-mile) radius of the site. Therefore, the area was classified as rural for the purposes of air dispersion modeling, indicating the use of rural dispersion coefficients would be appropriate.

Air Dispersion Model

The ISCLT2 model (EPA 1992e) was designed by the EPA to assess the air quality impact of emissions from a wide variety of sources. It incorporates a steady-state gaussian plume equation that is applicable in flat or gently rolling terrain, for multiple-point, area, and volume sources. The ISCLT2 model calculates the annual average concentration due to airborne emissions at user-selected receptor locations, based on sector-averaged statistical wind summaries. Data required for input to the model include source emissions rates, the locations and configurations of sources, statistical summaries of wind speed, wind direction, atmospheric stability, and mixing height, and the locations of the selected receptors.

This model is recommended by the EPA for air pathway analysis of Superfund sites (EPA 1989a). It is also identified as an acceptable air transport model in the RAWPA (DOE 1992).

Model Output Processing

The air dispersion modeling analysis was simplified by running the ISCLT2 model with an assumed emission rate of 1.0 g/s/m^2 for each area source. Options of the ISCLT2 program were used to group sources and write the grouped results to a plot file. The ISCLT2 source group

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results were multiplied by the product of the PM_{10} emission rate and the surface soil concentrations in Appendix D (Attachment D.2.I) to determine the COC-specific annual concentrations presented in Appendix D (Section D.2-V) of this FS. Spreadsheets were used to calculate the COC concentrations from the ISCLT2 model output and emissions data.

C.5.2.2.3 Air Modeling Results

The modeled maximum annual average COC air concentrations are presented in Tables C.5-20 through C.5-28. The tables present a summary of subunit-specific projected air concentrations per alternative. The values presented are the maximum on-property concentrations and maximum off-property (FEMP fenceline) concentrations. Maximum on-property values represent the exposure point concentrations for the on-property farm receptors. Maximum off-property numbers represent the exposure point concentrations for the off-property farm receptors. Based on a comparison of the maximum off-property and average on-property concentrations, the maximum off-property concentrations were also used to represent conservative concentrations for receptors that were assumed to roam or wander over the operable unit (i.e., the expanded trespasser).

TABLE C.5.20

PARTICULATE-PHASE CONTAMINANT CONCENTRATIONS IN AIR (ABOVE BACKGROUND) FOR CONSOLIDATION AND CAPPING WITH FEDERAL OWNERSHIP: SOUTH FIELD AREA (SF/AFP/IFP)

	Maximum On-Property		Maximum Off-Property	
COC	Concentration	Deposition Rate	Concentration	Deposition Rate
Radionuclides (pCi/m^3 or $pCi/m^2/s$)				
Cs-137	0.00	0.00	0.00	0.00
Np-237	2.84×10^{-6}	1.02×10^{-8}	1.75×10^{-7}	6.29×10^{-10}
Pu-238	0.00	0.00	0.00	0.00
Ra-226	3.65×10^{-6}	1.32×10^{-8}	1.90×10^{-7}	6.84×10^{-10}
Ra-228	1.16×10^{-6}	4.16×10^{-9}	6.12×10^{-8}	2.20×10^{-10}
Sr-90	2.29×10^{-5}	8.24×10^{-8}	1.12×10^{-6}	4.02×10^{-9}
Tc-99	5.06×10^{-6}	1.82×10^{-8}	2.34×10^{-7}	8.41×10^{-10}
Th-228	0.00	0.00	0.00	0.00
Th-230	1.67×10^{-5}	6.02×10^{-8}	8.64×10^{-7}	3.11×10^{-9}
Th-232	0.00	0.00	0.00	0.00
U-234	9.12×10^{-5}	3.28×10^{-7}	4.24×10^{-6}	1.53×10^{-8}
U-235/236	1.45×10^{-5}	5.22×10^{-8}	6.69×10^{-7}	2.41×10^{-9}
U-238	9.47×10^{-5}	3.41×10^{-7}	4.55×10^{-6}	1.64×10^{-8}
Inorganics and Organics (ug/m^3 or $ug/m^2/s$)				
Antimony	0.00	0.00	0.00	0.00
Aroclor 1254	2.31×10^{-7}	8.30×10^{-10}	1.06×10^{-8}	3.83×10^{-11}
Aroclor 1260	0.00	0.00	0.00	0.00
Arsenic	6.09×10^{-5}	2.19×10^{-7}	2.84×10^{-6}	1.02×10^{-8}
Benzo(a)anthracene	0.00	0.00	0.00	0.00
Benzo(a)pyrene	0.00	0.00	0.00	0.00
Benzo(b)fluoranthene	0.00	0.00	0.00	0.00
Benzo(k)fluoranthene	0.00	0.00	0.00	0.00
Beryllium	4.59×10^{-6}	1.65×10^{-8}	2.12×10^{-7}	7.62×10^{-10}
Carbazole	0.00	0.00	0.00	0.00
Dibenzo(a,h)anthracene	0.00	0.00	0.00	0.00
Dieldrin	0.00	0.00	0.00	0.00
Indeno(1,2,3-cd)pyrene	0.00	0.00	0.00	0.00
Uranium (total)	1.06×10^{-3}	3.83×10^{-6}	5.15×10^{-5}	1.85×10^{-7}

TABLE C.5-21

PARTICULATE-PHASE CONTAMINANT CONCENTRATIONS IN AIR (ABOVE BACKGROUND) FOR ON-SITE OR OFF-SITE DISPOSAL WITH FEDERAL OWNERSHIP: SOLID WASTE LANDFILL

	Maximum On-Property		Maximum Off-Property	
COC	Concentration	Deposition Rate	Concentration	Deposition Rate
Radionuclides (pCi/m^3 or $pCi/m^2/s$)				
Cs-137	0.00	0.00	0.00	0.00
Np-237	9.36×10^{-7}	3.37×10^{-9}	2.55×10^{-8}	9.19×10^{-11}
Pu-238	4.68×10^{-7}	1.68×10^{-9}	1.28×10^{-8}	4.59×10^{-11}
Ra-226	0.00	0.00	0.00	0.00
Ra-228	0.00	0.00	0.00	0.00
Sr-90	1.71×10^{-6}	6.15×10^{-9}	4.66×10^{-8}	1.68×10^{-10}
Tc-99	0.00	0.00	0.00	0.00
Th-228	0.00	0.00	0.00	0.00
Th-230	2.64×10^{-6}	9.52×10^{-9}	7.21×10^{-8}	2.59×10^{-10}
Th-232	0.00	0.00	0.00	0.00
U-234	6.08×10^{-7}	2.19×10^{-9}	1.66×10^{-8}	5.97×10^{-11}
U-235/236	0.00	0.00	0.00	0.00
U-238	5.57×10^{-6}	2.00×10^{-8}	1.52×10^{-7}	5.47×10^{-10}
Inorganics and Organics (ug/m^3 or $ug/m^2/s$)				
Antimony	5.29×10^{-5}	1.90×10^{-7}	1.44×10^{-6}	5.19×10^{-9}
Aroclor 1254	0.00	0.00	0.00	0.00
Aroclor 1260	0.00	0.00	0.00	0.00
Arsenic	0.00	0.00	0.00	0.00
Benzo(a)anthracene	6.78×10^{-7}	2.44×10^{-9}	1.85×10^{-8}	6.66×10^{-11}
Benzo(a)pyrene	6.78×10^{-7}	2.44×10^{-9}	1.85×10^{-8}	6.66×10^{-11}
Benzo(b)fluoranthene	6.08×10^{-7}	2.19×10^{-9}	1.66×10^{-8}	5.97×10^{-11}
Benzo(k)fluoranthene	0.00	0.00	0.00	0.00
Beryllium	9.36×10^{-7}	3.37×10^{-9}	2.55×10^{-8}	9.19×10^{-11}
Carbazole	4.91×10^{-7}	1.77×10^{-9}	1.34×10^{-8}	4.82×10^{-11}
Dibenzo(a,h)anthracene	2.57×10^{-7}	9.26×10^{-10}	7.02×10^{-9}	2.53×10^{-11}
Dieldrin	0.00	0.00	0.00	0.00
Indeno(1,2,3-cd)pyrene	4.91×10^{-7}	1.77×10^{-9}	1.34×10^{-8}	4.82×10^{-11}
Uranium (total)	1.01×10^{-5}	3.62×10^{-8}	2.74×10^{-7}	9.87×10^{-10}

TABLE C.5-22

PARTICULATE-PHASE CONTAMINANT CONCENTRATIONS IN AIR (ABOVE BACKGROUND) FOR ON-SITE OR OFF-SITE DISPOSAL WITH FEDERAL OWNERSHIP: LIME SLUDGE PONDS

	Maximum On-Property		Maximum Off-Property	
COC	Concentration	Deposition Rate	Concentration	Deposition Rate
Radionuclides (pCi/m^3 or pCi/m^2/s)				
Cs-137	0.00	0.00	0.00	0.00
Np-237	4.33×10^{-7}	1.56×10^{-9}	6.19×10^{-9}	2.23×10^{-10}
Pu-238	0.00	0.00	0.00	0.00
Ra-226	0.00	0.00	0.00	0.00
Ra-228	0.00	0.00	0.00	0.00
Sr-90	1.80×10^{-6}	6.48×10^{-9}	2.57×10^{-8}	9.26×10^{-11}
Tc-99	0.00	0.00	0.00	0.00
Th-228	0.00	0.00	0.00	0.00
Th-230	1.73×10^{-6}	6.24×10^{-9}	2.48×10^{-8}	8.91×10^{-11}
Th-232	0.00	0.00	0.00	0.00
U-234	0.00	0.00	0.00	0.00
U-235/236	0.00	0.00	0.00	0.00
U-238	0.00	0.00	0.00	0.00
Inorganics and Organics (ug/m^3 or ug/m^2/s)				
Antimony	0.00	0.00	0.00	0.00
Aroclor 1254	0.00	0.00	0.00	0.00
Aroclor 1260	0.00	0.00	0.00	0.00
Arsenic	2.23×10^{-5}	8.02×10^{-8}	3.19×10^{-7}	1.15×10^{-9}
Benzo(a)anthracene	0.00	0.00	0.00	0.00
Benzo(a)pyrene	0.00	0.00	0.00	0.00
Benzo(b)fluoranthene	0.00	0.00	0.00	0.00
Benzo(k)fluoranthene	0.00	0.00	0.00	0.00
Beryllium	0.00	0.00	0.00	0.00
Carbazole	0.00	0.00	0.00	0.00
Dibenzo(a,h)anthracene	0.00	0.00	0.00	0.00
Dieldrin	0.00	0.00	0.00	0.00
Indeno(1,2,3-cd)pyrene	0.00	0.00	0.00	0.00
Uranium (total)	3.63×10^{-5}	1.31×10^{-7}	5.19×10^{-7}	1.87×10^{-9}

TABLE C.5.23

PARTICULATE-PHASE CONTAMINANT CONCENTRATIONS IN AIR (ABOVE BACKGROUND) FOR ON-SITE OR OFF-SITE DISPOSAL WITH FEDERAL OWNERSHIP: SOUTH FIELD AREA (SF/AFP/IFP)

	Maximum On-Property		Maximum Off-Property	
COC	Concentration	Deposition Rate	Concentration	Deposition Rate
Radionuclides (pCi/m^3 or $pCi/m^2/s$)				
Cs-137	0.00	0.00	0.00	0.00
Np-237	3.62×10^{-6}	1.30×10^{-8}	2.50×10^{-7}	9.01×10^{-10}
Pu-238	0.00	0.00	0.00	0.00
Ra-226	3.67×10^{-6}	1.32×10^{-8}	1.89×10^{-7}	6.79×10^{-10}
Ra-228	5.93×10^{-6}	2.13×10^{-8}	2.44×10^{-7}	8.80×10^{-10}
Sr-90	2.99×10^{-5}	1.08×10^{-7}	1.62×10^{-6}	5.85×10^{-9}
Tc-99	8.67×10^{-6}	3.12×10^{-8}	4.44×10^{-7}	1.60×10^{-9}
Th-228	2.73×10^{-6}	9.84×10^{-9}	9.82×10^{-8}	3.54×10^{-10}
Th-230	9.28×10^{-5}	3.34×10^{-7}	3.89×10^{-6}	1.40×10^{-8}
Th-232	1.03×10^{-6}	3.72×10^{-9}	3.72×10^{-8}	1.34×10^{-10}
Ur-234	3.10×10^{-5}	1.12×10^{-7}	1.66×10^{-6}	5.97×10^{-9}
Ur-235/236	2.93×10^{-5}	1.06×10^{-7}	1.44×10^{-6}	5.18×10^{-9}
Ur-238	1.97×10^{-5}	7.08×10^{-8}	1.08×10^{-6}	3.89×10^{-9}
Inorganics and Organics (ug/m^3 or $ug/m^2/s$)				
Antimony	0.00	0.00	0.00	0.00
Aroclor 1254	3.26×10^{-6}	1.17×10^{-8}	1.23×10^{-7}	4.45×10^{-10}
Aroclor 1260	2.81×10^{-7}	1.01×10^{-9}	1.01×10^{-8}	3.63×10^{-11}
Arsenic	8.22×10^{-5}	2.96×10^{-7}	4.26×10^{-6}	1.53×10^{-8}
Benzo(a)anthracene	8.13×10^{-6}	2.93×10^{-8}	2.92×10^{-7}	1.05×10^{-9}
Benzo(a)pyrene	1.33×10^{-5}	4.79×10^{-8}	4.78×10^{-7}	1.72×10^{-9}
Benzo(b)fluoranthene	1.18×10^{-5}	4.26×10^{-8}	4.25×10^{-7}	1.53×10^{-9}
Benzo(k)fluoranthene	1.18×10^{-5}	4.26×10^{-8}	4.25×10^{-7}	1.53×10^{-9}
Beryllium	6.31×10^{-6}	2.27×10^{-8}	3.21×10^{-7}	1.15×10^{-9}
Carbazole	0.00	0.00	0.00	0.00
Dibenzo(a,h)anthracene	3.25×10^{-6}	1.17×10^{-8}	1.17×10^{-7}	4.20×10^{-10}
Dieldrin	7.17×10^{-8}	2.58×10^{-10}	2.57×10^{-9}	9.27×10^{-12}
Indeno(1,2,3-cd)pyrene	4.58×10^{-6}	1.65×10^{-8}	1.65×10^{-7}	5.92×10^{-10}
Uranium (total)	7.00×10^{-5}	2.52×10^{-7}	5.73×10^{-6}	2.06×10^{-8}

TABLE C.5-24

PARTICULATE-PHASE CONTAMINANT CONCENTRATIONS IN AIR (ABOVE BACKGROUND) FOR ON-SITE OR OFF-SITE DISPOSAL WITH PRIVATE OWNERSHIP: SOUTH FIELD AREA (SF/AFP/IFP)

	Maximum On-Property		Maximum Off-Property	
COC	Concentration	Deposition Rate	Concentration	Deposition Rate
Radionuclides (pCi/m^3 or pCi/m^2/s)				
Cs-137	0.00	0.00	0.00	0.00
Np-237	1.22×10^{-5}	4.38×10^{-8}	1.13×10^{-6}	4.06×10^{-9}
Pu-238	0.00	0.00	0.00	0.00
Ra-226	0.00	0.00	0.00	0.00
Ra-228	0.00	0.00	0.00	0.00
Sr-90	1.21×10^{-4}	4.35×10^{-7}	5.57×10^{-6}	2.01×10^{-8}
Tc-99	0.00	0.00	0.00	0.00
Th-228	0.00	0.00	0.00	0.00
Th-230	6.59×10^{-5}	2.37×10^{-7}	2.76×10^{-6}	9.92×10^{-9}
Th-232	0.00	0.00	0.00	0.00
U-234	1.30×10^{-5}	4.67×10^{-8}	1.00×10^{-6}	3.61×10^{-9}
U-235/236	0.00	0.00	0.00	0.00
U-238	1.14×10^{-5}	4.11×10^{-8}	8.83×10^{-7}	3.18×10^{-9}
Inorganics and Organics (ug/m^3 or ug/m^2/s)				
Antimony	0.00	0.00	0.00	0.00
Aroclor 1254	0.00	0.00	0.00	0.00
Aroclor 1260	0.00	0.00	0.00	0.00
Arsenic	0.00	0.00	0.00	0.00
Benzo(a)anthracene	0.00	0.00	0.00	0.00
Benzo(a)pyrene	0.00	0.00	0.00	0.00
Benzo(b)fluoranthene	0.00	0.00	0.00	0.00
Benzo(k)fluoranthene	0.00	0.00	0.00	0.00
Beryllium	0.00	0.00	0.00	0.00
Carbazole	0.00	0.00	0.00	0.00
Dibenzo(a,h)anthracene	0.00	0.00	0.00	0.00
Dieldrin	0.00	0.00	0.00	0.00
Indeno(1,2,3-cd)pyrene	0.00	0.00	0.00	0.00
Uranium (total)	2.48×10^{-4}	8.94×10^{-7}	1.52×10^{-5}	5.48×10^{-8}

TABLE C.5-25

PARTICULATE-PHASE CONTAMINANT CONCENTRATIONS IN AIR (ABOVE BACKGROUND) FOR ON-SITE OR OFF-SITE DISPOSAL WITH PRIVATE OWNERSHIP: LIME SLUDGE PONDS

	Maximum On-Property		Maximum Off-Property	
COC	Concentration	Deposition Rate	Concentration	Deposition Rate
Radionuclides (pCi/m^3 or pCi/m^2/s)				
Cs-137	0.00	0.00	0.00	0.00
Np-237	2.23×10^{-7}	8.04×10^{-10}	3.19×10^{-9}	1.15×10^{-11}
Pu-238	0.00	0.00	0.00	0.00
Ra-226	0.00	0.00	0.00	0.00
Ra-228	0.00	0.00	0.00	0.00
Sr-90	2.45×10^{-7}	8.83×10^{-10}	3.50×10^{-9}	1.26×10^{-11}
Tc-99	0.00	0.00	0.00	0.00
Th-228	0.00	0.00	0.00	0.00
Th-230	2.28×10^{-5}	8.20×10^{-8}	3.25×10^{-7}	1.17×10^{-9}
Th-232	0.00	0.00	0.00	0.00
U-234	0.00	0.00	0.00	0.00
U-235/236	0.00	0.00	0.00	0.00
U-238	0.00	0.00	0.00	0.00
Inorganics and Organics (ug/m^3 or ug/m^2/s)				
Antimony	0.00	0.00	0.00	0.00
Aroclor 1254	0.00	0.00	0.00	0.00
Aroclor 1260	0.00	0.00	0.00	0.00
Arsenic	2.93×10^{-4}	1.05×10^{-6}	4.19×10^{-6}	1.51×10^{-8}
Benzo(a)anthracene	0.00	0.00	0.00	0.00
Benzo(a)pyrene	0.00	0.00	0.00	0.00
Benzo(b)fluoranthene	0.00	0.00	0.00	0.00
Benzo(k)fluoranthene	0.00	0.00	0.00	0.00
Beryllium	0.00	0.00	0.00	0.00
Carbazole	0.00	0.00	0.00	0.00
Dibenzo(a,h)anthracene	0.00	0.00	0.00	0.00
Dieldrin	0.00	0.00	0.00	0.00
Indeno(1,2,3-cd)pyrene	0.00	0.00	0.00	0.00
Uranium (total)	0.00	0.00	0.00	0.00

TABLE C.5-26

PARTICULATE-PHASE CONTAMINANT CONCENTRATIONS IN AIR (ABOVE BACKGROUND) FOR ON-SITE OR OFF-SITE DISPOSAL WITH PRIVATE OWNERSHIP: SOLID WASTE LANDFILL

	Maximum On-Property		Maximum Off-Property	
COC	Concentration	Deposition Rate	Concentration	Deposition Rate
Radionuclides (pCi/m^3 or pCi/m^2/s)				
Cs-137	0.00	0.00	0.00	0.00
Np-237	1.32×10^{-6}	4.76×10^{-9}	3.60×10^{-8}	1.30×10^{-10}
Pu-238	6.15×10^{-6}	2.21×10^{-8}	1.68×10^{-7}	6.03×10^{-10}
Ra-226	0.00	0.00	0.00	0.00
Ra-228	0.00	0.00	0.00	0.00
Sr-90	4.92×10^{-7}	1.77×10^{-9}	1.34×10^{-8}	4.83×10^{-11}
Tc-99	0.00	0.00	0.00	0.00
Th-228	0.00	0.00	0.00	0.00
Th-230	2.37×10^{-5}	8.52×10^{-8}	6.45×10^{-7}	2.32×10^{-9}
Th-232	0.00	0.00	0.00	0.00
U-234	2.46×10^{-6}	8.85×10^{-9}	6.71×10^{-8}	2.41×10^{-10}
U-235/236	0.00	0.00	0.00	0.00
U-238	0.00	0.00	0.00	0.00
Inorganics and Organics (ug/m^3 or ug/m^2/s)				
Antimony	4.09×10^{-5}	1.47×10^{-7}	1.11×10^{-6}	4.01×10^{-9}
Aroclor 1254	0.00	0.00	0.00	0.00
Aroclor 1260	0.00	0.00	0.00	0.00
Arsenic	0.00	0.00	0.00	0.00
Benzo(a)anthracene	7.07×10^{-7}	2.55×10^{-9}	1.93×10^{-8}	6.94×10^{-11}
Benzo(a)pyrene	4.61×10^{-8}	1.66×10^{-10}	1.26×10^{-9}	4.53×10^{-12}
Benzo(b)fluoranthene	4.30×10^{-7}	1.55×10^{-9}	1.17×10^{-8}	4.22×10^{-11}
Benzo(k)fluoranthene	0.00	0.00	0.00	0.00
Beryllium	0.00	0.00	0.00	0.00
Carbazole	1.98×10^{-7}	7.12×10^{-10}	5.39×10^{-9}	1.94×10^{-11}
Dibenzo(a,h)anthracene	1.41×10^{-8}	5.09×10^{-11}	3.86×10^{-10}	1.39×10^{-12}
Dieldrin	0.00	0.00	0.00	0.00
Indeno(1,2,3-cd)pyrene	2.24×10^{-7}	8.08×10^{-10}	6.12×10^{-9}	2.20×10^{-11}
Uranium (total)	0.00	0.00	0.00	0.00

TABLE C.5-27

RADON-222 CONCENTRATION IN AIR FOR
ON-SITE OR OFF-SITE DISPOSAL

Subunit or Source	Maximum On-Property Concentration (pCi/m³)	Maximum Off-Property Concentration (pCi/m³)
Private Ownership, On-Property Farmer		
Disposal Cell (On-Site Disposal Alternative Only)	2.90×10^{-6}	1.05×10^{-6}
Federal Ownership, Expanded Trespasser		
Disposal Cell (On-Site Disposal Alternative Only)	5.62×10^{-6}	2.03×10^{-6}
South Field Area (SF/AFP/IFP)	1.68×10^{0}	8.70×10^{-2}

TABLE C.5-28

RADON-222 CONCENTRATION IN AIR FOR
CONSOLIDATION AND CAPPING

Subunit or Source	Maximum On-Property Concentration (pCi/m³)	Maximum Off-Property Concentration (pCi/m³)
Federal Ownership, Expanded Trespasser		
South Field Area (SF/AFP/IFP/Consolidation Area)	1.55×10^{0}	8.00×10^{-2}
Solid Waste Landfill	4.07×10^{-7}	1.12×10^{-8}
Lime Sludge Ponds	2.37×10^{-7}	3.42×10^{-9}

C.5.2.3 Farm Product Fate Modeling

This section describes the equations used to estimate residual exposure to chemicals and radionuclides from ingestion of contaminated farm products.

C.5.2.3.1 Ingestion of Vegetables

The equations used to estimate exposure to chemicals and radionuclides via ingestion of vegetables irrigated with contaminated water are from the NRC (NRC 1977) and the EPA (EPA 1989b). This process involves estimating the concentration of the COC on and in the plant as a result of foliar deposition and root uptake. The model used to estimate the concentration in and on vegetation irrigated with contaminated water is (NRC 1977):

$$C_{ivw} = d_w \left[\frac{r_w (1 - e^{-\lambda_{Ei} t_o})}{Y \lambda_{Ei}} + \frac{f_w B_{iv} (1 - e^{-\lambda_{di} t_{bw}})}{\rho \lambda_{di}} \right] e^{-\lambda_{ri} t_h} \qquad \text{(C.5-10)}$$

For vegetation exposed to atmospheric fallout of dust, the equation becomes (NRC 1977):

$$C_{ivd} = d_d \left[\frac{r_d (1 - e^{-\lambda_{Ei} t_o})}{Y \lambda_{Ei}} + \frac{f_d B_{iv} (1 - e^{-\lambda_{di} t_{bd}})}{\rho \lambda_{di}} \right] e^{-\lambda_{ri} t_h} \qquad \text{(C.5-11)}$$

where

λ_{Ei}	=	effective depletion constant of ith COC on the plant surface (hr^{-1}),
λ_{di}	=	effective depletion constant from root zone of soil (hr^{-1}),
λ_{ri}	=	radioactive or chemical decay constant of ith COC (hr^{-1}), from Howard 1991,
B_{iv}	=	dry soil to wet plant (vegetables, forage, and fruit) transfer coefficient of ith COC,
C_{ivd}	=	concentration of ith COC in plants as a result of deposition of contaminated dust on plants (pCi/kg or mg/kg),
C_{ivw}	=	concentration of ith COC in plants as a result of irrigating plants with contaminated water (pCi/kg or mg/kg),
d_d	=	dust deposition rate (pCi/m^2/hr or mg/m^2/hr),
d_w	=	irrigation deposition rate (pCi/m^2/hr or mg/m^2/hr),
f_w	=	fraction of year plant is irrigated (unitless),
f_d	=	fraction of year plant is downwind (unitless),
ρ	=	effective dry surface density of the soil (kg/m^2),
r_d	=	fraction of deposited dust retained on plant surface (unitless),
r_w	=	fraction of water borne material retained on plant surface (unitless),
t_{bd}	=	period soil is exposed to airborne emissions (hr),
t_{bw}	=	period soil is exposed to contaminated water (hr),

t_e = growing season (hr),
t_h = duration of period between harvest and consumption (hr), and
Y = agricultural yield (kg/m^2),

where

$$\lambda_{di} = \lambda_{ri} + \lambda_{Li} \quad \text{(C.5-12)}$$

$$\lambda_{Li} = \frac{V_w}{Z\theta\left[1 + \sigma\frac{K_d}{\theta}\right]} \quad \text{(C.5-13)}$$

where

$$d_w = (C_{iw})(I) \quad \text{(C.5-14)}$$
$$d_d = (C_{id})(V_d) \quad \text{(C.5-15)}$$

where

C_{iw} = concentration of ith COC in irrigation water (pCi/l or mg/l),
I = irrigation rate (l/m^2/hr),
C_{id} = concentration of ith COC in dust (pCi/g or mg/g),
K_d = water to soil partitioning coefficient of COC (cm^3/g),
λ_{Li} = leachate removal constant (hr^{-1})
θ = moisture fraction of soil in root zone (unitless),
σ = density of soil in root zone (g/cm^3),
v_d = deposition velocity for dust (g/m^2/hr),
V_w = percolation rate (cm/hr), and
Z = depth of root zone (cm).

In addition to exposure to contaminated dust and irrigation water, vegetables and livestock feed may be contaminated by root uptake from contaminated soil. The contribution by this pathway was estimated by the irrigation model; however, this pathway was also considered for areas that are not irrigated with contaminated water but that exhibit surface soil contamination from historical deposition on the soil by other means. The following equation was used to estimate the COC concentration in the plant from root uptake of COCs in the soil:

$$C_{ivs} = (C_s)(B_{iv})(e^{-\lambda_{di} t_h}) \quad \text{(C.5-16)}$$

where

C_{ivs} = concentration of ith COC in plants as a result of root uptake from contaminated soil (pCi/kg or mg/kg), and
C_s = concentration of ith COC in dry soil at harvest time (pCi/kg or mg/kg).

The total concentration of COCs in vegetables (C_{iv}) was estimated using the following equation:

$$C_{iv} = C_{ivw} + C_{ivd} + C_{ivs} \qquad \text{(C.5-17)}$$

Equations of the same form were used to estimate the COC concentration in livestock feed, substituting concentration factors for livestock feed in place of those for vegetables ingested by humans.

A summary of parameters used in the vegetable and forage uptake models is presented in Table C.5-29. Radioactive or chemical decay constants are presented in Table C.5-30. Transfer coefficients of COCs from dry soil to wet plant material are presented in Table C.5-31. Source concentrations for farm product fate modeling are presented in Tables C.5-20 through C.5-26 (Section C.5.2.2.3).

C.5.2.3.2 Ingestion of Meat and Dairy Products

Prior to the determination of intake following ingestion of animal products by humans, the concentration of chemicals and radionuclides in animal products must be estimated. The concentration of a COC in animal products, such as beef or milk, was estimated using the following equation (NRC 1977):

$$C_{iA} = F_{iA}[(C_{if})(Q_f) + (C_{iAw})(Q_{Aw})]\, e^{(-\lambda_{ri} t_{iA})} \qquad \text{(C.5-18)}$$

where

- C_{iA} = concentration of ith COC in the animal product (pCi/l or mg/l for milk, pCi/kg or mg/kg for beef,
- F_{iA} = element (stable) transfer coefficient that relates the daily intake by an animal to the concentration of ith COC in an edible portion of the animal product (day/l for milk, day/kg for beef),
- C_{if} = concentration of ith COC in forage (pCi/kg or mg/kg),
- Q_f = consumption rate of contaminated forage by an animal (kg/day),
- C_{iAw} = concentration of ith COC in livestock water (pCi/l or mg/l),
- Q_{Aw} = consumption rate of contaminated water by an animal (l/day),
- λ_{ri} = decay constant of ith COC (hr^{-1}), and
- t_{iA} = delay between harvest of animal product (milk or meat) and consumption (hr).

Transfer coefficients of COCs to milk or beef (F_{iA}) are presented in Table C.5-31.

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TABLE C.5-29

SUMMARY OF PARAMETERS FOR VEGETABLE/FORAGE UPTAKE MODELS

Parameter[a]	Value	Units	Reference
Irrigation Rate (I)	0.081	$l/m^2/hr$	USDA 1970
Typical Settling Velocity (V_d)	6.48	m/hr	EPA 1991
Percolation Rate (Vw)	0.00177	cm/hr	DOE 1994a
Depth to Root Zone (Z)	15	cm	DOE 1994a
Density of Soil (σ)	1.5	g/cm^3	DOE 1994a
Moisture Fraction in Root Zone (θ)	0.17	unitless	DOE 1994a
Fraction of Deposited Dust Retained on Crops (r_d)	0.25	unitless	NRC 1977
Fraction of Water Borne Material Retained on Crops (r_w)	0.20	unitless	NRC 1977
Effective Depletion Constant of Contaminant on Plant Surface (λ_{Ei})	0.0021	hr^{-1}	NRC 1977
Growing Season for Vegetables and Fruit Crops (t_{ec})	1440	hr	NRC 1977
Growing Season for Forage (t_{eg})	720	hr	NRC 1977
Agricultural Yield of Vegetables and Fruit Crop (Y)	1.5	kg/m^2	USDA 1979
Agricultural Yield of Forage (Y)	0.8	kg/m^2	USDA 1979
Fraction of Year Plants are Downwind (f_d)	LD[b]	unitless	—
Fraction of Year Plans are Irrigated (f_w)	1.0[c]	unitless	NRC 1977
Period Soil is Exposed to Contaminated Water (t_{bw})	8,760,000	hr	Assumed
Period Soil is Exposed to Airborne Emissions (t_{bd})	8,760,000	hr	Assumed
Effective Dry Surface Density of the Soil (ρ)	150[d]	kg/m^2	USDA 1982
Delay between Harvest and Consumption of Vegetables (t_{hv})	24	hr	NRC 1977
Delay between Harvest and Consumption of Vegetables and Fruit (t_{hc})	720	hr	Assumed
Delay between Harvest and Consumption of Forage (t_{hg})	0	hr	NRC 1977
Delay between Milking and Consumption (t_{iA})	48	hr	NRC 1977
Delay between Slaughter and Consumption(t_s)	48	hr	NRC 1977

[a] See the uncertainty analysis (Section C.8.0) for more information on these parameters.
[b] Location dependent.
[c] The fraction of time plants are irrigated is implicitly included in the irrigation rate. To avoid using this parameter twice in Equation 7-9 (RAWPA), f_d has been set to 1.0.
[d] Corresponds to a density of 1.5 g/cm^3 and a depth of 10 cm. Moist bulk densities of surface soil range from 1.4 to 1.55 g/cm^3 at the FEMP (USDA 1982).

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TABLE C.5-30
CHEMICAL AND RADIOACTIVE COC DECAY CONSTANTS

COC	K_d (cm^3/g)	Λ_{Li} (hr^{-1})	Λ_{vi} (hr^{-1})	Λ_{di} (hr^{-1})
Chemical				
Antimony	4.50×10^{1}	1.26×10^{-6}	1×10^{-14}	1.26×10^{-6}
Aroclor-1254	8.86×10^{3}	6.42×10^{-9}	0	6.42×10^{-9}
Aroclor-1260	1.07×10^{4}	5.32×10^{-9}	0	5.32×10^{-9}
Arsenic	2.0×10^{2}	2.84×10^{-7}	1×10^{-14}	2.84×10^{-7}
Beryllium	2.5×10^{2}	2.27×10^{-7}	1×10^{-14}	2.27×10^{-7}
Carbazole	ND	5.02×10^{-4}	1×10^{-14}	5.02×10^{-4}
Dieldrin	ND	5.28×10^{-4}	2.64×10^{-5}	5.02×10^{-4}
Uranium (total)	ND	5.02×10^{-4}	1×10^{-14}	5.02×10^{-4}
Radionuclides				
Cs-137	1.37×10^{3}	2.66×10^{-6}	2.62×10^{-6}	4.15×10^{-8}
Np-237	5.0×10^{0}	1.11×10^{-5}	3.70×10^{-11}	1.11×10^{-5}
Pu-238	1.0×10^{2}	1.47×10^{-6}	9.02×10^{-7}	5.68×10^{-7}
Ra-226	1.06×10^{2}	5.86×10^{-7}	4.95×10^{-8}	5.36×10^{-7}
Ra-228	1.06×10^{2}	1.43×10^{-5}	1.37×10^{-5}	5.36×10^{-7}
Rn-222		8.06×10^{-3}	7.55×10^{-3}	5.02×10^{-4}
Sr-90	2.50×10^{0}	2.45×10^{-5}	2.77×10^{-6}	2.18×10^{-5}
Tc-99	7.0×10^{-2}	3.10×10^{-4}	3.71×10^{-10}	3.10×10^{-4}
Th-228	3.2×10^{3}	4.44×10^{-5}	4.14×10^{-5}	1.78×10^{-8}
Th-230	3.2×10^{3}	1.88×10^{-8}	1.03×10^{-9}	1.78×10^{-8}
Th-232	3.2×10^{3}	1.78×10^{-8}	5.63×10^{-5}	1.78×10^{-8}
U-234	1.48×10^{0}	3.57×10^{-5}	3.25×10^{-10}	3.57×10^{-5}
U-235	1.48×10^{0}	3.57×10^{-5}	1.12×10^{-13}	3.57×10^{-5}
U-238	1.48×10^{0}	3.57×10^{-5}	1.77×10^{-14}	3.57×10^{-5}

ND = No data
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TABLE C.5-31

K_d AND TRANSFER COEFFICIENTS

COC	K_d(cm^3/g)	Beef $_{FIA}$	Milk $_{FIA}$	Vegetable B $_{iv(2)}$	Forage B $_{iv(1)}$
Chemical					
Antimony	4.50×10^{1}	1×10^{-3}	1.0×10^{-4}	1.28×10^{-2}	3.0×10^{-2}
Aroclor-1254	8.86×10^{3}	2.69×10^{-2}	8.5×10^{-3}	3.04×10^{-3}	7.1×10^{-3}
Aroclor-1260	1.07×10^{4}	3.52×10^{-1}	1.11×10^{-1}	4.71×10^{-3}	1.1×10^{-2}
Arsenic	2.0×10^{2}	2.0×10^{-3}	6.0×10^{-5}	1.71×10^{-2}	4.0×10^{-2}
Beryllium	2.5×10^{2}	1.0×10^{-3}	9.0×10^{-7}	4.28×10^{-3}	1.0×10^{-1}
Carbazole	ND	8.14×10^{-5}	2.57×10^{-5}	1.55×10^{-1}	3.62×10^{-1}
Dieldrin	ND	9.12×10^{-4}	2.88×10^{-4}	3.83×10^{-2}	8.96×10^{-2}
Uranium (total)	ND	2.0×10^{-4}	6.0×10^{-4}	3.64×10^{-3}	8.50×10^{-3}
Radionuclides					
Cs-137	1.37×10^{3}	2.0×10^{-2}	7.0×10^{-3}	3.42×10^{-2}	8.0×10^{-2}
Np-237	5.0×10^{0}	5.0×10^{-5}	5.0×10^{-6}	4.28×10^{-3}	1.0×10^{-2}
Pu-238	1.0×10^{2}	5.0×10^{-7}	1.0×10^{-7}	1.93×10^{-4}	4.50×10^{-4}
Ra-226	1.06×10^{2}	2.50×10^{-4}	4.50×10^{-4}	6.42×10^{-3}	1.50×10^{-2}
Ra-228	1.06×10^{2}	2.50×10^{-4}	4.50×10^{-4}	6.42×10^{-3}	1.50×10^{-2}
Rn-222					
Sr-90	2.50×10^{0}	3.0×10^{-4}	1.50×10^{-3}	1.07×10^{0}	2.50×10^{0}
Tc-99	7.0×10^{-2}	8.50×10^{-3}	1.0×10^{-2}	4.07×10^{0}	9.50×10^{0}
Th-228	3.2×10^{3}	6.0×10^{-6}	5.0×10^{-6}	3.64×10^{-4}	8.50×10^{-4}
Th-230	3.2×10^{3}	6.0×10^{-6}	5.0×10^{-6}	3.64×10^{-4}	8.50×10^{-4}
Th-232	3.2×10^{3}	6.0×10^{-6}	5.0×10^{-6}	3.64×10^{-4}	8.50×10^{-4}
U-234	1.48×10^{0}	2.0×10^{-4}	6.0×10^{-4}	3.64×10^{-3}	8.50×10^{-3}
U-235	1.48×10^{0}	2.0×10^{-4}	6.0×10^{-4}	3.64×10^{-3}	8.50×10^{-3}
U-236	1.48×10^{0}	2.0×10^{-4}	6.0×10^{-4}	3.64×10^{-3}	8.50×10^{-3}
U-238	1.48×10^{0}	2.0×10^{-4}	6.0×10^{-4}	3.64×10^{-3}	8.50×10^{-3}

In addition to receiving intake from irrigated forage and water, cows may receive a significant intake from soil ingestion if the soil is also a source of contamination (Zach and Mayoh 1984). The following equation was used to estimate the concentration in the animal product from soil ingestion (EPA 1989b):

$$C_{iA} = F_{iA}[(C_s)(Q_s)]e^{(-\lambda_{ai}t_w)} \qquad \text{(C.5-19)}$$

where

C_s = concentration of COC in soil (pCi/kg or mg/kg), and
Q_s = consumption rate of soil by livestock (kg/day).

Animal Consumption Rates

The following parameters were used to quantify the intake of COCs in food and water by beef and milk cattle at or near the FEMP:

Animal	Q_f Feed or Forage[a] (kg wet weight/day)	Q_{Aw} Water[a] (l/day)	Q_s Soil[b] (kg/day)
Milk cow	50	60	0.5
Beef cattle	50	50	0.5

[a]NRC 1977
[b]Zach and Mayoh (1984)

Radionuclide and Nonradioactive Transfer Coefficients

Transfer coefficients for radioelements and nonradioactive metals were taken from Baes et al. (1984), Till and Meyer (1983) and EPA (1989d). The radiological properties of atoms do not effect their elemental transfer in the environment. The soil-to-plant transfer coefficient for edible plants ingested by humans and forage ingested by cattle used for intake models, in the absence of site-specific information, are listed in Table C.5-31. These factors are the ratios of the dry-weight concentration of an element in the reproductive or vegetative portions of the plant to the dry-weight concentration of the element in soil. Edible portions of the plant include grain kernels, fruits, and tubers. These portions are most representative of the plant foods ingested by humans. The list of elements is not all inclusive. The cited references were used to obtain values for additional COCs in individual risk assessments as needed.

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Transfer coefficients for organic chemicals were taken from Travis and Arms (1988). If a transfer coefficient was not readily available, the following regression equations based on the relationship between transfer and the octanol-water partition coefficient (K_{ow}) were used to estimate transfer coefficients (Travis and Arms 1988):

$B_{iv(2)}$ (vegetables)	$\log B_{iv} = 1.588 - 0.578 \log K_{ow}$	(C.5-20)
F_{iA} (milk)	$\log F_{iA} = -8.10 + \log K_{ow}$	(C.5-21)
F_{iA} (beef)	$\log F_{iA} = -7.6 + \log K_{ow}$	(C.5-22)

Chemical-specific K_{ow} values are available from several sources. The major source used for K_{ow} values was Hansch and Leo (1979).

Concentrations in the aboveground vegetative part of plants were estimated using the following equation (Baes et al. 1984):

$$C_{iv} = (C_s)(B_{iv(1)}) \qquad \text{(C.5-23)}$$

where

C_{iv} = concentration of the ith COC in vegetation (mg/kg dry wt),
C_s = maximum concentration in soil (mg/kg dry wt), and
$B_{iv(1)}$ = soil-to-plant transfer factor of the ith COC (mg/kg dry wt plant per mg/kg dry wt soil).

C.5.2.3.3 Results of Farm Product Fate Modeling

The resulting COC concentrations in farm products, as modeled by alternative and by subunit, are presented in the risk calculation worksheets in Attachment C.III. These values have been incorporated into the intake equations presented in Section C.3.2. The risk results are presented in Section C.7.0.

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C.6

C.6.0 REMEDIAL ACTION RISK ASSESSMENT

Each remedial alternative involves a set of work activities. These activities incur varying degrees of physical hazards and human-health risks. This section presents the results of the risk estimates calculated for remedial action activities.

C.6.1 REMEDIAL ACTION RISK CHARACTERIZATION METHODOLOGY

The methods established in the RAWPA (DOE 1992) were employed to estimate potential physical hazards and human-health impacts from carcinogens and noncarcinogens to remediation workers, on-property nonremediation workers, off-property workers and individuals, and the public along the transportation route (for off-site disposal). The remedial action risk assessment evaluated receptor exposures via pathways from media impacted by remedial activities. Construction risks and transportation risks were evaluated for each remedial alternative.

Construction risks are the risks associated with the industrial hazards posed by construction operations during the implementation of remedial activities, except those related the transportation of waste material off-site (i.e., by rail). Construction risks include risks related to excavation, waste processing, and waste packaging. The following equation was used to calculate risks due to construction:

$$\text{Risk} = (\text{PH})(\text{RC}) \qquad \text{(C.6-1)}$$

where

Risk	=	risk of injury or fatality expressed as a probability,
PH	=	person-hours of construction work, (see Attachment II, Table C.II-21) and
RC	=	injury or fatality risk coefficient (risk/person/hr).

Risk factors (RCs) used are from the RAWPA:

- Injuries per man-hour = 3.4×10^{-5}
- Fatalities per man-hour = 5.0×10^{-7}

Construction risks from on-site trucking accidents were calculated separately, using the formula and risk factors presented in the RAWPA:

$$\text{Risk} = (\text{TM})(\text{AC}) \qquad \text{(C.6-2)}$$

where

Risk	=	risk of injury or fatality expressed as a probability,
TM	=	truck miles for construction work, (See Attachment II, Table C.II-22) and
AC	=	injury or fatality risk coefficient (risk/mile).

Risk (ACs) factors are:

- Injuries per mile = 2.1×10^{-9}
- Fatalities per 4.1×10^{-8}

Transportation risks were evaluated separately for the rail transportation activities. These risks include exposure of the train crew to direct radiation, exposure of the public living along or using the transportation route to direct radiation, exposure of the public to material released from a transportation accident, and exposure of train crews and the public to nonradiological hazards from accidents. The RADTRAN model (Section C.5.1.3), which was used to quantify transportation risks, takes into account emergency response activities. The following equation was used to calculate risks due to transportation of waste to an off-site disposal facility:

$$\text{Risk} = (N)(CF)(RC) \qquad \text{(C.6-3)}$$

where

Risk	=	risk of injury or fatality expressed as a unitless probability,
N	=	number of roundtrips made,
CF	=	mileage per round trip, and
RC	=	injury or fatality risk coefficient (risk/mile).

See Attachment C.II, Tables C.II-23 and 24 for N and CF values. Risk factors (RCs) are:

- Public injuries per mile = 6.8×10^{-6}
- Public fatalities per mile = 1.8×10^{-6}
- Rail Worker injuries per mile = 4.6×10^{-6}
- Rail Worker fatalities per mile = 4.6×10^{-8}

The sections below present the remedial action risks quantified for construction and transportation activities for each alternative.

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C.6.2 REMEDIAL ACTION RISKS

Remedial action risks were evaluated for impacts to potential human receptors from implementation of each remedial alternative. This section presents the remedial action risks quantified for the four remedial alternatives. For each alternative, construction risks are presented first, then transportation risks. Tables summarizing risk and hazards to potential receptors are provided by alternative. Complete calculation sheets of the risk values are presented in Attachment C.II. Note that Alternative 1, No Action, has no short-term impacts and was not evaluated in this section.

Evaluations for on-site activities are discussed in order of airborne pathways, dermal pathways, direct radiation, and industrial hazards for each alternative. Transportation risks were evaluated for incident-free transportation (i.e., no accidents) and for accidents during rail transport. The risks from activities conducted in the South Field and Inactive Flyash Pile have been combined because the analytical information on COC concentrations was combined in the RI.

Estimates of excavation duration were developed from engineering estimates for each phase of the remediation activities. The time spent at actual physical remediation was the longest time period for any direct exposure to contaminated materials by airborne pathways, dermal pathways or direct radiation exposure. This activity was evaluated in most cases, as the bounding remediation activity for each alternative. Workers may be involved in more than one remediation activity, but because this activity will be occurring over a long period of time, workers may be limited to only this activity. Risks at the majority of other activities will be considerably less because of factors such as shielding, limited volumes, limited activity duration, etc. In those cases where a possibility existed for significant risks, the other activities were also evaluated.

Based on assessment of South Field data, it would require 3 to 4 times less volumes and hours required to remediate under federal ownership land use, than under private ownership. Therefore, only the Private Ownership land use has been evaluated for risks from COCs. It can be expected that risks under the Federal Ownership land use will be only a fraction of the Private Ownership land use risks.

C.6.2.1 Alternative 2: Consolidation and Capping

For Alternative 2, risks are calculated for on-site activities. No transportation activities are envisioned.

On-Site Activities

Airborne Pathways. Inhalation pathways were evaluated for excavation activities for each subunit. Calculations are detailed in Tables C.II-1 through C.II-4, in Attachment C.II. Results are summarized in Table C.6-1.

TABLE C.6-1
ALTERNATIVE 2 INHALATION RISK RESULTS FROM EXCAVATION ACTIVITIES

Subunit	Risk Source	Risk
Solid Waste Landfill	Chemical COCs	2.1×10^{-7}
	Radionuclides	1.0×10^{-5}
Lime Sludge Pond	Chemical COCs	7.6×10^{-8}
	Radionuclides	9.1×10^{-7}
South Field/Inactive Flyash Pile	Chemical COCs	1.6×10^{-6}
	Radionuclides	7.6×10^{-6}
Active Flyash Pile	Chemical COCs	1.7×10^{-6}
	Radionuclides	4.0×10^{-6}

These risks were calculated using the dust loading factor (600 $\mu g/m^3$) and the soil concentrations for the various COCs. The worker was assumed to inhale the entire available concentration of dust (i.e., given by soil concentration x dust loading) regardless of particle size. The dispersion of particulate matter from excavation activities was based on EPA guidance for Superfund sites (EPA 1993f, Figure C). It was assumed that the active excavation area was approximately 0.5 acres and that the side of the excavation area was approximately 50 m. The distance to the nonremediation worker was assumed to be 300 m(1000 ft.) and the distance to the nearest fenceline was measured from the approximate center of each subunit, The remedial worker was assumed to be immersed in air laden with a dust concentration of 6.0×10^{-4} g/m^3 (DOE,1992). The ratio of the dispersion factor for 300 m to the factor for the 50m was multiplied by the remedial worker dust concentration to obtain the nonremediation worker dust concentration. The ratio of the dispersion factor for each fenceline

distance to the factor for 50 m was multiplied by the remedial worker dust concentration to obtain offsite dust concentration. The dust concentrations are presented in the Table C.6-1A.

TABLE C.6-1A
GENERAL PUBLIC AND NONREMEDIATION WORKER EXPOSURE DUST CONCENTRATION CALCULATIONS

Subunit	Distance to Fence		Dispersion Factors		Ratio of dispersion factors	Dust Concentrations
	feet	meter	50 meter	Fenceline		g/m^3
			Public			
South Field/ Inactive Flyash Pile	1100	335	19,000	2100	9.05	6.6×10^{-5}
Active Flyash Pile	1300	396	19,000	1900	10.00	6.0×10^{-5}
Solid Waste Landfill	1700	518	19,000	1400	13.58	4.4×10^{-5}
Lime Sludge Ponds	2300	701	19,000	850	22.35	2.7×10^{-5}
			Nonremediation Worker			
All	1000	305	19,000	2500	7.6	7.89×10^{-5}

A summary of the inhalation risks for the receptors is included in Table C.6-2.

TABLE C.6-2
SUMMARY OF INHALATION RISKS FROM EXCAVATION, ALTERNATIVE 2

Subunit	Receptor[a]	Total Risk
Solid Waste Landfill	Remediation Workers	1.0×10^{-5}
	Nonremediation Worker	1.3×10^{-6}
	Public	7.4×10^{-7}
Lime Sludge Pond	Remediation Workers	9.9×10^{-7}
	Nonremediation Worker	1.3×10^{-7}
	Public	4.4×10^{-8}
South Field/ Inactive Flyash Pile	Remediation Workers	9.2×10^{-6}
	Nonremediation Workers	1.2×10^{-6}
	Public	1.0×10^{-6}
Active Flyash Pile	Remediation Workers	5.7×10^{-6}
	Nonremediation Worker	7.5×10^{-7}
	Public	5.7×10^{-7}

[a]For public receptor, see Tables C.II-1, 2, 3, and 4, (Attachment C.II), Footnote 1.

The chemical COCs responsible for the majority of the risk from inhalation are based solely on the relative soil concentration of each COC; no single COC determines the risk. For radionuclides, the risks are driven by the thorium and uranium concentrations, which are in the highest concentrations. Risks from radon emissions during excavation were calculated separately for a remediation worker, using calculations more appropriate to radon, in Table C.II-13 (Attachment C.II) and the results indicate risks in the 9.1×10^{-8} (for the Lime Sludge Pond) to 2.3×10^{-6} (for the Active Flyash Pile). The radon exposures to the nonremediation workers and the public would be reduced in the same fashion as the particulate inhalation.

Dermal exposure routes include contact with contaminated soils and airborne dust. Risks are both carcinogenic and noncarcinogenic. These risks are presented in Table C.II-14 (Attachment C.II) and are summarized in Table C.6-3. Risks from dermal exposure to PAHs were not calculated. The EPA currently recommends using the oral exposure assessment to determine dermal exposure risk since it is currently inappropriate to extrapolate dermal slope factors from the oral slope factors for PAHs. There is no oral exposure route associated with the short-term risks from the remediation

activities. This does not imply that there is no risk from dermal exposure to PAHs for this activity. Since all risks are very low, it may be expected that the risk from PAHs would also be minimal.

TABLE C.6-3
REMEDIATION WORKER RISKS FROM DERMAL EXPOSURES FOR ALTERNATIVE 2

Subunit	Cancer Risk	HI
Solid Waste Landfill	6.0×10^{-8}	2.3×10^{-3}
Lime Sludge Pond	2.9×10^{-8}	1.3×10^{-3}
South Field/ Inactive Flyash Pile	2.1×10^{-7}	3.4×10^{-3}
Active Flyash Pile	1.0×10^{-7}	2.9×10^{-4}

Direct Radiation: Direct radiation risks were calculated for excavation activities for each subunit. Calculations are shown in Table C.II-28 (Attachment II) and summarized in Table C.6-4. Risks to public were calculated by apportioning the risk at 1 m (i.e., the remediation worker) to that at 305m (1000 ft) using the inverse square law applicable to direct penetrating radiation. The risks presented have been calculated using the methodology and values presented in HEAST, as opposed to MICROSHIELD. Risks calculated using MICROSHIELD were in the same order of magnitude as those presented.

TABLE C.6-4
DIRECT RADIATION RISKS FOR ALTERNATIVE 2

Subunit	Receptors	Cancer Risk
Solid Waste Landfill	Remediation Worker	5.9×10^{-6}
	Public	2.7×10^{-10}
Lime Sludge Pond	Remediation Worker	2.7×10^{-6}
	Public	1.2×10^{-10}
South Field/ Inactive Flyash Pile	Remediation Worker	1.8×10^{-5}
	Public	5.3×10^{-10}
Active Flyash Pile	Remediation Worker	2.3×10^{-5}
	Public	1.1×10^{-9}

Immersion doses from exposure to direct radiation of radionuclides suspended in a cloud were calculated by subunit using MICROSHIELD. The results are shown in Table C.II-18 (Attachment C.II) and are summarized in Table C.6-5. Dose rates shown for the public and nonremediation workers are the same as those calculated for a remediation worker during excavation activities and would be expected to be lower in reality, but were not specifically performed for the public or nonremediation workers because of the very low dose levels.

TABLE C.6-5
RISKS FROM IMMERSION IN A CONTAMINATED CLOUD, ALTERNATIVE 2

Subunit	Receptors	Dose (mrem)	Fatal Cancer Risk
Solid Waste Landfill	Remediation Worker	2.9×10^{-6}	1.8×10^{-12}
	Nonremediation Worker/Public	7.8×10^{-7}	4.8×10^{-12}
Lime Sludge Pond	Remediation Worker	1.2×10^{-6}	7.4×10^{-13}
	Nonremediation Worker/Public	3.5×10^{-7}	2.2×10^{-13}
South Field/ Inactive Flyash Pile	Remediation Worker	4.8×10^{-6}	3.0×10^{-12}
	Nonremediation Worker/Public	1.8×10^{-6}	1.1×10^{-12}
Active Flyash Pile	Remediation Worker	8.8×10^{-6}	5.5×10^{-12}
	Nonremediation Worker/Public	3.0×10^{-6}	1.9×10^{-12}

Industrial and Mechanical Hazards. Injury and fatality rates for standard industrial hazards associated with construction activities were used to estimate these risks for remediation activities. Table C.II-21 and C.II-22 (Attachment C.II) show the calculations for on-the-job construction accidents, and for those associated with on-site trucking activities in support of remediation. Calculations were made for volumes estimated from the PRLs for both land-use scenarios federal and private ownership. Table C.6-6 contains a summary of these results. These risks have been summed for all subunits and all remediation activities. The general accident risk rates may include a contribution from trucking accidents, but this information was not specified in the RAWPA.

TABLE C.6-6
RISKS FROM ON-SITE INDUSTRIAL HAZARDS, ALTERNATIVE 2

Source	Injury Risk		Fatality Risk	
	Private	Federal	Private	Federal
General Accidents	NC	4.0	NC	5.8×10^{-2}
Trucking Accidents	0	3.0×10^{-4}	0	1.5×10^{-5}

NC = Not calculated

C.6.2.2 Alternative 3: Excavation and Off-Site Disposal

For Alternative 3, risks were calculated for on-site activities and transportation.

Airborne Pathways. Inhalation pathways were evaluated for excavation activities for each subunit. Calculations are detailed in Tables C.II-5 through C.II-8 (Attachment C.II). Results are summarized in Table C.6-7.

TABLE C.6-7
ALTERNATIVE 3 INHALATION RESULTS FROM EXCAVATION ACTIVITIES

Subunit	Risk Source	Risk
Solid Waste Landfill	Chemical COCs	3.3×10^{-7}
	Radionuclides	1.6×10^{-5}
Lime Sludge Pond	Chemical COCs	1.7×10^{-7}
	Radionuclides	1.9×10^{-6}
South Field/Inactive Flyash Pile	Chemical COCs	5.0×10^{-7}
	Radionuclides	1.1×10^{-5}
Active Flyash Pile	Chemical COCs	4.1×10^{-7}
	Radionuclides	2.0×10^{-5}

These risks were calculated using the dust loading factor (600 $\mu g/m^3$) and the soil concentrations for the various COCs. The worker was assumed to inhale the entire available concentration of dust (i.e., given by soil concentration x dust loading) regardless of particle size. These risks to the nonremediation worker and the general public were calculated by applying a linear downwind

dispersion factor (EPA 1993f). A summary of the inhalation risks for the receptors is included in Table C.6-8.

TABLE C.6-8
SUMMARY OF INHALATION RISKS FROM EXCAVATION, ALTERNATIVE 3

Subunit	Receptor	Total Risk
Solid Waste Landfill	Remediation Workers	1.6×10^{-5}
	Nonremediation Worker	2.1×10^{-6}
	Public	1.2×10^{-6}
Lime Sludge Pond	Remediation Workers	2.6×10^{-6}
	Nonremediation Worker	3.4×10^{-7}
	Public	1.2×10^{-7}
South Field/ Inactive Flyash Pile	Remediation Workers	1.2×10^{-5}
	Nonremediation Workers	1.6×10^{-6}
	Public	1.3×10^{-6}
Active Flyash Pile	Remediation Workers	2.0×10^{-5}
	Nonremediation Workers	2.6×10^{-6}
	Public	2.0×10^{-6}

The chemical COCs responsible for the majority of the risk from inhalation are based solely on the relative soil concentration of each COC; no single COC determines the risk. For radionuclides, the risks are driven by the thorium and uranium concentrations, which also are in the highest concentrations. Doses from radon emissions during excavation were calculated separately for a remediation worker, using calculations more appropriate to radon, in Table C.II-13 (Attachment C.II) and the results indicate risks in the 3.1×10^{-6} to 1.9×10^{-7} range. The risk to the nonremediation worker and the general public are reduced by dispersion of radon concentrations in the same way as the particulate concentrations.

Dermal exposure routes include contact with contaminated soils and airborne dust. Risks are from carcinogens and noncarcinogens. These risks are presented in Table C.II-15 (Attachment C.II) and summarized Table C.6-9. Risks from dermal exposure to PAHs were not calculated. The EPA currently recommends using the oral exposure assessment to determine dermal exposure risk since it is currently inappropriate to extrapolate dermal slope factors from the oral slope factors for PAHs. There is no oral exposure route associated with the short-term risks from the remediation activities. This does not imply that there is no risk from dermal exposure to PAHs for this activity.

TABLE C.6-9
REMEDIATION WORKER RISKS FROM DERMAL EXPOSURES FOR ALTERNATIVE 3

Subunit	Cancer Risk	HI
Solid Waste Landfill	1.2×10^{-7}	4.6×10^{-3}
South Field/ Inactive Flyash Pile	5.4×10^{-7}	8.9×10^{-3}
Lime Sludge Pond	6.1×10^{-8}	2.7×10^{-3}
Active Flyash Pile	2.8×10^{-7}	8.1×10^{-4}

Calculations for VOC emissions from the dryer are shown in Table C.II-17 (Attachment C.II) and the results are summarized in Table C.6-10. Because of the very low risks, the off-site public was conservatively assumed to receive the same dose as the nonremediation worker, even though the public's dose would be much lower.

TABLE C.6-10
CANCER RISKS FROM VOCS EMITTED FROM THE DRYER, ALTERNATIVE 3

Subunit	Receptor	Inhalation Risk	Dermal Risk
Solid Waste Landfill	Nonremediation Worker/ Public	7.5×10^{-14}	3.5×10^{-9}
Lime Sludge Pond	Nonremediation Worker/ Public	1.5×10^{-12}	4.0×10^{-9}
South Field/ Inactive Flyash Pile	Nonremediation Worker/ Public	3.2×10^{-11}	1.0×10^{-8}
Active Flyash Pile	Nonremediation Worker/ Public	0	0

TABLE C.6-11
DIRECT RADIATION RISKS FOR ALTERNATIVE 3

Subunit	Receptors	Risk
Solid Waste Landfill	Remediation Worker	1.2×10^{-5}
	Nonremediation Worker/ Public	5.4×10^{-10}
Lime Sludge Pond	Remediation Worker	5.8×10^{-6}
	Nonremediation Worker/ Public	2.6×10^{-10}
South Field/ Inactive Flyash Pile	Remediation Worker	1.7×10^{-5}
	Nonremediation Worker/ Public	7.6×10^{-10}
Active Flyash Pile	Remediation Worker	3.1×10^{-5}
	Nonremediation Worker/ Public	1.4×10^{-9}

Direct Radiation. Direct radiation risks were calculated for excavation activities for each subunit. Calculations are shown in Table C.II-29 (Attachment II) and summarized in Table C.6-11. Risks to nonremediation workers were calculated by apportioning the risk at 1 m (i.e., the remediation worker) to that at 305m using the inverse square law applicable to direct penetrating radiation. Risks have been calculated using the methodology and values presented in HEAST, as opposed to MICROSHIELD. Risks calculated using MICROSHIELD were in the same order of magnitude as those presented.

Immersion doses from exposure to direct radiation of radionuclides suspended in a cloud were calculated by subunit using MICROSHIELD. The results are shown in Table C.II-19 (Attachment C.II) and are summarized in Table C.6-12. Dose rates shown for the public and nonremediation workers are the same as those calculated for a remediation worker during excavation activities and would be expected to be lower in reality, but were not specifically performed for the public or nonremediation workers because of the very low dose levels.

TABLE C.6-12
RISKS FROM IMMERSION IN A CONTAMINATED CLOUD, ALTERNATIVE 3

Subunit	Receptors	Dose (mrem)	Fatal Cancer Risk
Solid Waste Landfill	Remediation Worker	4.4×10^{-6}	2.7×10^{-12}
	Nonremediation Worker	1.6×10^{-6}	9.9×10^{-13}
	Public		
Lime Sludge Pond	Remediation Worker	2.3×10^{-6}	1.4×10^{-12}
	Nonremediation Worker	7.4×10^{-7}	4.6×10^{-13}
	Public		
South Field/Inactive Flyash Pile	All Receptors	2.5×10^{-6}	1.5×10^{-12}
Active Flyash Pile	All Receptors	3.9×10^{-6}	2.4×10^{-12}

Industrial and Mechanical Hazards. Injury and fatality rates for standard industrial hazards associated with construction activities were used to estimate these risks for remediation activities. Table C.II-21 and C.II-22 (Attachment C.II) show the calculations for on-the-job construction accidents, and for those associated with on-site trucking activities in support of remediation. Calculations were made for volumes estimated from the PRLs for both land-use scenarios federal and private ownership. Table C.6-13 contains a summary of these results. These risks have been summed for all subunits and all remediation activities. The general accident risk rates may include a contribution from trucking accidents, but this information was not specified in the RAWPA.

TABLE C.6-13
RISKS FROM ON-SITE INDUSTRIAL HAZARDS, ALTERNATIVE 3

Source	Injury Risk		Fatality Risk	
	Private	Federal	Private	Federal
General Accidents	NC	11.0	NC	1.6×10^{-1}
Trucking Accidents	2.4×10^{-3}	1.1×10^{-3}	1.25×10^{-4}	5.8×10^{-5}

NC = not calculated

Transportation Risks

Transportation risks are those associated with the shipment of contaminated materials off-site by rail. Risks presented include those based on standard accident rates for the rail transport industry, doses to workers and the public along the route from normal shipping conditions, and doses to workers and the public from accidents along the route. Impacts from accidents were calculated using the

RADTRAN code and include direct radiation, inhalation, ingestion and immersion exposure routes. These results have been left in terms of doses rather than risks because of the complexity of the combined exposure routes.

Risks from accidents expected in the normal operation of a rail system are presented in Table C.II-23 (Attachment C.II) and summarized in Table C.6-14. Calculations were made for volumes estimated from the PRLs for both land-use scenarios, federal and private ownership and are based on the number of trips required to transport the minimum number of railcars (159) at one time. Since rates are based on mileage, these risks would decrease as the number of cars increase in a train.

TABLE C.6-14
RISKS FROM EXPECTED ACCIDENTS FROM RAIL TRANSPORT, ALTERNATIVE 3

Receptor	Injury Risk		Fatality Risk	
	Private	Federal	Private	Federal
Rail Workers	1.2	5.0×10^{-1}	1.2×10^{-2}	5.0×10^{-3}
Public	1.8	7.3×10^{-1}	4.8×10^{-1}	1.9×10^{-1}

Doses received by the public from rail transportation are presented in Table C.II-25 (Attachment C.II) for incident-free transportation (i.e., no accidents) and in Table C.II-26 (Attachment C.II) for accidents. Table C.6-15 summarizes the risks for various receptors for the incident-free transportation. Two worker-receptors were calculated using RADTRAN. These workers are associated with the train and are not considered remediation workers. The public consists of four groups, as calculated with the built-in code assumptions described in Section C.5.1. All doses are based on 159 cars per shipment. As the number of railcars increases, the number of shipments would decrease, causing a net increase in dose per shipment, but no change in the total dose per subunit. The RADTRAN estimated maximum individual dose per shipment is 2.2×10^{-7} rem (based on 159 cars per shipment).

The calculations for incident-free transportation used the soil concentration levels found in the Active Flyash Pile as a source term for all subunit calculations, since this provided the maximum individual railcar dose rate. Other subunit source terms may be lower by a factor of 3 or more, which would have no significant impact on the total risks. The population total for the calculation was 549,760 persons encountered in the various RADTRAN scenarios.

TABLE C.6-15
RISKS FROM INCIDENT-FREE RAIL TRANSPORTATION, ALTERNATIVE 3

Receptors		Person-rem	Rem per person
Rail Workers	Rail Crew	0.00029	NC
	Handlers	1.53	NC
Public	Along route	0.34	NC
	On other trains	0.04	NC
	At stops	0.6	NC
	At storage depots	0.06	NC
Total		2.5	4.6×10^{-6}

NC = Not calculated

Accident analyses performed with RADTRAN calculated the expected accident frequencies per severity group, which is described in Section C.5.1. Frequencies per shipment range from 10^{-3} to 10^{-8} according to the severity of the postulated accident and associated release. The most frequently expected accident occurs in the frequency range of 10^{-3} but has no associated release (i.e., railcars are not breach). The next severity category has a postulated 0.1 fraction release and so on, up to a 100 percent release for the highest category. Accidents are calculated for urban, suburban, and rural populations. Table C.II-26 (Attachment C.II) contains the calculations for resulting doses from the postulated accidents. The highest dose levels result from the lowest frequency accidents.

Table C.6-16 summarizes the results of the postulated accidents along with the expected frequency per shipment from Table C.5-17 for those accidents with an expected per shipment frequency of greater than 10^{-6}. For Alternate 3, the total number of train trips is estimated at 70, based on 159 railcar trains. The total number of accidents that would be expected based on a frequency of 10^{-6} accident per shipment, for 70 shipments, is 7.0×10^{-5} for the entire waste disposal process. Results were calculated for both the federal and private PRL waste volumes. The federal ownership doses are approximately 2 orders of magnitude lower than those for the private ownership scenarios.

C.6.2.3 Alternative 6: Excavation and On-Site Disposal With Off-Site Disposal of Fraction Exceeding WAC

For Alternative 6, risks were calculated for on-site activities and transportation.

TABLE C.6-16
SUMMARY OF ACCIDENT RESULTS FOR TRAIN SHIPMENT FOR PRIVATE OWNERSHIP VOLUMES, ALTERNATIVE 3

Population	Severity Group	Expected Frequency per Shipment	Total Dose for All Shipments (person-rem)	Total Dose per Member of the Public (rem)
Urban	1	1.1×10^{-3}	0	0
	2	6.4×10^{-4}	2.0×10^{3}	4.1×10^{-3}
	3	1.4×10^{-4}	4.0×10^{3}	8.2×10^{-3}
	4	1.4×10^{-4}	5.9×10^{3}	1.2×10^{-2}
Suburban	1	2.0×10^{-3}	0	0
	2	1.6×10^{-4}	4.6×10^{2}	6.8×10^{-3}
	3	3.7×10^{-4}	9.2×10^{2}	1.4×10^{-2}
	4	3.7×10^{-5}	1.4×10^{3}	2.0×10^{-2}
	5	2.8×10^{-6}	1.8×10^{3}	2.7×10^{-2}
Rural	1	9.1×10^{-5}	0	0
	2	5.5×10^{-5}	8.5×10^{0}	6.8×10^{-3}
	3	9.8×10^{-5}	1.7×10^{1}	1.4×10^{-2}
	4	9.8×10^{-6}	2.6×10^{1}	2.0×10^{-2}
	5	1.6×10^{-6}	3.4×10^{1}	2.7×10^{-2}

C.6.2.3.1 On-Site Activities

Airborne Pathways. Inhalation pathways were evaluated for excavation activities for each subunit. Calculations are detailed in Tables C.II-9 through C.II-12 (Attachment C.II). Results are summarized in Table C.6-17.

TABLE C.6-17

ALTERNATIVE 6 INHALATION RESULTS FROM EXCAVATION ACTIVITIES

Subunit	Risk Source	Risk
Solid Waste Landfill	Chemical COCs	3.8×10^{-7}
	Radionuclides	1.8×10^{-5}
Lime Sludge Pond	Chemical COCs	1.8×10^{-7}
	Radionuclides	2.2×10^{-6}
South Field/Inactive Flyash Pile	Chemical COCs	4.6×10^{-7}
	Radionuclides	9.9×10^{-6}
Active Flyash Pile	Chemical COCs	1.2×10^{-6}
	Radionuclides	2.8×10^{-6}

These risks were calculated using the dust loading factor (600 $\mu g/m^3$) and the soil concentrations for the various COCs. The worker was assumed to inhale the entire available concentration of dust (i.e., given by soil concentration x dust loading) regardless of particle size. The risks to the nonremediation worker and the general public were calculated by applying a linear downwind dispersion factor (EPA1993f). A summary of inhalation risks for the receptors is included in Table C.6-18.

TABLE C.6-18
SUMMARY OF INHALATION RISKS FROM EXCAVATION, ALTERNATIVE 6

Subunit	Receptor	Total Risk
Solid Waste Landfill	Remediation Worker	1.8×10^{-5}
	Nonremediation Worker	2.4×10^{-6}
	Public	1.3×10^{-6}
Lime Sludge Pond	Remediation Worker	2.6×10^{-6}
	Nonremediation Worker	3.4×10^{-7}
	Public	1.2×10^{-7}
South Field/ Inactive Flyash Pile	Remediation Worker	1.4×10^{-5}
	Nonremediation Worker	1.8×10^{-6}
	Public	1.5×10^{-6}
Active Flyash Pile	Remediation Worker	4.0×10^{-6}
	Nonremediation Worker	5.3×10^{-7}
	Public	4.0×10^{-7}

The chemical COCs responsible for the majority of the risk from inhalation are based solely on the relative soil concentration of each COC; no single COC determines the risk. For radionuclides, the risks are driven by the thorium and uranium concentrations, which also are in the highest concentrations. Doses from radon emissions during excavation were calculated separately for a remediation worker, using calculations more appropriate to radon, in Table C.II-13 (Attachment C.II) and the results indicate risks in the 2.2×10^{-7} to 1.8×10^{-6} range. The risk to the nonremediation worker and general public are reduced by dispersion of radon concentrations in the same way as the particulate concentrations.

Dermal exposure routes include contact with contaminated soils and airborne dust. Risks are from carcinogens and noncarcinogens. These risks are presented in Table C.II-16 (Attachment C.II) and summarized Table C.6-19. Risks from dermal exposures to PAHs were not calculated. The EPA currently recommends using the oral exposure assessment to determine dermal exposure risk since it is currently inappropriate to extrapolate dermal slope factors from the oral slope factors for PAHs. There is no oral exposure route associated with the short-term risks from the remediation activities. This does not imply that there is no risk from dermal exposure to PAHs for this activity. Since all risks are so very low, it may be expected that the risk from PAHs will also be minimal.

TABLE C.6-19
REMEDIATION WORKER RISKS FROM DERMAL EXPOSURES FOR ALTERNATIVE 6

Subunit	Cancer Risk	HI
Solid Waste Landfill	1.0×10^{-7}	3.8×10^{-3}
Lime Sludge Pond	2.9×10^{-8}	1.3×10^{-3}
South Field/ Inactive Flyash Pile	1.9×10^{-7}	3.0×10^{-3}
Active Flyash Pile	1.0×10^{-7}	2.9×10^{-4}

Direct Radiation. Direct radiation risks were calculated for excavation activities for each subunit. Calculations are shown in Table C.II-30 (Attachment II) and summarized in Table C.6-20.. Risks to public were calculated by apportioning the risk at 1 m (i.e., the remediation worker) to that at 305m (1000 ft) using the inverse square law applicable to direct penetrating radiation. Risks have been calculated using the methodology and values presented in HEAST, as opposed to MICROSHIELD. Risks calculated using MICROSHIELD were in the same order of magnitude as those presented. Immersion doses from exposure to direct radiation of radionuclides suspended in a cloud were

calculated using MICROSHIELD by subunit. The results are shown in Table C.II-20 (Attachment II) and are summarized in Table C.6-21. Dose rates shown for the public and nonremediation workers

TABLE C.6-20

DIRECT RADIATION RISKS FOR ALTERNATIVE 6

Subunit	Receptors	Risk
Solid Waste Landfill	Remediation Worker	1.1×10^{-5}
	Nonremediation Worker	4.9×10^{-10}
	Public	
Lime Sludge Pond	Remediation Worker	6.6×10^{-6}
	Nonremediation Worker	3.0×10^{-10}
	Public	
South Field/ Inactive Flyash Pile	Remediation Worker	1.6×10^{-5}
	Nonremediation Worker	7.0×10^{-10}
	Public	
Active Flyash Pile	Remediation Worker	1.6×10^{-5}
	Nonremediation Worker	7.3×10^{-10}
	Public	

are the same as those calculated for a remediation worker during excavation activities and would be expected to be lower in reality, but were not specifically performed for the public or nonremediation workers because of the very low dose levels.

TABLE C.6-21
RISKS FROM IMMERSION IN A CONTAMINATED CLOUD, ALTERNATIVE 6

Subunit	Receptors	Dose (mrem)	Fatal Cancer Risk
Solid Waste Landfill	Remediation Worker	2.4×10^{-6}	1.5×10^{-12}
	Nonremediation Worker Public	1.4×10^{-6}	8.7×10^{-13}
Lime Sludge Pond	All Receptors	8.4×10^{-7}	5.2×10^{-13}
South Field/ Inactive Flyash Pile	Remediation Worker	5.3×10^{-6}	3.3×10^{-12}
	Nonremediation Worker Public	2.3×10^{-6}	1.4×10^{-12}
Active Flyash Pile	Remediation Worker	6.0×10^{-6}	3.7×10^{-12}
	Nonremediation Worker Public	2.0×10^{-6}	1.2×10^{-12}

Industrial and Mechanical Hazards. Injury and fatality rates for standard industrial hazards associated with construction activities were used to estimate these risks for remediation activities. Table C.II-21 and C.II-22 (Attachment C.II) show the calculations for on-the-job construction accidents, and for those associated with on-site trucking activities in support of remediation. Calculations were made for volumes estimated from the PRLs for both land-use scenarios federal and private ownership. Table C.6-22 contains a summary of these results. These risks have been summed for all subunits and all remediation activities. The general accident risk rates may include a contribution from trucking accidents, but this information was not specified in the RAWPA.

TABLE C.6-22
RISKS FROM ON-SITE INDUSTRIAL HAZARDS, ALTERNATIVE 6

Source	Injury Risk		Fatality Risk	
	Private	Federal	Private	Federal
General Accidents	NC	11.5	NC	0.17
Trucking Accidents	2.8×10^{-3}	1.1×10^{-3}	1.4×10^{-4}	5.5×10^{-5}

NC = Not Calculated

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Transportation Risks. Transportation risks are those associated with the shipment of contaminated materials off-site by rail. Risks presented include those based on standard accident rates for the rail transport industry, doses to workers and the public along the route from normal shipping conditions, and doses to workers and the public from accidents along the route. Impacts from accidents were calculated using the radtran code and include direct radiation, inhalation, ingestion and immersion exposure routes. These results have been left in terms of doses rather than risks because of the complexity of the combined exposure routes.

Risks from accidents expected in the normal operation of a rail system are calculated in Table C.II-24 (Attachment C.II) and summarized in Table C.6-23. Calculations were made for volumes estimated from the federal and private land-use PRLs and are based on the number of trips required to transport the minimum number of railcars (159) at one time. Results for the federal ownership scenario were not specifically calculated, but would be approximately 2 orders of magnitude less. Incidence rates are based on mileage. These risks would decrease as the number of cars increases in a train.

TABLE C.6-23
RISKS FROM EXPECTED ACCIDENTS FROM RAIL TRANSPORT, ALTERNATIVE 6

Receptor	Injury Risk	Fatality Risk
	Private	Private
Rail Workers	1.7×10^{-2}	1.7×10^{-4}
Public	2.6×10^{-2}	6.9×10^{-3}

Doses from rail transport are presented in Table C.II-25 (Attachment C.II) for incident-free transportation (i.e., no accidents) and in Table C.II-26 (Attachment C.II) for accidents. Table C.6-24 summarizes the risks for various receptors for the incident-free transportation. Two worker-receptors were calculated by RADTRAN. These workers are associated with the train and are not considered remediation workers. The public consists of four groups, as calculated with the built-in code assumptions described in Section C.5.1. All doses are based on 159 cars per shipment. As the number of railcars increases, the number of shipments would decrease, causing a net increase in dose per shipment, but no change in the total dose per subunit. The RADTRAN estimated maximum individual dose per shipment is 2.2×10^{-7} rem (based on 159 cars per shipment).

The calculations for incident-free transportation used the soil concentration levels found in the Active Flyash Pile as a source term for all subunit calculations, since this provided the maximum individual railcar dose rate. Other subunit source terms may be lower by a factor of 3 or more, which would have no significant impact on the total risks. The population total for the calculation was 549,760 persons encountered in the various RADTRAN scenarios.

TABLE C.6-24
RISKS FROM INCIDENT-FREE RAIL TRANSPORTATION, ALTERNATIVE 6

Receptors		Person-rem	Rem per person
Rail Workers	Rail Crew	1.3×10^{-6}	NC
Public	Along route	1.5×10^{-3}	NC
	On other trains	1.7×10^{-4}	NC
	At stops	2.5×10^{-3}	NC
	At storage depots	2.8×10^{-4}	NC
TOTAL		4.4×10^{-3}	8.0×10^{-9}

NC = Not calculated

Accident analyses performed with RADTRAN calculated the expected accident frequencies per severity group, which is described in Section C.5.2. Frequencies per shipment range from 10^{-3} to 10^{-8} according to the severity of the postulated accident and associated release. The most frequently expected accident occurs in the frequency range of 10^{-3} but has no associated release (i.e., railcars are not breach). The next severity category has a postulated 0.1 fraction release and so on, up to a 100 percent release for the highest category. Accidents are calculated for urban, suburban, and rural populations. Table C.II-27 (Attachment C.II) contains the calculations for resulting doses from the postulated accidents. The highest dose levels result from the lowest frequency accidents.

Table C.6-25 summarizes the results of the postulated accidents along with the expected frequency per shipment from Table C.5-17 for those accidents with an expected per shipment frequency of greater than 10^{-6}. For Alternate 6, the total number of train trips is estimated at 48, based on 159 railcar trains. Results were calculated for the federal and private PRL waste volumes. The federal ownership doses would be approximately 2 orders of magnitude lower than those for the private ownership scenarios.

TABLE C.6-25
SUMMARY OF ACCIDENT RESULTS FOR TRAIN SHIPMENT FOR RESIDENT FARMER VOLUMES, ALTERNATIVE 6

Population	Severity Group	Expected Frequency per Shipment	Total Dose for All Shipments (person-rem)	Total Dose per Member of the Public (rem)
Urban	1	1.1×10^{-3}	0	0
	2	6.4×10^{-4}	8.55	1.8×10^{-5}
	3	1.4×10^{-4}	17.1	3.6×10^{-5}
	4	1.4×10^{-4}	25.6	5.3×10^{-5}
Suburban	1	2.0×10^{-3}	0	0
	2	1.6×10^{-4}	2.0	3.0×10^{-5}
	3	3.7×10^{-4}	4.0	5.9×10^{-5}
	4	3.7×10^{-5}	6.0	8.8×10^{-5}
	5	2.8×10^{-6}	7.9	1.2×10^{-4}
Rural	1	9.1×10^{-5}	0	0
	2	5.5×10^{-5}	0.037	2.9×10^{-5}
	3	9.8×10^{-5}	0.074	5.9×10^{-5}
	4	9.8×10^{-6}	0.11	8.8×10^{-5}
	5	1.6×10^{-6}	0.15	1.2×10^{-4}

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C.7

C.7.0 RESIDUAL RISK ASSESSMENT

This section presents the results of residual risks calculated for potential human receptors for each remedial alternative and each land-use scenario (i.e., private ownership and federal ownership).

C.7.1 RISK CHARACTERIZATION METHODOLOGY

Potential residual risks to human health from exposure to residual COCs (chemical and radionuclides) following implementation of remedial alternatives for Operable Unit 2 were estimated using the methods described in the RAWPA (DOE 1992), and the Operable Unit 2 RI baseline risk assessment (DOE 1994a). The methods used to characterize residual risks are the same as those used in the baseline risk assessment for the corresponding exposure pathway and receptor combinations. Exposure pathway and receptor combinations quantitatively evaluated in the residual risk assessment are defined in the discussion of the conceptual model in Section C.2.5.2. Unless otherwise noted, all of the following equations are from RAGS (EPA 1989a).

C.7.1.1 Hazardous Chemical Exposures

Risks from nonradionuclide COCs were estimated for carcinogenic and noncarcinogenic effects. Risk values were calculated for all COCs known to have a published SF (see Section C.4.0). Those COCs that have an RfD available, the noncarcinogenic HQ was calculated. Some carcinogens may also pose a noncarcinogenic toxic hazard. Effects due to exposures from these chemicals were characterized for both types of health effects.

C.7.1.1.1 Risk Characterization Methodology for Carcinogens

The risk attributed to a carcinogen was estimated as the ILCR of an individual as a result of exposure to the substance. At low doses, the risk of developing cancer was estimated as follows:

$$\text{Risk} = (\text{CDI})(\text{SF}) \qquad \text{(C.7-1)}$$

where

Risk	=	risk of cancer incidence, expressed as a unitless probability,
CDI	=	chronic daily intake averaged over 70 years (mg/kg/day) (equivalent to the I values from Section C.3), and
SF	=	slope factor $(\text{mg/kg/day})^{-1}$ (see Section C.4, Tables 4-2, 4-4 and 4-5).

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For dermal exposure, cancer risks were calculated using adjusted toxicity factors based on absorbed doses of COCs rather than COC intakes. For a given pathway with simultaneous exposure of a receptor to several carcinogens, the following equation was used to sum cancer risks:

$$Risk_p = Risk\ (chem_1) + Risk\ (chem_2) + \ldots\ Risk\ (chem_i) \qquad (C.7\text{-}2)$$

where

$Risk_p$	=	total pathway risk of cancer incidence, and
Risk ($chem_i$)	=	risk associated with an individual carcinogenic chemical.

C.7.1.1.2 Risk Characterization Methodology for Noncarcinogens

The risk associated with exposure to noncarcinogenic hazardous COCs was evaluated by comparing an exposure level or intake to a reference dose (RfD (see Section C.4.0). It is recognized that this methodology for assessing the human-health effect for noncarcinogens does not give a measure of risk as is calculated for the carcinogens. Even so, for convenience the term "risk" will continue to be used when discussing these evaluations. The ratio of intake/RfD for a single COC is the HQ and is defined as:

$$HQ = I/RfD \qquad (C.7\text{-}3)$$

where

HQ	=	hazard quotient (unitless),
I	=	intake of a chemical (mg/kg/day) (see Section C.3), and
RfD	=	reference dose (mg/kg/day) (see Section 4.0, Tables C.4-1 and C.4-4).

When using this equation to estimate potential noncarcinogenic risk, the intake and RfD must be derived from exposures of equivalent duration (e.g., subchronic, chronic, or fewer than two weeks). For residual risk, COC exposures were evaluated in all cases on a chronic basis, using chronic RfD values. Analogous to cancer risks, dermal noncancer risks were assessed using absorbed dose rather than intake.

In the case of simultaneous exposure of a receptor to several chemicals, an HI was calculated as the sum of the HQs by:

$$HI = I_i/RfD_1 + I_2/RfD_2 + \ldots I_i/RfD_i \qquad \text{(C.7-4)}$$

where

HI	=	hazard index (unitless),
I_i	=	intake for the ith toxicant, and
RfD_i	=	reference dose for the ith toxicant.

An HI is an indicator of the potential for adverse effects associated with chronic exposures to multiple chemicals. In effect, HIs assume dose additivity for all COCs (RAGS).

C.7.1.2 Radiological Exposures

The procedures for estimating the total lifetime excess cancer risks due to exposure to radionuclides are described in this section.

Risk Characterization Methodology for Internal and External Exposures

Risk characterization for internal exposures to radionuclides (intake via inhalation or ingestion) was calculated as follows:

$$Risk = (I)(SF) \qquad \text{(C.7-5)}$$

where

Risk	=	risk of cancer incidence, expressed as a unitless probability,
I	=	lifetime radionuclide intake (pCi) defined in Section C.3, and
SF	=	slope factor $(pCi)^{-1}$.

For residual risk, risk characterization for external exposure to gamma-emitting radionuclides in contaminated surface soil was calculated as follows (RAWPA):

$$Risk = (DE)(SF) \quad (C.7\text{-}6)$$

where

Risk	=	risk of cancer incidence, expressed as a unitless probability,
DE	=	direct exposure defined in equation C.3-19 in Section C.3.0, and
SF	=	slop factor $(pCi)^{-1}$.

The slope factor is either a HEAST value for a particular radionuclide or the sum of the HEAST slope factors for that radionuclide and its short-lived progeny to account for ingrowth during storage and/or environmental transport.

C.7.2 Residual Risks

Residual risks were evaluated for potential impacts to human receptors based on postremediation conditions. This section presents the residual risks quantified for each receptor, pathway, and land-use scenario for Alternatives 2, 3, and 6 (Alternative 1, No Action, is summarized in Section C.1.4; for details, see the RI baseline risk assessment). Tables are provided to summarize the ILCR and hazards calculated. Complete calculation sheets of the risk values are presented in Attachment C.III.

Residual risks at the Lime Sludge Ponds are quantified in Tables C.7-1 through C.7-19, below. Under Alternative 2 for this subunit the risks for all receptors are well below the 1.0 level of concern for HI, and better than the ILCR target risk range of 10^{-4} to 10^{-6}. For Alternative 3 the HI for all receptors are similarly well below the 1.0 level of concern. The ILCR for most receptors is also better than the target risk range. For the perched groundwater user (Table C.7-9), the ILCR is within the lower end of this range (4.6×10^{-6}). Similarly, the on-property adult farmer (Table C.7-10) has an ILCR of 3.4×10^{-6}. The same pattern can be seen under Alternative 6 as under Alternative 3. The HI for all receptors are well below the 1.0 level of concern. The ILCR is better than the target risk range, except for the perched groundwater user (Table C.7-17) at 4.6×10^{-6}, and the on-property adult farmer (Table C.7-18) at 3.4×10^{-6}.

Tables C.7-20 through C.7-38 present the residual risks at the Solid Waste Landfill for Alternatives 2, 3, and 6. Under Alternative 2 the risks for all receptors are well below the 1.0 level of concern for HI, and better than the ILCR target risk range of 10^{-4} to 10^{-6}. Alternative 3 has HI levels below the 1.0 level of concern, with the highest level being 7.6×10^{-1} for the on-property child (Table C.7-30). This level is primarily due to the ingestion of vegetables and fruit. ILCR levels are generally below

the target risk range of 10^{-4} to 10^{-6}. The exceptions are ILCR levels of 4.8×10^{-6} for the perched groundwater user (Table C.7-28) and 3.4×10^{-6} for the on-property adult farmer (Table C.7-29). These levels are due to the combined effects of several pathways. Alternative 6 presents similar risk levels to those calculated for Alternative 3. HI levels are also below the 1.0 level of concern, with the highest level being 7.6×10^{-1} for the on-property child (Table C.7-38). This level is primarily due to the ingestion of vegetables and fruit. ILCR levels are also below the target risk range of 10^{-4} to 10^{-6}, with the exception of 4.8×10^{-6} for the perched groundwater user (Table C.7-36) and 3.4×10^{-6} for the on-property adult farmer (Table C.7-37). These levels are due to the combined effects of several pathways.

The three southern subunits of Operable Unit 2 (South Field, Active Flyash Pile, and Inactive Flyash Pile) have been combined into one area for risk assessment purposes, due to their proximity. This combined area is identified as the South Field Area in the Tables C.7-39 through C.7-55 below. For Alternative 2 the HI levels are all below the 1.0 level of concern, with the highest level being 1.3×10^{-1} for the expanded trespasser (Table C.7-39). Dermal contact is the only significant pathway for determining this value. ILCR values range from 9.3×10^{-8} for the off-property child (Table C.7-41) to 1.6×10^{-6} for the off-property adult farmer (Table C.7-40). HI values under Alternative 3 are all below the 1.0 standard, with the highest level being 7.2×10^{-2} for the off-property child with federal ownership (Table C.7-44). The ingestion of vegetables, fruit and drinking water are the principal contributors to this risk. ILCR levels are all in the 10^{-6} range or below. The highest ILCR value for Alternative 3 is 6.4×10^{-6} for the on-property adult farmer (Table C.7-47). The ingestion of particulates, vegetables, and fruit are the principal pathways for this receptor.

Alternative 6 for the South Field area has uniformly low HI values. The highest HI is only 7.2×10^{-2} for the off-property child with federal ownership (Table C.7-51). The ingestion of vegetables, fruit, and drinking water are the principal contributors to this risk. Similar to Alternative 3, the highest ILCR for Alternative 6 is 6.4×10^{-6} for the on-property adult farmer (Table C.7-54). The ingestion of particulates, vegetables, and fruit are the principal pathways for this receptor.

The final source area included in this risk assessment is the proposed disposal cell. Tables C.7-56 through C.7-61 present the risks for this area, which was only evaluated under Alternative 6. HI values are all well below the 1.0 level of concern, with the maximum value of 6.9×10^{-2} being calculated for both the off-property child with federal ownership (Table C.7-58), and the off-property

child with private ownership (Table C.7-61). The ingestion of vegetables, fruit, and drinking water are the principal pathways for both these receptors. ILCR values are below 10^{-6}, with the exception of 1.6×10^{-6} being calculated for both the off-property adult farmer with federal ownership (Table C.7-57), and the off-property adult farmer with private ownership (Table C.7-60). The ingestion of drinking water is the primary contributor to risk for both of these receptors.

TABLE C.7-1
SUMMARY OF POTENTIAL HEALTH EFFECTS:
LIME SLUDGE PONDS WITH FEDERAL OWNERSHIP, ALTERNATIVE 2,
EXPANDED TRESPASSER

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Dermal Contact While Bathing (Chemicals)	NA
Total Receptor HI =	NA

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	5.9×10^{-15}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	NA
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	NA
Direct Radiation	NA
Total Receptor ILCR =	5.9×10^{-15}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-2
SUMMARY OF POTENTIAL HEALTH EFFECTS:
LIME SLUDGE PONDS WITH FEDERAL OWNERSHIP, ALTERNATIVE 2,
OFF PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	3.5×10^{-11}
Ingestion of Dairy Products (Chemicals)	4.9×10^{-10}
Ingestion of Vegetables and Fruit (Chemicals)	2.7×10^{-8}
Ingestion of Drinking Water (Chemicals)	9.1×10^{-8}
Dermal Contact While Bathing (Chemicals)	5.3×10^{-9}
Total Receptor HI =	1.2×10^{-7}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	1.3×10^{-14}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	2.5×10^{-11}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	$9.7 \text{ X } 10^{-15}$
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	1.4×10^{-13}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	7.6×10^{-12}
Direct Radiation	
Total Receptor ILCR =	3.3×10^{-11}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-3
SUMMARY OF POTENTIAL HEALTH EFFECTS: LIME SLUDGE PONDS WITH FEDERAL OWNERSHIP, ALTERNATIVE 2, OFF-PROPERTY FARMER CHILD

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	6.2×10^{-11}
Ingestion of Dairy Products (Chemicals)	5.2×10^{-9}
Ingestion of Vegetables and Fruit (Chemicals)	1.0×10^{-7}
Ingestion of Drinking Water (Chemicals)	2.1×10^{-7}
Dermal Contact While Bathing (Chemicals)	8.5×10^{-9}
Total Receptor HI =	3.3×10^{-7}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	6.6×10^{-16}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.1×10^{-12}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	3.2×10^{-16}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	2.7×10^{-14}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	5.3×10^{-13}
Direct Radiation	
Total Receptor ILCR =	1.7×10^{-12}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-4
SUMMARY OF POTENTIAL HEALTH EFFECTS:
LIME SLUDGE POND WITH FEDERAL OWNERSHIP, ALTERNATIVE 3,
EXPANDED TRESPASSER

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	3.9×10^{-4}
Dermal Contact with Residual Soils (Chemicals)	2.8×10^{-2}
Ingestion of Meat (Chemicals)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Dermal Contact While Bathing (Chemicals)	NA
Total Receptor HI =	2.8×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	2.0×10^{-10}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	1.8×10^{-9}
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	NA
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	NA
Direct Radiation	2.4×10^{-8}
Total Receptor ILCR =	2.6×10^{-8}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-5
SUMMARY OF POTENTIAL HEALTH EFFECTS:
LIME SLUDGE POND WITH FEDERAL OWNERSHIP, ALTERNATIVE 3,
OFF-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	4.3×10^{-7}
Ingestion of Dairy Products (Chemicals)	6.1×10^{-6}
Ingestion of Vegetables and Fruit (Chemicals)	3.4×10^{-4}
Ingestion of Drinking Water (Chemicals)	1.1×10^{-3}
Dermal Contact While Bathing (Chemicals)	6.5×10^{-5}
Total Receptor HI =	1.5×10^{-3}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	4.4×10^{-10}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	7.1×10^{-8}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	2.7×10^{-11}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	3.9×10^{-10}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	2.1×10^{-8}
Direct Radiation	
Total Receptor ILCR =	9.3×10^{-8}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-6
SUMMARY OF POTENTIAL HEALTH EFFECTS:
LIME SLUDGE POND WITH FEDERAL OWNERSHIP, ALTERNATIVE 3,
OFF-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	7.7×10^{-7}
Ingestion of Dairy Products (Chemicals)	6.4×10^{-5}
Ingestion of Vegetables and Fruit (Chemicals)	1.3×10^{-3}
Ingestion of Drinking Water (Chemicals)	2.6×10^{-3}
Dermal Contact While Bathing (Chemicals)	1.0×10^{-4}
Total Receptor HI =	4.1×10^{-3}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	2.3×10^{-11}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	3.0×10^{-9}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	8.9×10^{-13}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	7.4×10^{-11}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	1.5×10^{-9}
Direct Radiation	NA
Total Receptor ILCR =	4.6×10^{-9}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

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TABLE C.7-7
SUMMARY OF POTENTIAL HEALTH EFFECTS:
LIME SLUDGE POND WITH PRIVATE OWNERSHIP, ALTERNATIVE 3,
OFF-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	8.0×10^{-10}
Ingestion of Dairy Products (Chemicals)	1.1×10^{-8}
Ingestion of Vegetables and Fruit (Chemicals)	6.3×10^{-7}
Ingestion of Drinking Water (Chemicals)	2.1×10^{-6}
Dermal Contact While Bathing (Chemicals)	1.2×10^{-7}
Total Receptor HI =	2.9×10^{-6}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	4.7×10^{-9}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.4×10^{-10}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	8.2×10^{-14}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	1.2×10^{-12}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	5.7×10^{-11}
Direct Radiation	NA
Total Receptor ILCR =	4.9×10^{-9}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-8
SUMMARY OF POTENTIAL HEALTH EFFECTS:
LIME SLUDGE POND WITH PRIVATE OWNERSHIP, ALTERNATIVE 3,
OFF-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	1.4×10^{-9}
Ingestion of Dairy Products (Chemicals)	1.2×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	2.4×10^{-6}
Ingestion of Drinking Water (Chemicals)	4.9×10^{-6}
Dermal Contact While Bathing (Chemicals)	2.0×10^{-7}
Total Receptor HI =	7.6×10^{-6}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	2.4×10^{-10}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	5.8×10^{-12}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	2.7×10^{-15}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	2.2×10^{-13}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	4.0×10^{-12}
Direct Radiation	NA
Total Receptor ILCR =	2.5×10^{-10}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

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TABLE C.7-9
SUMMARY OF POTENTIAL HEALTH EFFECTS:
LIME SLUDGE POND WITH PRIVATE OWNERSHIP, ALTERNATIVE 3,
PERCHED GROUNDWATER USER

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	2.1×10^{-8}
Ingestion of Dairy Products (Chemicals)	3.0×10^{7}
Ingestion of Vegetables and Fruit (Chemicals)	1.6×10^{-5}
Ingestion of Drinking Water (Chemicals)	NA
Dermal Contact While Bathing (Chemicals)	NA
Total Receptor HI =	1.7×10^{-5}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	3.3×10^{-7}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	5.8×10^{-8}
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.2×10^{-6}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	1.6×10^{-8}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	3.0×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	1.7×10^{-6}
Direct Radiation	9.9×10^{-7}
Total Receptor ILCR =	4.6×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-10
SUMMARY OF POTENTIAL HEALTH EFFECTS:
LIME SLUDGE POND WITH PRIVATE OWNERSHIP, ALTERNATIVE 3,
ON-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	2.1×10^{-8}
Ingestion of Dairy Products (Chemicals)	3.0×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	1.6×10^{-5}
Ingestion of Drinking Water (Chemicals)	5.5×10^{-5}
Dermal Contact While Bathing (Chemicals)	3.2×10^{-6}
Total Receptor HI =	7.5×10^{-5}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	3.3×10^{-7}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	5.8×10^{-8}
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	3.5×10^{-9}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	1.6×10^{-8}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	3.0×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	1.7×10^{-6}
Direct Radiation	9.9×10^{-7}
Total Receptor ILCR =	3.4×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-11
SUMMARY OF POTENTIAL HEALTH EFFECTS:
LIME SLUDGE POND WITH PRIVATE OWNERSHIP, ALTERNATIVE 3,
ON-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	3.7×10^{-8}
Ingestion of Dairy Products (Chemicals)	3.1×10^{-6}
Ingestion of Vegetables and Fruit (Chemicals)	6.3×10^{-5}
Ingestion of Drinking Water (Chemicals)	1.3×10^{-4}
Dermal Contact While Bathing (Chemicals)	5.1×10^{-6}
Total Receptor HI =	2.0×10^{-4}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	1.7×10^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	5.5×10^{-9}
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.5×10^{-10}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	5.3×10^{-10}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	5.8×10^{-8}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	1.2×10^{-7}
Direct Radiation	7.4×10^{-8}
Total Receptor ILCR =	2.7×10^{-7}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-12
SUMMARY OF POTENTIAL HEALTH EFFECTS:
LIME SLUDGE POND WITH FEDERAL OWNERSHIP, ALTERNATIVE 6,
EXPANDED TRESPASSER

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	3.9×10^{-4}
Dermal Contact with Residual Soils (Chemicals)	2.8×10^{-2}
Ingestion of Meat (Chemicals)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Dermal Contact While Bathing (Chemicals)	NA
Total Receptor HI =	2.8×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	2.0×10^{-10}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	1.8×10^{-9}
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	NA
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	NA
Direct Radiation	2.4×10^{-8}
Total Receptor ILCR =	2.6×10^{-8}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-13
SUMMARY OF POTENTIAL HEALTH EFFECTS:
LIME SLUDGE POND WITH FEDERAL OWNERSHIP, ALTERNATIVE 6,
OFF-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	4.3×10^{-7}
Ingestion of Dairy Products (Chemicals)	6.1×10^{-6}
Ingestion of Vegetables and Fruit (Chemicals)	3.4×10^{-4}
Ingestion of Drinking Water (Chemicals)	1.1×10^{-3}
Dermal Contact While Bathing (Chemicals)	6.5×10^{-5}
Total Receptor HI =	1.5×10^{-3}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	4.4×10^{-10}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	7.1×10^{-8}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	2.7×10^{-11}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	3.9×10^{-10}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	2.1×10^{-8}
Direct Radiation	NA
Total Receptor ILCR =	9.3×10^{-8}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-14
SUMMARY OF POTENTIAL HEALTH EFFECTS:
LIME SLUDGE POND WITH FEDERAL OWNERSHIP, ALTERNATIVE 6,
OFF-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	7.7×10^{-7}
Ingestion of Dairy Products (Chemicals)	6.4×10^{-5}
Ingestion of Vegetables and Fruit (Chemicals)	1.3×10^{-3}
Ingestion of Drinking Water (Chemicals)	2.6×10^{-3}
Dermal Contact While Bathing (Chemicals)	1.0×10^{-4}
Total Receptor HI =	4.1×10^{-3}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	2.3×10^{-11}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	3.0×10^{-9}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	8.9×10^{-13}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	7.4×10^{-11}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	1.5×10^{-9}
Direct Radiation	NA
Total Receptor ILCR =	4.6×10^{-9}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

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TABLE C.7-15
SUMMARY OF POTENTIAL HEALTH EFFECTS: LIME SLUDGE POND WITH PRIVATE OWNERSHIP, ALTERNATIVE 6, OFF-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	8.0×10^{-10}
Ingestion of Dairy Products (Chemicals)	1.1×10^{-8}
Ingestion of Vegetables and Fruit (Chemicals)	6.3×10^{-7}
Ingestion of Drinking Water (Chemicals)	2.1×10^{-6}
Dermal Contact While Bathing (Chemicals)	1.2×10^{-7}
Total Receptor HI =	2.9×10^{-6}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	4.7×10^{-9}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.4×10^{-10}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	8.2×10^{-14}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	1.2×10^{-12}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	5.7×10^{-11}
Direct Radiation	NA
Total Receptor ILCR =	4.9×10^{-9}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-16
SUMMARY OF POTENTIAL HEALTH EFFECTS:
LIME SLUDGE POND WITH PRIVATE OWNERSHIP, ALTERNATIVE 6,
OFF-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	1.4×10^{-9}
Ingestion of Dairy Products (Chemicals)	1.2×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	2.4×10^{-6}
Ingestion of Drinking Water (Chemicals)	4.9×10^{-6}
Dermal Contact While Bathing (Chemicals)	2.0×10^{-7}
Total Receptor HI =	7.6×10^{-6}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	2.4×10^{-10}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	5.8×10^{-12}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	2.7×10^{-15}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	2.2×10^{-13}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	4.0×10^{-12}
Direct Radiation	NA
Total Receptor ILCR =	2.5×10^{-10}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-17
SUMMARY OF POTENTIAL HEALTH EFFECTS:
LIME SLUDGE POND WITH PRIVATE OWNERSHIP, ALTERNATIVE 6,
PERCHED GROUNDWATER USER

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	2.1×10^{-8}
Ingestion of Dairy Products (Chemicals)	3.0×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	1.6×10^{-5}
Ingestion of Drinking Water (Chemicals)	NA
Dermal Contact While Bathing (Chemicals)	NA
Total Receptor HI =	1.7×10^{-5}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	3.3×10^{-7}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	5.8×10^{-8}
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.2×10^{-6}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	1.6×10^{-8}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	3.0×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	1.7×10^{-6}
Direct Radiation	9.9×10^{-7}
Total Receptor ILCR =	4.6×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-18
SUMMARY OF POTENTIAL HEALTH EFFECTS:
LIME SLUDGE POND WITH PRIVATE OWNERSHIP, ALTERNATIVE 6,
ON-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	2.1×10^{-8}
Ingestion of Dairy Products (Chemicals)	3.0×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	1.6×10^{-5}
Ingestion of Drinking Water (Chemicals)	5.5×10^{-5}
Dermal Contact While Bathing (Chemicals)	3.2×10^{-6}
Total Receptor HI =	7.5×10^{-5}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	3.3×10^{-7}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	5.8×10^{-8}
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	3.5×10^{-9}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	1.6×10^{-8}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	3.0×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	1.7×10^{-6}
Direct Radiation	9.9×10^{-7}
Total Receptor ILCR =	3.4×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

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TABLE C.7-19
SUMMARY OF POTENTIAL HEALTH EFFECTS:
LIME SLUDGE POND WITH PRIVATE OWNERSHIP, ALTERNATIVE 6,
ON-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	3.7×10^{-8}
Ingestion of Dairy Products (Chemicals)	3.1×10^{-6}
Ingestion of Vegetables and Fruit (Chemicals)	6.3×10^{-5}
Ingestion of Drinking Water (Chemicals)	1.3×10^{-4}
Dermal Contact While Bathing (Chemicals)	5.1×10^{-6}
Total Receptor HI =	2.0×10^{-4}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	1.7×10^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	5.5×10^{-9}
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.5×10^{-10}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	5.3×10^{-10}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	5.8×10^{-8}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	1.2×10^{-7}
Direct Radiation	7.4×10^{-7}
Total Receptor ILCR =	2.7×10^{-7}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-20
SUMMARY OF POTENTIAL HEALTH EFFECTS:
SOLID WASTE LANDFILL WITH FEDERAL OWNERSHIP, ALTERNATIVE 2,
EXPANDED TRESPASSER

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Dermal Contact While Bathing (Chemicals)	NA
Total Receptor HI =	NA

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	1.0×10^{-14}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	NA
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	NA
Direct Radiation	NA
Total Receptor ILCR =	1.0×10^{-14}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-21
SUMMARY OF POTENTIAL HEALTH EFFECTS:
SOLID WASTE LANDFILL WITH FEDERAL OWNERSHIP,
ALTERNATIVE 2, OFF-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	6.9×10^{-9}
Ingestion of Dairy Products (Chemicals)	9.9×10^{-8}
Ingestion of Vegetables and Fruit (Chemicals)	5.5×10^{-6}
Ingestion of Drinking Water (Chemicals)	1.8×10^{-5}
Dermal Contact While Bathing (Chemicals)	1.1×10^{-6}
Total Receptor HI =	2.5×10^{-5}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	4.2×10^{-14}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.8×10^{-9}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	6.8×10^{-13}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	9.6×10^{-12}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	5.3×10^{-10}
Direct Radiation	NA
Total Receptor ILCR =	2.3×10^{-9}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-22
SUMMARY OF POTENTIAL HEALTH EFFECTS:
SOLID WASTE LANDFILL WITH FEDERAL OWNERSHIP, ALTERNATIVE 2,
OFF-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	1.2×10^{-8}
Ingestion of Dairy Products (Chemicals)	1.0×10^{-6}
Ingestion of Vegetables and Fruit (Chemicals)	2.1×10^{-5}
Ingestion of Drinking Water (Chemicals)	4.3×10^{-5}
Dermal Contact While Bathing (Chemicals)	1.7×10^{-6}
Total Receptor HI =	6.6×10^{-5}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	2.2×10^{-15}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	7.6×10^{-11}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	2.2×10^{-14}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	1.9×10^{-12}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	3.7×10^{-11}
Direct Radiation	NA
Total Receptor ILCR =	1.2×10^{-10}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

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TABLE C.7-23
SUMMARY OF POTENTIAL HEALTH EFFECTS:
SOLID WASTE LANDFILL WITH FEDERAL OWNERSHIP, ALTERNATIVE 3,
EXPANDED TRESPASSER

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	5.2×10^{-4}
Dermal Contact with Residual Soils (Chemicals)	2.0×10^{-2}
Ingestion of Meat (Chemicals)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Dermal Contact While Bathing (Chemicals)	NA
Total Receptor HI =	2.0×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	3.1×10^{-11}
Inhalation of Particulates (Radionuclides)	8.8×10^{-10}
Incidental Ingestion of Residual Soils (Chemicals)	9.2×10^{-8}
Incidental Ingestion of Residual Soils (Radionuclides)	6.4×10^{-9}
Dermal Contact with Residual Soils (Chemicals)	1.7×10^{-7}
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	NA
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	NA
Direct Radiation	1.3×10^{-7}
Total Receptor ILCR =	4.0×10^{-7}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-24
SUMMARY OF POTENTIAL HEALTH EFFECTS:
SOLID WASTE LANDFILL WITH FEDERAL OWNERSHIP, ALTERNATIVE 3,
OFF-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	2.4×10^{-6}
Ingestion of Dairy Products (Chemicals)	3.4×10^{-5}
Ingestion of Vegetables and Fruit (Chemicals)	1.9×10^{-3}
Ingestion of Drinking Water (Chemicals)	6.3×10^{-3}
Dermal Contact While Bathing (Chemicals)	3.6×10^{-4}
Total Receptor HI =	8.6×10^{-3}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	9.0×10^{-11}
Inhalation of Particulates (Radionuclides)	3.6×10^{-9}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	4.0×10^{-7}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	3.6×10^{-10}
Ingestion of Meat (Radionuclides)	1.5×10^{-10}
Ingestion of Dairy Products (Chemicals)	4.3×10^{-10}
Ingestion of Dairy Products (Radionuclides)	2.2×10^{-9}
Ingestion of Vegetables and Fruit (Chemicals)	5.3×10^{-10}
Ingestion of Vegetables and Fruit (Radionuclides)	1.2×10^{-7}
Direct Radiation	NA
Total Receptor ILCR =	5.3×10^{-7}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-25
SUMMARY OF POTENTIAL HEALTH EFFECTS:
SOLID WASTE LANDFILL WITH FEDERAL OWNERSHIP, ALTERNATIVE 3,
OFF-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	4.3×10^{-6}
Ingestion of Dairy Products (Chemicals)	3.6×10^{-4}
Ingestion of Vegetables and Fruit (Chemicals)	7.2×10^{-3}
Ingestion of Drinking Water (Chemicals)	1.5×10^{-2}
Dermal Contact While Bathing (Chemicals)	5.9×10^{-4}
Total Receptor HI =	2.3×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	2.2×10^{-11}
Inhalation of Particulates (Radionuclides)	1.9×10^{-10}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.7×10^{-8}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	5.6×10^{-11}
Ingestion of Meat (Radionuclides)	5.0×10^{-12}
Ingestion of Dairy Products (Chemicals)	3.9×10^{-10}
Ingestion of Dairy Products (Radionuclides)	4.2×10^{-10}
Ingestion of Vegetables and Fruit (Chemicals)	1.8×10^{-10}
Ingestion of Vegetables and Fruit (Radionuclides)	8.4×10^{-9}
Direct Radiation	NA
Total Receptor ILCR =	2.7×10^{-8}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-26
SUMMARY OF POTENTIAL HEALTH EFFECTS:
SOLID WASTE LANDFILL WITH PRIVATE OWNERSHIP, ALTERNATIVE 3,
OFF-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	3.2×10^{-7}
Ingestion of Dairy Products (Chemicals)	1.0×10^{-4}
Ingestion of Vegetables and Fruit (Chemicals)	1.3×10^{-5}
Ingestion of Drinking Water (Chemicals)	2.5×10^{-5}
Dermal Contact While Bathing (Chemicals)	1.4×10^{-6}
Total Receptor HI =	1.4×10^{-4}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	2.1×10^{-12}
Inhalation of Particulates (Radionuclides)	1.4×10^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.5×10^{-9}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	2.3×10^{-11}
Ingestion of Meat (Radionuclides)	6.9×10^{-13}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	6.5×10^{-9}
Ingestion of Vegetables and Fruit (Chemicals)	1.6×10^{-11}
Ingestion of Vegetables and Fruit (Radionuclides)	6.2×10^{-19}
Direct Radiation	NA
Total Receptor ILCR =	2.2×10^{-8}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

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TABLE C.7-27
SUMMARY OF POTENTIAL HEALTH EFFECTS: SOLID WASTE LANDFILL WITH PRIVATE OWNERSHIP, ALTERNATIVE 3, OFF-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	5.8×10^{-7}
Ingestion of Dairy Products (Chemicals)	1.1×10^{-3}
Ingestion of Vegetables and Fruit (Chemicals)	5.0×10^{-5}
Ingestion of Drinking Water (Chemicals)	5.8×10^{-5}
Dermal Contact While Bathing (Chemicals)	2.3×10^{-6}
Total Receptor HI =	1.2×10^{-3}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	5.1×10^{-13}
Inhalation of Particulates (Radionuclides)	7.1×10^{-10}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	6.6×10^{-11}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	3.6×10^{-12}
Ingestion of Meat (Radionuclides)	2.3×10^{-14}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	1.3×10^{-9}
Ingestion of Vegetables and Fruit (Chemicals)	5.1×10^{-12}
Ingestion of Vegetables and Fruit (Radionuclides)	4.4×10^{-11}
Direct Radiation	NA
Total Receptor ILCR =	2.1×10^{-9}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-28
SUMMARY OF POTENTIAL HEALTH EFFECTS:
SOLID WASTE LANDFILL WITH PRIVATE OWNERSHIP, ALTERNATIVE 3,
PERCHED GROUNDWATER USER

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	8.2×10^{-3}
Dermal Contact with Residual Soils (Chemicals)	1.7×10^{-2}
Ingestion of Meat (Chemicals)	6.9×10^{-3}
Ingestion of Dairy Products (Chemicals)	3.4×10^{-3}
Ingestion of Vegetables and Fruit (Chemicals)	1.7×10^{-1}
Ingestion of Drinking Water (Chemicals)	NA
Dermal Contact While Bathing (Chemicals)	NA
Total Receptor HI =	2.0×10^{-1}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	7.7×10^{-11}
Inhalation of Particulates (Radionuclides)	5.0×10^{-7}
Incidental Ingestion of Residual Soils (Chemicals)	2.7×10^{-8}
Incidental Ingestion of Residual Soils (Radionuclides)	2.9×10^{-7}
Dermal Contact with Residual Soils (Chemicals)	3.4×10^{-9}
Ingestion of Drinking Water (Chemicals)	2.6×10^{-7}
Ingestion of Drinking Water (Radionuclides)	1.2×10^{-6}
Dermal Contact While Bathing (Chemicals)	8.2×10^{-9}
Ingestion of Meat (Chemicals)	3.9×10^{-7}
Ingestion of Meat (Radionuclides)	1.5×10^{-9}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	6.4×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	2.9×10^{-7}
Ingestion of Vegetables and Fruit (Radionuclides)	4.2×10^{-7}
Direct Radiation	7.7×10^{-7}
Total Receptor ILCR =	4.8×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-29
SUMMARY OF POTENTIAL HEALTH EFFECTS:
SOLID WASTE LANDFILL WITH PRIVATE OWNERSHIP, ALTERNATIVE 3,
ON-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	8.2×10^{-3}
Dermal Contact with Residual Soils (Chemicals)	1.7×10^{-2}
Ingestion of Meat (Chemicals)	6.9×10^{-3}
Ingestion of Dairy Products (Chemicals)	3.4×10^{-3}
Ingestion of Vegetables and Fruit (Chemicals)	1.7×10^{-1}
Ingestion of Drinking Water (Chemicals)	7.3×10^{-4}
Dermal Contact While Bathing (Chemicals)	4.2×10^{-5}
Total Receptor HI =	2.0×10^{-1}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	7.7×10^{-11}
Inhalation of Particulates (Radionuclides)	5.0×10^{-7}
Incidental Ingestion of Residual Soils (Chemicals)	2.7×10^{-8}
Incidental Ingestion of Residual Soils (Radionuclides)	2.9×10^{-7}
Dermal Contact with Residual Soils (Chemicals)	3.4×10^{-9}
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	4.5×10^{-8}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	3.9×10^{-7}
Ingestion of Meat (Radionuclides)	1.5×10^{-9}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	6.4×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	2.9×10^{-7}
Ingestion of Vegetables and Fruit (Radionuclides)	4.2×10^{-7}
Direct Radiation	7.7×10^{-7}
Total Receptor ILCR =	3.4×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-30
SUMMARY OF POTENTIAL HEALTH EFFECTS:
SOLID WASTE LANDFILL WITH PRIVATE OWNERSHIP, ALTERNATIVE 3,
ON-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	4.3×10^{-2}
Dermal Contact with Residual Soils (Chemicals)	2.8×10^{-2}
Ingestion of Meat (Chemicals)	1.2×10^{-2}
Ingestion of Dairy Products (Chemicals)	3.6×10^{-2}
Ingestion of Vegetables and Fruit (Chemicals)	6.4×10^{-1}
Ingestion of Drinking Water (Chemicals)	1.7×10^{-3}
Dermal Contact While Bathing (Chemicals)	6.8×10^{-5}
Total Receptor HI =	7.6×10^{-1}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	1.8×10^{-11}
Inhalation of Particulates (Radionuclides)	2.6×10^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	1.2×10^{-8}
Incidental Ingestion of Residual Soils (Radionuclides)	2.7×10^{-8}
Dermal Contact with Residual Soils (Chemicals)	4.7×10^{-10}
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.9×10^{-9}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	6.0×10^{-8}
Ingestion of Meat (Radionuclides)	5.0×10^{-11}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	1.2×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	9.5×10^{-8}
Ingestion of Vegetables and Fruit (Radionuclides)	2.9×10^{-8}
Direct Radiation	5.8×10^{-8}
Total Receptor ILCR =	4.3×10^{-7}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

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TABLE C.7-31
SUMMARY OF POTENTIAL HEALTH EFFECTS: SOLID WASTE LANDFILL WITH PRIVATE OWNERSHIP, ALTERNATIVE 6, EXPANDED TRESPASSER

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	5.2×10^{-4}
Dermal Contact with Residual Soils (Chemicals)	2.0×10^{-2}
Ingestion of Meat (Chemicals)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Dermal Contact While Bathing (Chemicals)	NA
Total Receptor HI =	2.0×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	3.1×10^{-11}
Inhalation of Particulates (Radionuclides)	8.8×10^{-10}
Incidental Ingestion of Residual Soils (Chemicals)	9.2×10^{-8}
Incidental Ingestion of Residual Soils (Radionuclides)	6.4×10^{-9}
Dermal Contact with Residual Soils (Chemicals)	1.7×10^{-7}
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	NA
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	NA
Direct Radiation	1.3×10^{-7}
Total Receptor ILCR =	4.0×10^{-7}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-32
SUMMARY OF POTENTIAL HEALTH EFFECTS:
SOLID WASTE LANDFILL WITH FEDERAL OWNERSHIP, ALTERNATIVE 6,
OFF-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	2.4×10^{-6}
Ingestion of Dairy Products (Chemicals)	3.4×10^{-5}
Ingestion of Vegetables and Fruit (Chemicals)	1.9×10^{-3}
Ingestion of Drinking Water (Chemicals)	6.3×10^{-3}
Dermal Contact While Bathing (Chemicals)	3.6×10^{-4}
Total Receptor HI =	8.6×10^{-3}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	9.0×10^{-11}
Inhalation of Particulates (Radionuclides)	3.6×10^{-9}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	4.0×10^{-7}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	3.6×10^{-10}
Ingestion of Meat (Radionuclides)	1.5×10^{-10}
Ingestion of Dairy Products (Chemicals)	4.3×10^{-10}
Ingestion of Dairy Products (Radionuclides)	2.2×10^{-9}
Ingestion of Vegetables and Fruit (Chemicals)	5.3×10^{-10}
Ingestion of Vegetables and Fruit (Radionuclides)	1.2×10^{-7}
Direct Radiation	NA
Total Receptor ILCR =	5.3×10^{-7}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-33
SUMMARY OF POTENTIAL HEALTH EFFECTS:
SOLID WASTE LANDFILL WITH FEDERAL OWNERSHIP, ALTERNATIVE 6,
OFF-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	4.3×10^{-6}
Ingestion of Dairy Products (Chemicals)	3.6×10^{-4}
Ingestion of Vegetables and Fruit (Chemicals)	7.2×10^{-3}
Ingestion of Drinking Water (Chemicals)	1.5×10^{-2}
Dermal Contact While Bathing (Chemicals)	5.9×10^{-4}
Total Receptor HI =	2.3×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	2.2×10^{-11}
Inhalation of Particulates (Radionuclides)	1.9×10^{-10}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.7×10^{-8}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	5.6×10^{-11}
Ingestion of Meat (Radionuclides)	5.0×10^{-12}
Ingestion of Dairy Products (Chemicals)	3.9×10^{-10}
Ingestion of Dairy Products (Radionuclides)	4.2×10^{-10}
Ingestion of Vegetables and Fruit (Chemicals)	1.8×10^{-10}
Ingestion of Vegetables and Fruit (Radionuclides)	8.4×10^{-9}
Direct Radiation	NA
Total Receptor ILCR =	2.7×10^{-8}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-34
SUMMARY OF POTENTIAL HEALTH EFFECTS:
SOLID WASTE LANDFILL WITH PRIVATE OWNERSHIP, ALTERNATIVE 6,
OFF-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	3.2×10^{-7}
Ingestion of Dairy Products (Chemicals)	1.0×10^{-4}
Ingestion of Vegetables and Fruit (Chemicals)	1.3×10^{-5}
Ingestion of Drinking Water (Chemicals)	2.5×10^{-5}
Dermal Contact While Bathing (Chemicals)	1.4×10^{-6}
Total Receptor HI =	1.4×10^{-4}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	2.1×10^{-12}
Inhalation of Particulates (Radionuclides)	1.4×10^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.5×10^{-9}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	2.3×10^{-11}
Ingestion of Meat (Radionuclides)	6.9×10^{-13}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	6.5×10^{-9}
Ingestion of Vegetables and Fruit (Chemicals)	1.6×10^{-11}
Ingestion of Vegetables and Fruit (Radionuclides)	6.2×10^{-10}
Direct Radiation	NA
Total Receptor ILCR =	2.2×10^{-8}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

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TABLE C.7-35
SUMMARY OF POTENTIAL HEALTH EFFECTS:
SOLID WASTE LANDFILL WITH PRIVATE OWNERSHIP, ALTERNATIVE 6,
OFF-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	5.8×10^{-7}
Ingestion of Dairy Products (Chemicals)	1.1×10^{-3}
Ingestion of Vegetables and Fruit (Chemicals)	5.0×10^{-5}
Ingestion of Drinking Water (Chemicals)	5.8×10^{-5}
Dermal Contact While Bathing (Chemicals)	2.3×10^{-6}
Total Receptor HI =	1.2×10^{-3}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	5.1×10^{-13}
Inhalation of Particulates (Radionuclides)	7.1×10^{-10}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	6.6×10^{-11}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	3.6×10^{-12}
Ingestion of Meat (Radionuclides)	2.3×10^{-14}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	1.3×10^{-9}
Ingestion of Vegetables and Fruit (Chemicals)	5.1×10^{-12}
Ingestion of Vegetables and Fruit (Radionuclides)	4.4×10^{-11}
Direct Radiation	NA
Total Receptor ILCR =	2.1×10^{-9}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-36
SUMMARY OF POTENTIAL HEALTH EFFECTS:
SOLID WASTE LANDFILL WITH PRIVATE OWNERSHIP, ALTERNATIVE 6,
PERCHED GROUNDWATER USER

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	8.2×10^{-3}
Dermal Contact with Residual Soils (Chemicals)	1.7×10^{-2}
Ingestion of Meat (Chemicals)	6.9×10^{-3}
Ingestion of Dairy Products (Chemicals)	3.4×10^{-3}
Ingestion of Vegetables and Fruit (Chemicals)	1.7×10^{-1}
Ingestion of Drinking Water (Chemicals)	NA
Dermal Contact While Bathing (Chemicals)	NA
Total Receptor HI =	2.0×10^{-1}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	7.7×10^{-11}
Inhalation of Particulates (Radionuclides)	5.0×10^{-7}
Incidental Ingestion of Residual Soils (Chemicals)	2.7×10^{-8}
Incidental Ingestion of Residual Soils (Radionuclides)	2.9×10^{-7}
Dermal Contact with Residual Soils (Chemicals)	3.4×10^{-7}
Ingestion of Drinking Water (Chemicals)	2.6×10^{-7}
Ingestion of Drinking Water (Radionuclides)	1.2×10^{-6}
Dermal Contact While Bathing (Chemicals)	8.2×10^{-9}
Ingestion of Meat (Chemicals)	3.9×10^{-7}
Ingestion of Meat (Radionuclides)	1.5×10^{-9}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	6.4×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	2.9×10^{-7}
Ingestion of Vegetables and Fruit (Radionuclides)	4.2×10^{-7}
Direct Radiation	7.7×10^{-7}
Total Receptor ILCR =	4.8×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-37
SUMMARY OF POTENTIAL HEALTH EFFECTS: SOLID WASTE LANDFILL WITH PRIVATE OWNERSHIP, ALTERNATIVE 6 ON-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	8.2×10^{-3}
Dermal Contact with Residual Soils (Chemicals)	1.7×10^{-2}
Ingestion of Meat (Chemicals)	6.9×10^{-3}
Ingestion of Dairy Products (Chemicals)	3.4×10^{-3}
Ingestion of Vegetables and Fruit (Chemicals)	1.7×10^{-1}
Ingestion of Drinking Water (Chemicals)	7.3×10^{-4}
Dermal Contact While Bathing (Chemicals)	4.2×10^{-5}
Total Receptor HI =	2.0×10^{-1}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	7.7×10^{-11}
Inhalation of Particulates (Radionuclides)	5.0×10^{-7}
Incidental Ingestion of Residual Soils (Chemicals)	2.7×10^{-8}
Incidental Ingestion of Residual Soils (Radionuclides)	2.9×10^{-7}
Dermal Contact with Residual Soils (Chemicals)	3.4×10^{-9}
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	4.5×10^{-8}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	3.9×10^{-7}
Ingestion of Meat (Radionuclides)	1.5×10^{-9}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	6.4×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	2.9×10^{-7}
Ingestion of Vegetables and Fruit (Radionuclides)	4.2×10^{-7}
Direct Radiation	7.7×10^{-7}
Total Receptor ILCR =	3.4×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-38
SUMMARY OF POTENTIAL HEALTH EFFECTS:
SOLID WASTE LANDFILL WITH PRIVATE OWNERSHIP, ALTERNATIVE 6
ON-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	4.3×10^{-2}
Dermal Contact with Residual Soils (Chemicals)	2.8×10^{-2}
Ingestion of Meat (Chemicals)	1.2×10^{-2}
Ingestion of Dairy Products (Chemicals)	3.6×10^{-2}
Ingestion of Vegetables and Fruit (Chemicals)	6.4×10^{-1}
Ingestion of Drinking Water (Chemicals)	1.7×10^{-3}
Dermal Contact While Bathing (Chemicals)	6.8×10^{-5}
Total Receptor HI =	7.6×10^{-1}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	1.8×10^{-11}
Inhalation of Particulates (Radionuclides)	2.6×10^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	1.2×10^{-8}
Incidental Ingestion of Residual Soils (Radionuclides)	2.7×10^{-8}
Dermal Contact with Residual Soils (Chemicals)	4.7×10^{-10}
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.9×10^{-9}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	6.0×10^{-8}
Ingestion of Meat (Radionuclides)	5.0×10^{-11}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	1.2×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	9.5×10^{-8}
Ingestion of Vegetables and Fruit (Radionuclides)	2.9×10^{-8}
Direct Radiation	5.8×10^{-8}
Total Receptor ILCR =	4.3×10^{-7}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

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TABLE C.7-39
SUMMARY OF POTENTIAL HEALTH EFFECTS: SOUTH FIELD AREA WITH FEDERAL OWNERSHIP, ALTERNATIVE 2, EXPANDED TRESPASSER

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	2.9×10^{-3}
Dermal Contact with Residual Soils (Chemicals)	1.3×10^{-1}
Ingestion of Meat (Chemicals)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Dermal Contact While Bathing (Chemicals)	NA
Total Receptor HI =	1.3×10^{-1}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	2.5×10^{-9}
Inhalation of Particulates (Radionuclides)	5.7×10^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	1.5×10^{-7}
Incidental Ingestion of Residual Soils (Radionuclides)	1.4×10^{-8}
Dermal Contact with Residual Soils (Chemicals)	2.0×10^{-7}
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	NA
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	NA
Direct Radiation	8.2×10^{-7}
Total Receptor ILCR =	1.2×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-40
SUMMARY OF POTENTIAL HEALTH EFFECTS:
SOUTH FIELD AREA WITH FEDERAL OWNERSHIP, ALTERNATIVE 2,
OFF-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	1.2×10^{-5}
Ingestion of Dairy Products (Chemicals)	7.7×10^{-5}
Ingestion of Vegetables and Fruit (Chemicals)	4.1×10^{-3}
Ingestion of Drinking Water (Chemicals)	1.4×10^{-2}
Dermal Contact While Bathing (Chemicals)	7.8×10^{-4}
Total Receptor HI =	1.8×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	1.2×10^{-8}
Inhalation of Particulates (Radionuclides)	4.3×10^{-7}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	8.6×10^{-7}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	4.3×10^{-9}
Ingestion of Meat (Radionuclides)	3.5×10^{-10}
Ingestion of Dairy Products (Chemicals)	1.0×10^{-9}
Ingestion of Dairy Products (Radionuclides)	4.9×10^{-9}
Ingestion of Vegetables and Fruit (Chemicals)	3.1×10^{-8}
Ingestion of Vegetables and Fruit (Radionuclides)	2.6×10^{-7}
Direct Radiation	NA
Total Receptor ILCR =	1.6×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

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TABLE C.7-41
SUMMARY OF POTENTIAL HEALTH EFFECTS
SOUTH FIELD AREA WITH FEDERAL OWNERSHIP, ALTERNATIVE 2,
OFF-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	2.2×10^{-5}
Ingestion of Dairy Products (Chemicals)	8.1×10^{-4}
Ingestion of Vegetables and Fruit (Chemicals)	1.6×10^{-2}
Ingestion of Drinking Water (Chemicals)	3.2×10^{-2}
Dermal Contact While Bathing (Chemicals)	1.3×10^{-3}
Total Receptor HI =	4.9×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	2.9×10^{-9}
Inhalation of Particulates (Radionuclides)	2.2×10^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	3.7×10^{-8}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	6.6×10^{-10}
Ingestion of Meat (Radionuclides)	1.1×10^{-11}
Ingestion of Dairy Products (Chemicals)	9.2×10^{-10}
Ingestion of Dairy Products (Radionuclides)	9.4×10^{-10}
Ingestion of Vegetables and Fruit (Chemicals)	1.0×10^{-8}
Ingestion of Vegetables and Fruit (Radionuclides)	1.8×10^{-8}
Direct Radiation	NA
Total Receptor ILCR =	9.3×10^{-8}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-42
SUMMARY OF POTENTIAL HEALTH EFFECTS:
SOUTH FIELD AREA WITH FEDERAL OWNERSHIP, ALTERNATIVE 3,
EXPANDED TRESPASSER

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	1.1×10^{-3}
Dermal Contact with Residual Soils (Chemicals)	1.2×10^{-2}
Ingestion of Meat (Chemicals)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Dermal Contact While Bathing (Chemicals)	NA
Total Receptor HI =	1.3×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	3.5×10^{-9}
Inhalation of Particulates (Radionuclides)	5.9×19^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	2.3×10^{-7}
Incidental Ingestion of Residual Soils (Radionuclides)	1.2×10^{-8}
Dermal Contact with Residual Soils (Chemicals)	9.5×10^{-7}
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	NA
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	MA
Ingestion of Meat (Radionuclides)	MA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	NA
Direct Radiation	1.2×10^{-6}
Total Receptor ILCR =	2.5×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

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TABLE C.7-43
SUMMARY OF POTENTIAL HEALTH EFFECTS
SOUTH FIELD AREA WITH FEDERAL OWNERSHIP, ALTERNATIVE 3,
OFF-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	1.8×10^{-5}
Ingestion of Dairy Products (Chemicals)	1.1×10^{-4}
Ingestion of Vegetables and Fruit (Chemicals)	6.0×10^{-3}
Ingestion of Drinking Water (Chemicals)	2.0×10^{-2}
Dermal Contact While Bathing (Chemicals)	1.1×10^{-3}
Total Receptor HI =	2.7×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	1.9×10^{-8}
Inhalation of Particulates (Radionuclides)	4.5×10^{-7}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.2×10^{-6}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	3.3×10^{-8}
Ingestion of Meat (Radionuclides)	5.0×10^{-10}
Ingestion of Dairy Products (Chemicals)	3.5×10^{-8}
Ingestion of Dairy Products (Radionuclides)	7.0×10^{-9}
Ingestion of Vegetables and Fruit (Chemicals)	5.9×10^{-8}
Ingestion of Vegetables and Fruit (Radionuclides)	3.7×10^{-7}
Direct Radiation	NA
Total Receptor ILCR =	2.2×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-44
SUMMARY OF POTENTIAL HEALTH EFFECTS:
SOUTH FIELD AREA WITH FEDERAL OWNERSHIP, ALTERNATIVE 3,
OFF-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	3.2×10^{-5}
Ingestion of Dairy Products (Chemicals)	1.1×10^{-3}
Ingestion of Vegetables and Fruit (Chemicals)	2.3×10^{-2}
Ingestion of Drinking Water (Chemicals)	4.6×10^{-2}
Dermal Contact While Bathing (Chemicals)	1.8×10^{-3}
Total Receptor HI =	7.2×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	4.6×10^{-9}
Inhalation of Particulates (Radionuclides)	2.3×10^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	5.3×10^{-8}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	4.3×10^{-9}
Ingestion of Meat (Radionuclides)	1.6×10^{-11}
Ingestion of Dairy Products (Chemicals)	2.6×10^{-8}
Ingestion of Dairy Products (Radionuclides)	1.4×10^{-9}
Ingestion of Vegetables and Fruit (Chemicals)	1.8×10^{-8}
Ingestion of Vegetables and Fruit (Radionuclides)	2.6×10^{-8}
Direct Radiation	NA
Total Receptor ILCR =	1.6×10^{-7}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000334

TABLE C.7-45
SUMMARY OF POTENTIAL HEALTH EFFECTS:
SOUTH FIELD AREA WITH PRIVATE OWNERSHIP, ALTERNATIVE 3,
OFF-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	4.4×10^{-7}
Ingestion of Dairy Products (Chemicals)	6.0×10^{-6}
Ingestion of Vegetables and Fruit (Chemicals)	2.9×10^{-4}
Ingestion of Drinking Water (Chemicals)	9.4×10^{-4}
Dermal Contact While Bathing (Chemicals)	5.4×10^{-5}
Total Receptor HI =	1.3×10^{-3}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	6.7×10^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	5.9×10^{-8}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	2.5×10^{-11}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	3.6×10^{-10}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	1.8×10^{-8}
Direct Radiation	NA
Total Receptor ILCR =	1.4×10^{-7}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-46
SUMMARY OF POTENTIAL HEALTH EFFECTS
SOUTH FIELD AREA WITH PRIVATE OWNERSHIP, ALTERNATIVE 3,
OFF-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	7.8×10^{-7}
Ingestion of Dairy Products (Chemicals)	6.3×10^{-5}
Ingestion of Vegetables and Fruit (Chemicals)	1.1×10^{-3}
Ingestion of Drinking Water (Chemicals)	2.2×10^{-3}
Dermal Contact While Bathing (Chemicals)	8.8×10^{-5}
Total Receptor HI =	3.5×10^{-3}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	3.4×10^{-9}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	2.5×10^{-9}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	8.4×10^{-13}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	6.9×10^{-11}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	1.3×10^{-9}
Direct Radiation	NA
Total Receptor ILCR =	7.3×10^{-9}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

000336

TABLE C.7-47
SUMMARY OF POTENTIAL HEALTH EFFECTS:
SOUTH FIELD AREA WITH PRIVATE OWNERSHIP, ALTERNATIVE 3,
ON-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	6.5×10^{-4}
Dermal Contact with Residual Soils (Chemicals)	4.2×10^{-3}
Ingestion of Meat (Chemicals)	5.4×10^{-5}
Ingestion of Dairy Products (Chemicals)	6.5×10^{-4}
Ingestion of Vegetables and Fruit (Chemicals)	5.5×10^{-3}
Ingestion of Drinking Water (Chemicals)	5.5×10^{-3}
Dermal Contact While Bathing (Chemicals)	3.2×10^{-4}
Total Receptor HI =	1.7×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	1.3×10^{-6}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	2.8×10^{-8}
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	3.5×10^{-7}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	3.3×10^{-8}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	6.4×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	3.7×10^{-6}
Direct Radiation	3.4×10^{-7}
Total Receptor ILCR =	6.4×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-48
SUMMARY OF POTENTIAL HEALTH EFFECTS
SOUTH FIELD AREA WITH PRIVATE OWNERSHIP, ALTERNATIVE 3,
ON-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	3.4×10^{-3}
Dermal Contact with Residual Soils (Chemicals)	6.8×10^{-3}
Ingestion of Meat (Chemicals)	9.8×10^{-5}
Ingestion of Dairy Products (Chemicals)	6.8×10^{-3}
Ingestion of Vegetables and Fruit (Chemicals)	2.1×10^{-2}
Ingestion of Drinking Water (Chemicals)	1.3×10^{-2}
Dermal Contact While Bathing (Chemicals)	5.2×10^{-4}
Total Receptor HI =	5.2×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	6.7×10^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	2.7×10^{-9}
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.5×10^{-8}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	1.1×10^{-9}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	1.2×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	2.6×10^{-7}
Direct Radiation	2.5×10^{-8}
Total Receptor ILCR =	4.9×10^{-7}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

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TABLE C.7-49
SUMMARY OF POTENTIAL HEALTH EFFECTS:
SOUTH FIELD AREA WITH FEDERAL OWNERSHIP, ALTERNATIVE 6,
EXPANDED TRESPASSER

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	1.1×10^{-3}
Dermal Contact with Residual Soils (Chemicals)	1.2×10^{-2}
Ingestion of Meat (Chemicals)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Dermal Contact While Bathing (Chemicals)	NA
Total Receptor HI =	1.3×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	3.5×10^{-9}
Inhalation of Particulates (Radionuclides)	5.9×10^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	2.3×10^{-7}
Incidental Ingestion of Residual Soils (Radionuclides)	1.2×10^{-8}
Dermal Contact with Residual Soils (Chemicals)	9.5×10^{-7}
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	NA
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	NA
Ingestion of Vegetables and Fruit (Chemicals)	MA
Ingestion of Vegetables and Fruit (Radionuclides)	NA
Direct Radiation	1.2×10^{-6}
Total Receptor ILCR =	2.5×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-50
SUMMARY OF POTENTIAL HEALTH EFFECTS:
SOUTH FIELD AREA WITH FEDERAL OWNERSHIP, ALTERNATIVE 6,
OFF-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	1.8×10^{-5}
Ingestion of Dairy Products (Chemicals)	1.1×10^{-4}
Ingestion of Vegetables and Fruit (Chemicals)	6.0×10^{-3}
Ingestion of Drinking Water (Chemicals)	2.0×10^{-2}
Dermal Contact While Bathing (Chemicals)	1.1×10^{-3}
Total Receptor HI =	2.7×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	1.9×10^{-8}
Inhalation of Particulates (Radionuclides)	4.5×10^{-7}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.2×10^{-6}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	3.3×10^{-8}
Ingestion of Meat (Radionuclides)	5.0×10^{-10}
Ingestion of Dairy Products (Chemicals)	3.5×10^{-8}
Ingestion of Dairy Products (Radionuclides)	$7.0 \text{ X } 10^{-9}$
Ingestion of Vegetables and Fruit (Chemicals)	5.9×10^{-8}
Ingestion of Vegetables and Fruit (Radionuclides)	3.7×10^{-9}
Direct Radiation	NA
Total Receptor ILCR =	2.2×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

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TABLE C.7-51
SUMMARY OF POTENTIAL HEALTH EFFECTS:
SOUTH FIELD AREA WITH FEDERAL OWNERSHIP, ALTERNATIVE 6,
OFF-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	3.2×10^{-5}
Ingestion of Dairy Products (Chemicals)	1.1×10^{-3}
Ingestion of Vegetables and Fruit (Chemicals)	2.3×10^{-2}
Ingestion of Drinking Water (Chemicals)	4.6×10^{-2}
Dermal Contact While Bathing (Chemicals)	1.8×10^{-3}
Total Receptor HI =	7.2×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	4.6×10^{-9}
Inhalation of Particulates (Radionuclides)	2.3×10^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	5.3×10^{-8}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	4.3×10^{-9}
Ingestion of Meat (Radionuclides)	1.6×10^{-11}
Ingestion of Dairy Products (Chemicals)	2.6×10^{-8}
Ingestion of Dairy Products (Radionuclides)	1.4×10^{-9}
Ingestion of Vegetables and Fruit (Chemicals)	1.8×10^{-8}
Ingestion of Vegetables and Fruit (Radionuclides)	2.6×10^{-8}
Direct Radiation	NA
Total Receptor ILCR =	1.6×10^{-7}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-52
SUMMARY OF POTENTIAL HEALTH EFFECTS:
SOUTH FIELD AREA WITH PRIVATE OWNERSHIP, ALTERNATIVE 6,
OFF-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	4.4×10^{-7}
Ingestion of Dairy Products (Chemicals)	6.0×10^{-6}
Ingestion of Vegetables and Fruit (Chemicals)	2.9×10^{-4}
Ingestion of Drinking Water (Chemicals)	9.4×10^{-4}
Dermal Contact While Bathing (Chemicals)	5.4×10^{-5}
Total Receptor HI =	1.3×10^{-3}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	6.7×10^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	5.9×10^{-8}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	2.5×10^{-11}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	3.6×10^{-10}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	1.8×10^{-8}
Direct Radiation	NA
Total Receptor ILCR =	1.4×10^{-7}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-53
SUMMARY OF POTENTIAL HEALTH EFFECTS:
SOUTH FIELD AREA WITH PRIVATE OWNERSHIP, ALTERNATIVE 6,
OFF-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	7.8×10^{-7}
Ingestion of Dairy Products (Chemicals)	6.3×10^{-5}
Ingestion of Vegetables and Fruit (Chemicals)	1.1×10^{-3}
Ingestion of Drinking Water (Chemicals)	2.2×10^{-3}
Dermal Contact While Bathing (Chemicals)	8.8×10^{-5}
Total Receptor HI =	3.5×10^{-3}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	3.4×10^{-9}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	2.5×10^{-9}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	8.4×10^{-13}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	6.9×10^{-11}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	1.3×10^{-9}
Direct Radiation	NA
Total Receptor ILCR =	7.3×10^{-9}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-54
SUMMARY OF POTENTIAL HEALTH EFFECTS:
SOUTH FIELD AREA WITH PRIVATE OWNERSHIP, ALTERNATIVE 6,
ON-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	6.5×10^{-4}
Dermal Contact with Residual Soils (Chemicals)	4.2×10^{-3}
Ingestion of Meat (Chemicals)	5.4×10^{-5}
Ingestion of Dairy Products (Chemicals)	6.5×10^{-4}
Ingestion of Vegetables and Fruit (Chemicals)	5.5×10^{-3}
Ingestion of Drinking Water (Chemicals)	5.5×10^{-3}
Dermal Contact While Bathing (Chemicals)	3.2×10^{-4}
Total Receptor HI =	1.7×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	1.3×10^{-6}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	2.8×10^{-8}
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	3.5×10^{-7}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	3.3×10^{-8}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	6.4×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	3.7×10^{-6}
Direct Radiation	3.4×10^{-7}
Total Receptor ILCR =	6.4×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

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TABLE C.7-55
SUMMARY OF POTENTIAL HEALTH EFFECTS:
SOUTH FIELD AREA WITH PRIVATE OWNERSHIP, ALTERNATIVE 6,
ON-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	3.4×10^{-3}
Dermal Contact with Residual Soils (Chemicals)	6.8×10^{-3}
Ingestion of Meat (Chemicals)	9.8×10^{-5}
Ingestion of Dairy Products (Chemicals)	6.8×10^{-3}
Ingestion of Vegetables and Fruit (Chemicals)	2.1×10^{-2}
Ingestion of Drinking Water (Chemicals)	1.3×10^{-2}
Dermal Contact While Bathing (Chemicals)	5.2×10^{-4}
Total Receptor HI =	5.2×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	6.7×10^{-8}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	2.7×10^{-9}
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.5×10^{-8}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	1.1×10^{-9}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	1.2×10^{-7}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	2.6×10^{-7}
Direct Radiation	2.5×10^{-8}
Total Receptor ILCR =	4.9×10^{-7}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

TABLE C.7-56
SUMMARY OF POTENTIAL HEALTH EFFECTS:
DISPOSAL CELL WITH FEDERAL OWNERSHIP*, ALTERNATIVE 6,
EXPANDED TRESPASSER

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Dermal Contact While Bathing (Chemicals)	NA
Total Receptor HI =	NA

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	1.4×10^{-13}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	NA
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	NA
Direct Radiation	NA
Total Receptor ILCR =	1.4×10^{-13}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

* Assumes federal ownership of FEMP, with federal ownership of disposal cell.

TABLE C.7-57
SUMMARY OF POTENTIAL HEALTH EFFECTS: DISPOSAL CELL WITH FEDERAL OWNERSHIP*, ALTERNATIVE 6, OFF-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	7.2×10^{-6}
Ingestion of Dairy Products (Chemicals)	1.0×10^{-4}
Ingestion of Vegetables and Fruit (Chemicals)	5.7×10^{-3}
Ingestion of Drinking Water (Chemicals)	1.9×10^{-2}
Dermal Contact While Bathing (Chemicals)	1.1×10^{-3}
Total Receptor HI =	2.6×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	7.7×10^{-12}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.2×10^{-6}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	4.6×10^{-10}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	6.5×10^{-9}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	3.6×10^{-7}
Direct Radiation	NA
Total Receptor ILCR =	1.6×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

* Assumes federal ownership of FEMP, with federal ownership of disposal cell.

TABLE C.7-58
SUMMARY OF POTENTIAL HEALTH EFFECTS:
DISPOSAL CELL WITH FEDERAL OWNERSHIP*, ALTERNATIVE 6,
OFF-PROPERTY (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	1.3×10^{-5}
Ingestion of Dairy Products (Chemicals)	1.1×10^{-3}
Ingestion of Vegetables and Fruit (Chemicals)	2.2×10^{-2}
Ingestion of Drinking Water (Chemicals)	4.4×10^{-2}
Dermal Contact While Bathing (Chemicals)	1.8×10^{-3}
Total Receptor HI =	6.9×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	3.9×10^{-13}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	5.2×10^{-8}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	1.5×10^{-11}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	1.3×10^{-9}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	2.5×10^{-8}
Direct Radiation	NA
Total Receptor ILCR =	7.8×10^{-8}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

* Assumes federal ownership of FEMP, with federal ownership of disposal cell.

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TABLE C.7-59
SUMMARY OF POTENTIAL HEALTH EFFECTS:
DISPOSAL CELL WITH PRIVATE OWNERSHIP*, ALTERNATIVE 6,
EXPANDED TRESPASSER

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Dermal Contact While Bathing (Chemicals)	NA
Total Receptor HI =	NA

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	7.3×10^{-14}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	NA
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	NA
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	NA
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	NA
Direct Radiation	
Total Receptor ILCR =	7.3×10^{-14}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

* Assumes private ownership of FEMP, with federal ownership of disposal cell.

TABLE C.7-60
SUMMARY OF POTENTIAL HEALTH EFFECTS:
DISPOSAL CELL WITH PRIVATE OWNERSHIP*, ALTERNATIVE 6,
OFF-PROPERTY FARMER (ADULT)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	7.2×10^{-6}
Ingestion of Dairy Products (Chemicals)	1.0×10^{-4}
Ingestion of Vegetables and Fruit (Chemicals)	5.7×10^{-3}
Ingestion of Drinking Water (Chemicals)	1.9×10^{-2}
Dermal Contact While Bathing (Chemicals)	1.1×10^{-3}
Total Receptor HI =	2.6×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	4.0×10^{-12}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	1.2×10^{-6}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	4.6×10^{-10}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	6.5×10^{-9}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	3.6×10^{-7}
Direct Radiation	NA
Total Receptor ILCR =	1.6×10^{-6}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

* Assumes private ownership of FEMP, with federal ownership of disposal cell.

TABLE C.7-61
SUMMARY OF POTENTIAL HEALTH EFFECTS:
DISPOSAL CELL WITH PRIVATE OWNERSHIP*, ALTERNATIVE 6,
OFF-PROPERTY FARMER (CHILD)

Exposure Pathway	Pathway HI
Inhalation of Particulates (Chemicals)	NA
Incidental Ingestion of Residual Soils (Chemicals)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Meat (Chemicals)	1.3×10^{-5}
Ingestion of Dairy Products (Chemicals)	1.1×10^{-3}
Ingestion of Vegetables and Fruit (Chemicals)	2.2×10^{-2}
Ingestion of Drinking Water (Chemicals)	4.4×10^{-2}
Dermal Contact While Bathing (Chemicals)	1.8×10^{-3}
Total Receptor HI =	6.9×10^{-2}

Exposure Pathway	Pathway ILCR
Inhalation of Particulates (Chemicals)	NA
Inhalation of Particulates (Radionuclides)	2.0×10^{-13}
Incidental Ingestion of Residual Soils (Chemicals)	NA
Incidental Ingestion of Residual Soils (Radionuclides)	NA
Dermal Contact with Residual Soils (Chemicals)	NA
Ingestion of Drinking Water (Chemicals)	NA
Ingestion of Drinking Water (Radionuclides)	5.2×10^{-8}
Dermal Contact While Bathing (Chemicals)	NA
Ingestion of Meat (Chemicals)	NA
Ingestion of Meat (Radionuclides)	1.5×10^{-11}
Ingestion of Dairy Products (Chemicals)	NA
Ingestion of Dairy Products (Radionuclides)	1.3×10^{-9}
Ingestion of Vegetables and Fruit (Chemicals)	NA
Ingestion of Vegetables and Fruit (Radionuclides)	2.5×10^{-8}
Direct Radiation	NA
Total Receptor ILCR =	7.8×10^{-8}

HI = Hazard Index
ILCR = Incremental Lifetime Cancer Risk
NA = Not applicable. Exposure route is incomplete (see Section C.2.3.4)

* Assumes private ownership of FEMP with federal ownership of disposal cell.

C.8.0 UNCERTAINTY ANALYSIS

Risk assessments contain various elements of uncertainty. The purpose of identifying and reviewing those uncertainties is to gauge the accuracy of the risk estimates and thus aid in the formation of risk management decisions. For the major categories of uncertainty relevant to remedial and residual risks, questions were posed to evaluate the contributors to uncertainty:

- COC Selection:
  Are all COCs identified and their concentrations adequately quantified?

- Toxicity Information and Models:
  How complete is current information concerning toxic properties and dose-response characteristics of the COCs?

- Exposure Pathways and Parameters:
  Are all potential pathways for transporting COCs from site environmental media to receptors identified?

- Receptor Characterization:
  Are land use scenarios conservative, and are all potential receptors identified? Are exposure factors reasonable?

- Exposure Point Concentrations:
  Are models for estimating COC transport from site media to the receptor, and for estimating COC exposures and intakes, realistic and reasonable? Are the assumptions used for developing risks reasonable and bounding of potential exposure ranges?

- Risk Characterization:
  What uncertainties are associated with cancer risks or HIs for multiple COCs?

At the FEMP site, the approach taken on an FS risk assessment differs from that of a baseline risk assessment. FS risk assessments estimate exposure point concentrations using models and assumptions about site conditions both during and following remedial actions. Baseline risk assessments use existing data to evaluate current risks. The results of FS risk assessments have much more inherent uncertainty with regard to exposure patterns, exposed populations, and exposure concentrations than do the results of baseline risk assessments. One purpose of this uncertainty analysis is to characterize the sources of uncertainty which contribute most to the overall uncertainty in the FS risk assessment.

C.8.1 COC SELECTION

A major concern of this FS risk assessment is the reliability of COC identification, both in terms of ensuring that all chemicals or radionuclides have been correctly identified as COCs and that their potential concentrations are adequately quantified. The accuracy of COC identification is directly related to the quality of COC characterization data, including information on contaminant identification, location, and concentrations. Characterization was controlled by the CERCLA sampling and analysis plan, which identified sampling locations and analytical protocols.

The source of COC data for this risk assessment was the Operable Unit 2 RI report (DOE 1994a), particularly the baseline risk assessment. The RI report was prepared according to CERCLA guidelines, and the data were validated. Whenever possible, COC identification was based on risk results in the baseline risk assessment from data collected according to the CERCLA sampling plan. However, uncertainty is inherently high in the Solid Waste Landfill data due to the heterogeneity of the waste forms. Uncertainty of soil data is inherently higher than groundwater data because soils are heterogeneous.

It is unlikely that major COC contributors to risk for Operable Unit 2 have been overlooked. Any shortcomings in the chemical data that have been gathered at the FEMP site are compensated for by a large database of contaminant type and concentration data. Evaluation of these data have identified a large number of COCs which are present in Operable Unit 2 wastes and associated materials, and confirm general contamination patterns indicated by past site operations. There is a high degree of certainty that the major COCs (uranium and other radionuclides, arsenic and other metals, and organics) which could credibly contribute to site risks have been identified.

According to RAGS (EPA 1989a), the UCLs are used for all exposure concentrations. This means that 95 percent of the time, the actual mean concentration can be less than the value used in the exposure assessment. Conversely, 5 percent of the time the actual mean concentration can be greater than the value used in the exposure assessment.

C.8.2 TOXICITY INFORMATION AND MODELS

EPA-supplied RfDs and cancer slope factors were used throughout the residual risk evaluation. Because of this, toxicological evaluations (upon which the residual risk evaluation is based) contribute no more uncertainty than in comparable CERCLA documents.

As described in the Operable Unit 2 RI report, considerable uncertainty is associated with qualitative (hazard assessment) and quantitative (dose-response) evaluations of Superfund risk assessments. The hazard assessment characterizes the nature and strength of the evidence of causation, or the likelihood that a chemical that induces adverse effects in animals will induce adverse effects in humans. The hazard assessment of carcinogenicity is evaluated as a weight-of-evidence determination, using criteria from EPA (1986). Positive results in animal cancer tests suggest humans may also manifest a carcinogenic response, but the animal data cannot necessarily be used to predict the target tissue in humans. In the hazard assessment of noncarcinogenic effects, positive animal test results may suggest the nature of the human effects, i.e., the target tissues and type of effects (EPA 1989a).

There are many sources of uncertainty in dose-response evaluation of carcinogenic (i.e., slope factor or unit risk calculations) and noncarcinogenic effects (i.e., RfD or RfC calculations). The three major sources are:

1. Interspecies extrapolations:

   Animal-to-human extrapolation, commonly used in the absence of quantitative pharmacokinetics, dosimetric, or mechanistic data, is usually based on a consideration of interspecies differences in body weight, surface area, or basal metabolic rate.

2. Intraspecies or individual variation:

   Most toxicity experiments are performed with animals that are similar in age and genotype so that intragroup biological variation is minimal. The human population of concern may reflect a great deal of heterogeneity, however, including unusual sensitivity to specific toxic effects or contaminants.

   Toxicity data from human occupational studies reflect a bias because only those individuals sufficiently healthy to attend work regularly and those not unusually sensitive to the COCs are likely to be occupationally exposed.

3. Key study and database quality:

The quality of key studies (from which the quantitative data are derived) and the quality of the literature databases add to the uncertainty. For carcinogenic effects, the uncertainty associated with some quality factors (i.e., group size) is incorporated into the 95 percent upper bound estimate of the slope factor. For noncarcinogenic effects, additional uncertainty factors may be applied in the derivation of the RfD or RfC to reflect gaps in the database.

Another source of uncertainty in the quantitative risk estimation for carcinogenicity is the method by which data from high doses in animal studies are extrapolated to the dose range expected for environmentally exposed humans. The linear multi-stage model, which is used in almost all quantitative estimations of human risk from animal data, is based on the nonthreshold assumption of carcinogenesis. A large body of evidence, however, suggests that epigenetic carcinogens (carcinogens, which do not induce mutations), as well as many genotoxic carcinogens may have a threshold dose level below which they are noncarcinogenic (Williams and Weisberger 1991). The linear multi-stage model is therefore regarded as being conservative for many chemicals.

Adding to this uncertainty is the fact that the EPA-derived slope factors found in IRIS (EPA 1994a) are set at the 95 percent UCL of the linear slope of the multi-stage model. Thus, risks evaluated using the slope factors may be overestimated. This consideration applies to both radiological and chemical estimates of carcinogenic risk. The slope factors derived by EPA for the evaluation of risks due to external exposure to radiation are of particular concern in this regard. These values were derived using conservative assumptions about exposure conditions and are likely to provide conservative risk estimates.

The methods used to define RfD values for chemical contaminants also incorporate a large degree of conservatism. Sets of multiplicative uncertainty factors (UFs) are used to adjust the results of animal and human toxicologic studies to take into account the nature of the endpoint No Observed Adverse Effect Level (NOAEL) to Lowest Observed Adverse Effect Level (LOAEL) seen in the studies, differences in response to different dose schedules, the presence of especially sensitive populations, and the possible differences between human and animal sensitivity to contaminant exposures. Each UF may have a value as high as ten; thus, RfD values typically are set between 100 and 1000 times lower than the lowest dose seen to cause any adverse effects in animal studies. If the human and animal responses to contaminant exposures are not as dissimilar as reflected in the UFs (or if humans are less, rather than more, sensitive to

contaminants), it is possible that the use of RfDs overstates the potential for adverse health effects in humans.

The level of uncertainty in the toxicologic data for different chemicals varies because information concerning some constituents and their associated health effects is comparatively scarce, whereas for others much more information is available from health effects studies. Also, different amounts of data may be available concerning the different types of effects for a given COC. For example, uranium (a key COC at Operable Unit 2) has been established as a chemical toxicant (mainly affecting the kidneys) based on human and animal studies. The RfD for uranium was based on the results of animal studies and was calculated by applying an uncertainty factor of 1000 to a LOAEL for nephrotoxicity in rabbits to provide a margin of safety for extrapolation to humans. The uncertainty factor consists of three factors of 10 each for: 1) estimation of a NOAEL from a LOAEL, 2) extrapolation from animals to humans, and 3) the range of sensitivities among exposed humans.

There is even greater uncertainty regarding the carcinogenicity of uranium. As an alpha-particle emitter, uranium is also considered a carcinogen; however, epidemiological evidence of uranium-induced excess cancers is difficult to obtain. This is largely because the human data available on the radiocarcinogenic effects of uranium exposure are for underground miners who were simultaneously exposed to radon and radon progeny, which are known carcinogens. The studies of humans sometimes lack quantitative information concerning uranium exposure, including potential uranium exposure through previous employment, concurrent smoking patterns, or concurrent radon exposure levels, all of which are needed to definitively determine the risk attributable to uranium exposure. These facts weaken the power of the human studies to detect excess risk, if any, above natural risk. These uncertainties are not well known or easily quantified.

Uncertainties in the interpretation of toxicologic data also affect risk assessment results for inhalation exposures to metals. Hazard index values associated with particulate inhalation exposures exceed one for several receptors at Operable Unit 2. Almost all of the HI values are contributed by exposures to antimony.

Subchronic health effects as a result of short-term exposures during remedial actions were assessed in this FS using chronic risk parameters. This assumption was made because the

duration of on-property exposures during remediation could potentially exceed the two-week to seven-year exposure period defined for subchronic exposures. The use of the more conservative chronic risk parameters provide a more conservative approximation of health effects with less uncertainty.

Uncertainty in the derivation of reference doses in mitigated by the use of uncertainty and modifying factors that normally range between three and ten. Uncertainty factors (UF) and modifying factors (MF) are assigned as follows:

- A UF of ten is used to account for sensitive subpopulations.
- A UF of ten is used when extrapolating from animals to humans to account for interspecies variability.
- A UF of ten is applied to a NOAEL (no observed adverse effect level) derived from a subchronic study rather than a chronic study.
- A UF of ten is applied to a LOAEL (lowest observed adverse effect level) to estimate a NOAEL.
- An MF from zero to ten is applied to data to reflect the quality of the data from the critical study used to derive the reference does.

As a result, a combination of uncertainty and modifying factors may exceed 100, 1000, or more for a particular compound. Other toxicity information used in the Operable Unit 2 risk assessment that introduces uncertainty include (DOE 1994a):

- The EPA inhalation slope factor of 7.7×10^{-12} pCi^{-1} for Rn-222 plus its daughters is used to calculate risks resulting from indoor inhalation of radon gases. The EPA bases this slope factor on a 50% equilibrium ratio between Rn-222 and its short-lived daughters. Studies cited in NCRP Report No. 78 (NCRP 1984) report a lower value for this equilibrium ratio in indoor air (i.e.: 100/50/30/20/20 for Ra-222, Po-218, Pb-214, Bi-214, and Po-214, respectively). Since the concentration of daughters expected in indoor air is lower than the EPA assumption, the slope factor is probably conservative in this respect.
- PAHs that are classified as B2 probable human carcinogens for which no toxicity data were available are evaluated using benzo(a)pyrene toxicity data. This assumption likely leads to an overestimation of the carcinogenicity of those PAHs because conservative assumptions were used to relate their carcinogenicity to that of benzo(a)pyrene. However, when toxicity equivalency factors were used in this assessment to evaluate their carcinogenicity, this may either underestimate or overestimate the carcinogenic risks. Overall, this increased conservatism does not

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significantly impact the overall risks from Operable Unit 2 since the majority of risks are posed by other COCs.

- The only PCB with positive carcinogenicity results is Aroclor-1260. The carcinogenicity of all PCB isomers were assumed to be equal to the carcinogenicity of Aroclor-1260 because the dose-response data for other isomers are inconclusive. Statistically significant cancer results were not seen for Aroclors with lower percentages of chlorine atoms. The conservatism introduced in the evaluation of PCBs is not anticipated to impact the selection of COCs for final risks because they did not exceed the concentration-toxicity screen.

- As with PAHs, the carcinogenicity of dioxins and furans other than the 2,3,7,8-isomer were determined using EPA's revised Toxicity Equivalency Factors (TEFs) in the absence of toxicity values for the different isomers. The TEFs are based on the assumption that all dioxin and furan congeners are carcinogenic. This may introduce a large positive bias to the results of the assessment.

A significant source of uncertainty for calculating risks from radionuclides in surface soil is the use of EPA slope factors for external radiation exposure. In deriving these slope factors, EPA has assumed that an individual stands continuously on an infinitely thick slab of soil with a uniform radionuclide concentration. To manage complicated calculations for photon attenuation and scattering in soil, EPA has assumed that the activity in the slab source is present on an infinite plane with uniform surface concentration. The slope factors for external radiation exposure are, therefore, based on calculated exposures (and associated risks of cancer incidence) from the hypothetical plane source. In addition, EPA calculates slope factors for ingestion of many radionuclides using the maximum value for the GI absorption factor. The actual chemical form(s) that influence the magnitude of the GI absorption factor have not been considered.

C.8.3 EXPOSURE PATHWAYS AND PARAMETERS

Both remedial and residual exposure pathways are derived from EPA guidance (EPA 1989a) and the RAWPA (DOE 1992). As such, the components for each pathway are based on information derived from literature or scientific hypothesis. The associated uncertainties are reviewed below.

C.8.3.1 Remedial Action Exposure Pathways

In general, estimates of remedial action risks in this assessment are conservative. The estimates tend to overestimate the risks likely to be experienced by potential receptors during remedial activities. Conservative analyses are necessary to compensate for uncertainties inherent in the

assessment and to insure that potential risks are not missed. These uncertainties are examined by exposure mode below.

Direct Radiation

Excavation. Direct radiation exposure to a remediation worker during excavation requires an individual standing on contaminated ground during the last phase of excavation. The magnitude of his exposure is directly related to the time he spends standing on the ground. The exposure time is very uncertain. It is likely that a person will spend very little time on contaminated ground, since excavation through the liner will take place without monitoring (and therefore without the presence of monitoring personnel) and contaminated ground should exist only in areas where the liner has been breached.

If a heavy-equipment accident should occur, protection from direct radiation afforded the remediation worker inside the cab could be greatly diminished. Exposure parameters for this scenario are difficult to quantify and the results uncertain. Qualitatively, it can be stated that impacts would be small since exposure time would be short and radiation fields would be low.

Drying. Direct radiation exposure to an operator from drying depends on the proximity of the operator to the dryer containing soil material and on the shielding afforded by the dryer. Given the low radiation dose rates associated with the material and the "hands-off" nature of the drying process, it is likely that radiation exposure would be unmeasurable using personnel dosimetry devices. Impacts predicted in the assessment, though small, likely overestimate the dose equivalent that would occur.

Gondola Handling. Direct radiation exposure impact to a gondola handler depends on the proximity of the handler to the gondolas. Handlers will need to perform radiation surveys of each gondola. The estimate of the duration of these operations represents the primary uncertainty in this assessment. However, these operations comprise only a small fraction of the total time needed to load a gondola.

Immersion and Inhalation

Excavation. Similar to direct radiation from discrete sources, exposure via ionizing radiation from immersion in and inhalation of airborne contaminants depends on source strength (air

concentration) and exposure duration. For assessment of excavation risks, it is uncertain where the receptors will be with respect to the excavation. This assessment assumes the receptors are located as near as possible to the excavation site. It is likely that nonremediation workers and off-site individuals would be exposed to greatly reduced concentrations, thus reducing their overall exposure.

For remediation workers, inhalation impacts were ignored since the workers would use respirators. However, respirators do not completely eliminate intake of COCs in the air. Respirators afford a protection factor on the order of a factor of 50 (per 10 CFR Part 20) to the worker. This means that the worker wearing a respirator is exposed to a COC concentration 50 times less than is in the air. However, in spite of the anticipated low risk from inhalation to nonremediation workers, and the lower exposure time than for nonremediation workers (a factor of 5), to be conservative, this risk was quantified.

As with direct radiation, if a heavy equipment accident should occur, the protection from inhalation of contaminated soil afforded the remediation worker inside the cab could be greatly diminished. Exposure parameters for this scenario are difficult to quantify and the results uncertain. Qualitatively, it can be stated that impacts would be small since the exposure time would be short and COC concentrations low.

The remedial action risk assessment assumes that subsurface waste materials and underlying liners (when present) are unavailable for transport to receptors due to the high amount of moisture in these materials. Although a reasonable assumption, concentrations of arsenic in waste material would result in cancer risk of 10^{-3} if resuspended. Any uncertainty regarding the resuspension of waste material must be eliminated to reduce the resuspension risks; that is, engineering controls must be in place to ensure that waste materials and liner will not be resuspended during excavation.

Drying, Shredding, and Crushing

To evaluate releases during waste processing operations, receptors were placed close to the release point (200 meters for nonremediation workers and 400 meters for off-site individuals), thus exposing them to a higher-than-expected concentration of COCs. Waste processing is assumed to be released from ground level, although any such release will likely be elevated (from

a stack vent). Elevated releases result in greater dispersion and lower COC exposure point concentrations.

Finally, the off-gas system will likely remove a fraction of the COCs assumed to be released. No credit was taken for off-gas contaminant removal in the assessment.

For nonremediation workers, a breathing rate of 3 cubic meters per hour is used. This assumes the worker is doing heavy labor continually for the 8 hours per day he is working and is exposed. A nominal value of approximately 1 cubic meter, or one third as great, is probably a more reasonable estimate.

Mechanical Hazards

Mechanical hazard risk coefficients are based on general construction activities. Remedial activities considered in this FS generally involve less "hands-on" work. It is likely that actual risk to workers from mechanical hazards will be less than that calculated in this assessment, due to the use of remote operations. Also, the man-hour estimates used in the cost estimate do not have a fine distinction of worker type. Many of the hours could be attributable to nonlaborers.

Transportation

Transportation impacts were assessed with the RADTRAN 4 computer code. The exposure scenario was defined based on many of the code default parameter values. These defaults are designed to give upperbound estimates of impacts.

Risk Perspectives for Risks to Remediation Workers

Remediation worker inhalation and direct radiation doses, as calculated in Tables C.II-1 through 13, 18-21, and 28-30 were in range of 10^{-5} to 10^{-6} for the various subunits for the total duration of the project, approximately 4 years. These doses were calculated assuming:

- No worker protective equipment (PPE)
- The 95% UCL soil concentration
- Worst-case exposure durations
- Assumes that one worker receives the maximum exposure in each subunit for all Remediation activities
- Inhalation and uptake (i.e., is taken into the lungs) of 100% of the soil which is airborne at the maximum dust loading (600 $\mu g/m^3$) for the entire exposure duration
- Worst-case soil volumes.

The assumptions used in these calculations must be considered as bounding, and in many cases, far exceed even worst-case scenarios. The method of evaluating worker inhalation doses based on dust loading ignores the following critical "dose-lowering" considerations:

- Only a fraction of the soil is respirable. Dust must be of a respirable fraction to be taken into the lungs. This respirable fraction is in the size range of 0.2 - 10 μm (AMAD), with the most likely intake size at 1 μm.
- Of the respirable fraction, only 60% of the amount inhaled will be taken in by the body.
- Only a fraction of the soil will contain contamination at the 95% UCL level.
- Because of the duration of some of the activities, workers will not be exposed to the maximum hours for any subunit.

Any one of these considerations could be responsible for an order of magnitude over-estimation of actual doses. Many of these considerations are "built-in" to the EPA methodology (assumptions) in order to ensure conservatism in the estimations, but they do not represent "real" risks to a worker, and were developed to ensure the safety of the public exposed to chronic releases of contaminants over long (e.g., lifetime) exposures. A lifetime is currently defined as 70 years. The exposure duration of this project is approximately 4 years. While it is assumed that carcinogens, once taken into the body, continue to pose a cancer risk for the rest of an individual's life, these calculational methods are based on continuous intakes (i.e., new carcinogen exposure) over the 70 years.

The total doses over the life of the project as calculated in Tables C.II-1 to -12, that are responsible for the largest part of these risks are (given approximately):

- 200 mrem maximum for direct radiation
- 50 mrem inhalation

The dust loading for construction activities is 600 $\mu g/m^3$ (RAWPA). For the most limiting uranium isotopes (U-234, -235, and -236), DOE has calculated a derived air concentration (DAC), i.e., the air concentration that will give a dose of 5 rem is breathed by a worker for 2000 hr/year, of 2×10^{-11} μCi/ml (10 CFR 835). Using a uranium soil concentration of 500 pCi/gm (based on the solid waste landfill U-total listed in Table C.II-4), the following estimate can be made:

$$[500\frac{pCi}{gm}][6x10^{-4}\frac{gm}{m^3}] = 0.3\frac{pCi}{m^3} = 3x10^{-13}\frac{\mu Ci}{cm^3} \qquad \text{Eq. C.8-1}$$

When compared to the DAC of 2 x 10^{-11} μCi/ml, this estimate is two orders of magnitude lower, giving an approximate, but conservative dose of 50 mrem/year.

TABLE C.8-1

SUMMARY OF CURRENT REGULATORY STANDARDS FOR PROTECTION OF RADIATION WORKERS

Regulatory Standard	Regulatory Agency	Limit Value (rem)	Conditions
10 CFR 20, 835	US NRC, DOE	5 rem/yr	External + internal
10 CFR 20, 835	US NRC, DOE	25 rem	Lifetime special exposure
10 CFR 20, 835	US NRC, DOE	0.5	To a declared pregnant worker
10 CFR 20, 835	US NRC, DOE	0.05	Maximum per year without consideration of respiratory protection
10 CFR 20, 835	US NRC, DOE	0.1	Maximum per year in a controlled area
10 CFR 20, 835	US NRC, DOE	0.005 rem/hr	Areas which must be designated as radiation areas
29 CFR 1910.96	OSHA	1.25 rem/quarter	Worker whole body limit
29 CFR 1910.96	OSHA	7.5 rem/quarter	Skin

Since the project is on a four year basis, the annual doses would be about 50 mrem/yr for direct radiation and 15 mrem/year for inhalation.

The risks presented may be put into perspective for remediation workers by comparing the dose used to calculate this risk to current regulatory standards for exposure. These are summarized in Table C.8-1.

As shown in Table C.8-1, the doses estimated are in the range that is considered acceptable for workers in controlled areas, but these activities may not even require respiratory protection. Estimates of direct radiation performed using the MICROSHIELD code predicted dose rates up to a maximum of 0.00003 rem/hr (for excavation of the Active Flyash Pile). And the areas may

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not need to be declared as radiation areas. These doses are well within the acceptable current standard for exposures to members of the public from licensed sources, 100 mrem/yr.

These risks are more commensurate with those that would be acceptable for risks to members of the public (10^{-4} to 10^{-6}), than those deemed acceptable to workers. Workers are assumed to voluntarily be exposed to risks that are higher than those to which the public should be exposed. The key is in risks assumed voluntarily as opposed to "public" risks which are assumed to be involuntary risks. This can be seen in the regulatory limits for workers (Table C.8-1) that include OSHA, NRC, and DOE limits at 5 rem/yr as opposed to the public dose limit of 100 mrem/yr. OSHA is charged with setting safe worker levels for various work hazards while EPA has been tasked with ensuring public and environmental safety to hazardous materials.

Members of the public are currently exposed to background radiation of 100 mrem (New York) to 125 mrem (Denver) yearly based on their place of residence. Public risks which can be considered voluntary include those shown in Table C.8-2. The risks to workers from radiation are orders of magnitude below those posed by industrial hazards, as shown in Tables C.II-21 and -22.

TABLE C.8-2

ACTIVITIES CAUSING A RISK OF DEATH OF 10^{-6} PER YEAR

Activity per year	Nature of Risk
Smoking 3 cigarettes	Cancer, heart disease
Drinking 1/2 liter of wine	Cirrhosis of the liver
Spending 1 hour in a coal mine	Black lung disease
Traveling 300 miles by car	Accident
Flying 6,000 miles by jet	Cancer caused by cosmic radiation
One chest X-ray	Cancer caused by radiation

Source: Jacobson, A.P. and G.P. Sakalosky, 1980. *Radiation in Medicine & Industry*, Public Information Committee of the Health Physics Society, Bethesda, Maryland.

C.8.3.2 Residual Exposure Pathways

Receptors considered in the FS residual risk assessment are the off-property farmer (adult and child), on-property resident farmer (adult and child), on-property perched water user, and expanded trespasser. Other receptors may be exposed to FEMP COCs; however, the conservative exposure scenarios used in this report provide a high degree of assurance that no actual exposed population will receive levels of exposure greater than those estimated in the FS risk assessment.

Potential exposure pathways were evaluated for each exposed receptor. All pathways which could be complete under either land use scenario (federal or private ownership) were evaluated quantitatively for their potential to be associated with adverse health effects. Each specific receptor population was assumed to be exposed through all pathways which might be complete under minimally plausible conditions. There is a high degree of assurance that total exposures are not underestimated for any actual exposed populations.

Default exposure factor values for characterizing exposures to FEMP receptors are presented in the RAWPA. For this FS risk assessment, receptor scenarios were selected to represent the highest potential exposures. Exposure factors in the risk assessment are based on surveys of physiological characteristics and behavioral profiles across the United States. Attributes and activities studied in these surveys generally have a broad distribution. To account for most of this distribution, this risk assessment follows the EPA's recommendation in RAGS to use the 95th percentile values for most exposure factors (EPA 1989a).

Exposure Duration

In accordance with EPA guidance (EPA 1989a), it was assumed that farm families occupy the land for a full lifetime (70-year) exposure period. This is a conservative approach. The exposure durations for all individuals within an age bracket are realistic, because of the historic stability of communities in the FEMP area.

Exposure Frequency

It was assumed on-property and off-property families would occupy the property for 350 days per year, a conservative but realistic assumption for farm families.

Exposure Time

Farming family members were assumed to spend 24 hours a day on the farm property, whether it is assumed to be on or off the FEMP property. This is a conservative assumption as it does not take into account school time, shopping time, off-farm work, and other activities.

Body Weight

Body weights used in the evaluation of residual risks were derived from standard tables for United States body weight distributions. Values were selected from distribution midpoints because of the certainty regarding those distributions. The actual variation for adults is likely to be less than a factor of two. Although children have a wide range of body weights, the uncertainty is, at most, a factor of two or three (plus or minus for a given age group). Selection of the midpoint (rather than the 95th percentile) for this variable adds conservatism to the risk estimates because this quantity appears in the denominator of the intake equations (i.e., risk is inversely proportional to body weight).

Ingestion of Soil, Food, and Water

There has been considerable discussion in the scientific literature concerning the appropriate oral ingestion rate of soil and dust for adults and children. Current EPA guidance recommends 100 mg/day for adults and 200 mg/day for children under the age of six. Since the evaluation of residual risk considered farmers who would be exposed to quantities of dust through farming activities, a weighted value of 180 mg/day was used for the on- and off-property farmers. These values are realistic as a multi-year average, but soil ingestion rates could potentially be higher for short-term exposures.

The rate and type of food consumption vary greatly from locality to locality and individual to individual. Estimates of food consumption used in the residual risk assessment are national averages and may not be appropriate for some individuals exposed to FEMP COCs. It should be noted that it was assumed that the majority of food consumed will be from local farm products. This is a very conservative assumption. The values presented represent conservative estimates and are not likely to vary by more than a factor of two for the average individual. The greatest uncertainty is in the consumption of specific foods (e.g., vegetables) by children. The direction and magnitude of this uncertainty are unknown.

Consumption of drinking water was set to EPA Region V default values, which are conservative estimates. Over multi-year exposures, these values are not likely to vary widely and may be overestimated by a factor of less than two. Most likely, drinking water consumed will be less than the default values.

Dermal Exposure Factors

Four critical assumptions have been made relating to the assessment of dermal exposure to soils: 1) amount of exposed skin surface area, 2) quantity of soil adhering to the skin, 3) length of time the soil adheres to the skin, and 4) partitioning rate of the COC from soil across the skin barrier. In addition, intake of contaminants associated with dermal contact to water is controlled by dermal permeability to specific waterborne contaminants. These factors vary widely and may contribute substantially to uncertainty in the risk assessment by these pathways. In general, assumptions used to estimate dermal absorption are consistent with the conservative default values defined in EPA guidance (EPA 1989a). The average extent of uncertainty in dermal exposure factors is quite large (an order of magnitude or more). In addition, the adjustment of toxicity values for use in the dermal pathway risk assessment, particularly in the case of inorganic contaminants, was performed using conservative assumptions about contaminant intake and likely contributes a further, unknown degree of conservatism to the characterization of dermal pathway risks.

C.8.4 RECEPTOR CHARACTERIZATION

Receptor characterizations were developed primarily from the RAWPA and EPA comments dated June 27, 1994 (EPA 1994d) on the Operable Unit 2 FS risk assessment. For this FS, receptor scenarios for the two future land uses, government and private ownership, were selected to represent the reasonable maximum potential exposure.

As described in Section C.8.3.2, exposure factors were based on surveys of physiological and lifestyle profiles across the Untied States and attributes and activities studies generally have a broad distribution. To account for most of this distribution, this risk assessment follows EPA's recommendation in RAGS to use the 95th percentile for most exposure factors (EPA 1989a). In addition, the exposure factors are consistent with EPA Region V guidance. This introduces a conservative bias into the results.

The following RME receptors were chosen for the FS remedial action risk assessment:

- Remediation workers
- Nonremediation workers
- Off-property residents at the FEMP boundary
- General public

Exposure pathways for these receptors include inhalation of resuspended dust and gaseous emissions, ingestion of and dermal contact with soil, direct radiation effects, and physical injury.

The following receptors were selected for the residual risk assessment:

Federal Ownership with Access Controls	Private Ownership
Off-property farmer (adult)	On-property resident farmer (adult using water from GMA)
Off-property farmer (child)	On-property resident farmer (child using water from GMA)
Expanded trespasser	Off-property farmer (adult)
	Off-property farmer (child)
	On-property farmer (adult using perched water)

As previously stated, other receptors may be exposed to FEMP COCs; however, the conservative exposure scenarios addressed in this report make it likely that no actual exposed population will receive greater exposures than those estimated in the FS risk assessment.

A major uncertainly associated with predicting future exposures at the FEMP is the future disposition of the property itself. Because it is not possible to accurately predict what the future uses of the land may be, the most conservative (rather than the most likely) land use was evaluated, as stipulated by the NCP. The receptors evaluated in this assessment have been generally selected to reflect and encompass those types of activities that would produce the reasonable maximum exposure. The uncertainty associated with receptors identified in the two future land use scenarios is high (i.e., potential to overestimate risk by 2 or more orders of magnitude) due to the low probability of the site being used as a residence or for agricultural purposes (DOE 1994c).

C.8.5 EXPOSURE POINT CONCENTRATIONS

Predicted concentrations were used as exposure point concentrations since measured data are not available (e.g., the future. These predictions were made using mathematical representations (models) of the natural systems found or suspected to exist in the study area. Due to the complexity of natural environments, conservative assumptions were often used in these models to calculate exposure point concentrations. Uncertainties associated with modeled exposure point concentrations in Operable Unit 2 can be attributed to the following sources:

- Use of Toxicity Characteristic Leaching Procedure (TCLP) data to characterize leachate concentrations in the natural environment adds conservatism to the groundwater fate and transport modeling process because TCLP leaching is performed with an acidic solution. This tends to overestimate the leachate concentration of inorganics over natural (more neutral) leaching conditions.

- The selection of parameters related to the attenuation and retardation of constituents is a major uncertainty in the analysis. The attenuation and retardation factors of every constituent except uranium were determined after an extensive literature search. The use of site-specific values are assumed to result in lower uncertainty than using literature values.

- The organic decay rates at the FEMP were determined after an extensive literature search. The actual decay rates may or may not follow the assumed literature values because of site-specific conditions. The use of site data to determine organic decay rates is assumed to result in lower uncertainty than that resulting from the use of literature values.

- Transport through the vadose zone is approximated by using a one-dimensional model and assuming the zone is homogeneous. The unsaturated seepage flow rate is a function of several parameters, such as porosity, residual saturation, and pore size distribution index. Due to the heterogeneous nature of the till, these parameters change from location to location and from depth to depth.

- The total mass of each contaminant is calculated by multiplying the UCL by the volume of the entire waste area, except for U238 which was kriiged, thus assuming the UCL concentration is uniformly distributed through the entire source.

- The fate and transport modeling uses a "70-year rule" for these constituents where no or inadequate leachate data exist. This "rule" assumes all the chemical leaches from a particular waste unit in 70 years. This method is considered very conservative for compounds that are insoluble but may underestimate the maximum exposure for soluble compounds.

- Air modeling is based on a number of conservative assumptions. In combination these assumptions appear to overestimate the exposure point concentrations for air based on site air monitoring data and according to a literature search for typical ambient air PM_{10} measurements for EPA Region V. The long-term average PM_{10}

concentrations calculated are comparable to measured dust concentrations on constructions. This uncertainty is expected to moderately overestimate risk (i.e., overestimate risks by 1 to 2 orders-of-magnitude).

- The future configuration of the OU2 subunits is uncertain at this time; thus, a reasonable worst-case configuration is used to determine source concentrations for both air and surface water modeling. If the actual configuration differs from that used in this evaluation, the future source concentrations may change and the models will have incorrectly estimated the exposure point concentrations.

- The transport models individually made assumptions regarding the fate of individual constituents within source media. However, these models were not combined or linked to consider assumptions made regarding depletion of chemicals from one model and the effect of that assumption on another model (i.e., the leaching models did not consider source depletion from volatilization or fugitive emissions and the air emissions models did not consider losses via leaching). Further, the direct exposure pathways to a particular source (i.e., incidental ingestion of surface soil) did not consider source depletion by leaching, surface water transport, or air emissions. Consequently, this assumption is considered very conservative.

These uncertainties for modeling collectively are assumed to moderately overestimate the concentrations expected in groundwater and for aerial deposition (i.e., overestimate concentration and risk by a factor of one to two orders of magnitude) based on the above discussion. Models were also used to calculate chemical concentrations in plants and animals. Each time concentrations at one level in the food chain are extrapolated from a lower level, uncertainty is introduced into the result. For example, soil-to-plant transfer factors (B_{iv} values) generally represent the maximum amount of contaminant transfer that may occur. In reality, the contaminant transfer is quite dependent on the form of the constituent (e.g., metal specifies) and other site-related physical conditions (e.g., soil type). Thus actual site transfer factors are unknown. The values chosen are intended to be conservative and they are likely to overestimate risk.

Each exposure factor selected for use in this risk assessment has some uncertainty associated with it. Generally these factors are based on surveys of physiological and lifestyle profiles across the Unite States. The attributes and activities studied in these surveys generally have a broad distribution. To avoid the underestimation of exposure, this risk assessment followed EPA's recommendation and used the 96th percentile for most of the exposure parameters used in this risk assessment. In other words, the values selected represent the observed or expected habits of

a small percentage of the population (usually the upper 5 or 10 percent). For example, the resident farmer scenarios were assumed to inhale air at the location of the highest annual average concentration for 350 days per year for 70 years. Seventy years represents the maximum exposure duration and is not based on a statistical assessment of local or regional residence time for farm families. This factor tends to overestimate risk.

Few intake parameters have high uncertainty associated with them. In the risk assessment for Operable Unit 2, the particular exposure parameters with the greatest uncertainty are judged to be those associated with time (combination of frequency and duration on the site). The particular exposure pathway with the combination of exposure parameters with the highest uncertainty is dermal contact, which is assumed to result in moderate uncertainty (over- or underestimate actual exposure by one to two orders of magnitude) for exposure.

Values used to represent exposure point concentrations were defined to provide conservative estimates of exposure, thus ensuring a conservative evaluation of risks. All residual risk assessment exposure point groundwater concentrations are projected or modeled values. Uncertainties associated with exposure point concentrations estimated by models are additive or multiplicative and include uncertainties associated with each input parameter (diffusion coefficients, groundwater flow rates, etc.), model characteristics, release mechanisms, and source terms. Residual risk evaluation input parameters were based on site information and professional judgment and were designed to be conservative. Input parameters and models were selected and used in a manner consistent with the RAWPA. Further, representation of future conditions such as the three southern operable units are modeled as one unit for post remediation conditions. This is a result of the mixing and co-location of the remediated units.

C.8.6 RISK CHARACTERIZATION

Throughout this risk assessment, potential health effects caused by the simultaneous exposure to multiple on-site COCs were assumed to be additive in nature. Uncertainties associated with summing cancer risks or HIs for multiple substances are of particular concern in the risk characterization step. The assumption of dose additivity ignores possible synergism or antagonism among chemicals and assumes similarity in mechanisms of action. However, data to quantitatively assess chemical interactions are generally lacking. In the absence of adequate information on chemical interactions, EPA guidelines indicate that carcinogenic risks should be treated as

additive, and noncancer HIs should also be treated as additive. These assumptions are made to help prevent an underestimation of cancer risk or potential noncancer health effects at a site (EPA 1989a). Table C.8-3 provides on overview of the boundary of uncertainty for risk.

TABLE C.8-3

SUMMARY OF UNCERTAINTIES, AND RISK BOUNDING

Uncertainty Problem	Specification of Problem	Direction and Extent of Uncertainty	Effects on the Reported Risks
COC Selection			
1. Species of Contaminants	Not all COCs have been identified.	Low order of uncertainty. Probably localized in small areas:	Probably underestimates risks by a factor less than 10.
2. Quality of COC Information	Not all quantities are known and validated in various media.	Moderate order of uncertainty involving material volumes.	Varied. Can overestimate or underestimate risk by more than 1 order of magnitude.
Toxicological Information and Models	Extrapolation of data missing RfDs or slope factors.	Underestimates COCs not quantified.	Varied. Can range from less than a factor of 10 to 1 order of magnitude.
	Conservative derivation of slope factors and RfDs.	Overestimates risks for all COCs.	May overestimate risk by 2 to 3 orders of magnitude.
	Linear dose-response modeling.	Overestimates risks for some contaminants.	May overestimate risks by several orders of magnitude.
	EPA slope factor for external radiation	Assumes infinitely thick slab of soil and external source	May overestimates risk by severe orders of magnitude
Exposure Pathways	Improbable pathways to receptors; lack of institutional controls after 70 years.	Depending on the land use, the receptors may represent an overestimate.	Moderate. Possibly 1 order of magnitude.
Receptor Characterization			
1. Expanded Trespasser	Exposure of 110 days per year may be excessive.	Mild overestimate for drinking water exposures by using a maximum concentration and swimming in Paddys Run, etc.	Overestimates by less than a factor of 3.
2. Resident Farm Receptors	Assumption that 50 percent of fruit and vegetables and 100 percent of meat and milk is derived from the farm.	Overestimate.	Possibly a factor of 3.
	Estimation of exposure parameters.	In general, the exposure parameters are mild overestimates.	Mild. Less than 1 order of magnitude.

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TABLE I.11-6
(Continued)

Uncertainty Problem	Specification of Problem	Direction and Extent of Uncertainty	Effects on the Reported Risks
3. 70-year Exposure	Seventy years of exposure for farmer receptor represents the maximum duration and not statistical assessment	Overestimates risk.	Moderate current EPA RAGs recommends a 30-year exposure.
Exposure Point Concentration			
1. Air Concentrations	Surface soil concentrations.	Unknown due to lack of data.	Unknown.
	Dust emission rate relating to vegetative cover and particle size.	Vegetative cover assumptions may cause underestimate, particularly relating to farming activities. May be offset if particle size distribution shows low potential for particulate generation.	Mild. Less than 1 order of magnitude.
	Temporal correlation between particulate generation and dispersion not accounted for.	Overestimate of air particulate expansion.	Probably moderate. 1 order of magnitude or less.
2. Groundwater Concentration	Migration rate.	Overestimate due to selecting small K_d values. This affects both concentrations and time of peak.	Moderate. 1 to 2 orders of magnitude.
	Leachate concentrations.	Overestimate due to conservative assumptions, also availability of contaminants.	Moderate. 1 to 2 orders of magnitude.
	Source term.	Direction is unknown due to the overall uncertainty in the extent of contamination. Could be an underestimate.	Moderate. Could vary both plus and minus 1 order of magnitude.
3. Farm Product Concentrations	Toxicity of COC on Farm Product.	Could be an overestimate.	Unknown.

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C.9

C.9.0 SUMMARY OF RISK ASSESSMENT RESULTS

This section summarizes the calculated remedial action and residual risks for each receptor under the four FS remedial alternatives. Six COC sources were modeled including the five subunits and Disposal Cell. As such, the remedial action and residual risks are presented side by side for consolidation of information. The remedial action and residual risks are not additive, due to the differing time spans in which they are likely to occur. For example, remedial action is assumed to occur within the next 10 to 20 years. In contrast, residual risks are considered to occur over a 1000-year time span, likely peaking at least a century after remediation is complete. Therefore, these categories of potential risk should be and are considered separately in the FS.

Within the following summary tables, the potential carcinogenic and noncarcinogenic human-health risks, the risk of injury, and the risk of fatality are presented. For the no-action risk scenarios (Alternative 1), the baseline risk assessment from the Operable Unit 2 RI report (DOE 1994a) was used. These matrices present the complete combination of land uses, receptors remedial and residual risks, subunits, sources and alternatives. This information is provided to risk managers and stakeholders so they can select the preferred remedial alternative based on the EPA's criteria for the feasibility study. Specifically, the matrices can be compared to the EPA criteria for the overall protection of human health and the environment, long-term effectiveness, and short-term effectiveness.

C.9.1 REMEDIAL ACTION RISKS

Remedial action risks were calculated for carcinogenic and noncarcinogenic risks to remediation workers, on-property nonremediation workers, off-site public, off-property workers, and the public along the transportation route. Both construction and transportation risks were evaluated. Transportation risks were evaluated for rail transportation. On-site trucking risks were evaluated as part of the on-site industrial hazards. A summary of the results is presented in Tables C.9-1 through C.9-14. The following provides a brief discussion of the result.

For all alternatives, risks due to inhalation exceed the 10^{-6} target risk value for remediation and on-site nonremediation workers except for risk associated with the lime sludge pond for alternative two. Risks to the public range from less than 10^{-7} to less than 10^{-5}.

For dermal exposure, all alternatives show cancer risks less than 10^{-6} and HIs less than 1. For direct radiation, risks for the remediation worker exceed the 10^{-6} target for all alternatives. The risks for nonremediation workers and the public are below the target value. Risks from VOCs and immersion in a contaminated cloud are well below the targeted risk value for all alternatives. Risk from on-site industrial hazards are less for Alternative 2, increasing for Alternatives 3 and 6 respectively.

Remedial risks were calculated based on volumes and remediation hours developed from the public ownership land use. For the South Field, Solid Waste Landfill, and Lime Sludge Ponds, the volumes and remediation hours are approximately 2 to 5 times less than the volume and hours for the federal ownership scenario. For the Inactive and Active Flyash Piles, the volume and hours are a fraction of those calculated for the federal ownership scenario. Associated risks for the federal ownership scenario would be less than the risk presented in this section, for the public ownership scenario.

C.9.2 SUMMARY OF ESTIMATED RISKS

Table C.9-15 summarizes the highest (of the four subunit areas) remedial action and residual risks and hazards estimated to potential receptors resulting from the implementation of Alternatives 2, 3, and 6. The subunits contributing these risks and hazards are denoted by a footnote. The highest risks and hazards estimated for the No Action alternative are also presented to provide a comparison of potential risks in the event that no remedial actions are taken.

Risks posed by the implementation of remedial actions under Alternatives 2, 3, and 6 are generally on the order of 10^{-5} for the remedial worker and 10^{-6} for the nonremedial worker and general public. The greatest risk and hazard is to the remedial worker (5.1×10^{-5} and 8.9×10^{-3}, respectively) from the implementation of Alternative 3. The risks to the remedial worker are developed without the benefit of personnel protective equipment per Section 10 of the RAWPA. As such, the level of protection provided by personnel protective equipment would further reduce risk.

The greatest residual risks and hazards posed to any potential receptors, under either federal or private ownership, are from Alternative 1 (No Action). Total ILCRs are in the range of 10^{-2} to 10^{-6} while total HIs range from below 1.0 to 65.

The next greatest residual risks and hazards posed result from the implementation of remedial alternatives (i.e., Alternatives 2, 3, and 6). For the federal ownership scenario, the greatest risk is to

the expanded trespasser (2.5×10^{-6}) under Alternatives 3 and 6. The greatest hazard for this scenario is to this same receptor (0.13) under Alternative 3. For the private ownership scenario, the greatest risk is to the on-property resident farmer (6.4×10^{-6}) under Alternatives 3 and 6. The greatest hazards for this scenario are to the on-property resident child (0.76), also under Alternatives 3 and 6.

REMEDIAL ACTION RISKS

REMEDIAL ALTERNATIVE	RISK	1. ACTIVE FLYASH PILE	2. INACTIVE FLYASH PILE**	3. SOUTH FIELD**	4. LIME SLUDGE POND	5. SOLID WASTE LANDFILL
1 NO ACTION	ILCR					
	HI					
	PI/F					
	p-rem					
2 CONSOLIDATION AND CAPPING	ILCR	2.09×10^{-5}	2.7×10^{-5}	2.7×10^{-5}	3.7×10^{-6}	1.6×10^{-5}
	HI	2.9×10^{-4}	3.4×10^{-3}	3.4×10^{-3}	1.3×10^{-3}	2.3×10^{-3}
	PI/F	$1.77/2.6 \times 10^{-2}$	$1.27/1.9 \times 10^{-2}$	$0.38/5.5 \times 10^{-3}$	$0.14/2.0 \times 10^{-3}$	$0.41/6.0 \times 10^{-3}$
	p-rem					
3 EXCAVATION AND OFF-SITE DISPOSAL	ILCR	5.1×10^{-5}	2.9×10^{-5}	2.9×10^{-5}	8.4×10^{-6}	2.7×10^{-5}
	HI	8.1×10^{-4}	8.9×10^{-3}	8.9×10^{-3}	2.7×10^{-3}	4.6×10^{-3}
	PI/F	$1.4/2.1 \times 10^{2}$	$1.8/2.6 \times 10^{2}$	$4.9/7.1 \times 10^{2}$	$1.4/2.1 \times 10^{-2}$	$1.5/2.2 \times 10^{2}$
	p-rem					
6 EXCAVATION AND ON-SITE DISPOSAL WITH OFF-SITE DISPOSAL OF FRACTION EXCEEDING WAC	ILCR	2.0×10^{-5}	3.0×10^{-5}	3.0×10^{-5}	9.2×10^{-6}	9.2×10^{-5}
	HI	2.9×10^{-4}	3.0×10^{-3}	3.0×10^{-3}	1.3×10^{-3}	3.8×10^{-3}
	PI/F	$1.2/1.8 \times 10^{2}$	$2.0/3.0 \times 10^{2}$	$5.3/7.8 \times 10^{2}$	$2.4/3.6 \times 10^{-2}$	$0.5/7.0 \times 10^{3}$
	p-rem					

SOURCES:

- THE RAWPA (DOE 1992) AND PREVIOUS FS RISK ASSESSMENTS DEFINE THE SCOPE OF QUANTITATIVE ANALYSIS FOR SHORT-TERM (REMEDIAL ACTION) AND LONG-TERM (RESIDUAL) RISKS. NOTE THAT CARCINOGENIC AND NONCARCINOGENIC RISKS RESULTING FROM ACCIDENTS ARE NOT INDICATED AND THEREFORE HAVE NOT BEEN CALCULATED.

RISKS

- CARCINOGENIC = INCREMENTAL LIFETIME CANCER RISK (ILCR) FROM CHEMICAL AND ALL RADIOLOGICAL IMPACTS (NCP TARGET RANGE IS 10^{-4} TO 10^{-6})
- NON CARCINOGENIC = HAZARD INDEX (HI) (HI NOT TO EXCEED 1.0)
- PHYSICAL INJURY = INJURIES PREDICTED PER WORK HOUR (PI)
- FATALITIES = DEATHS PREDICTED PER WORK HOUR (F)
- WHOLE BODY DOSE EQUIVALENT (PERSON REM, i.e., p=rem)
- DOE ANNUAL DOSE RATE = 5 REM (10CFR20 835)

ND = NOT DETERMINED

= NOT APPLICABLE

- For residual risk analysis, these subunits are modeled as one combined, southern subunit, due to postremediation commingling.

** For remedial action risks, these subunits are modeled as one combined subunit, because the soil concentration data presented in the RI is for a combined subunit.

TABLE C.9-1
RISK SUMMARY FOR OU2 ALTERNATIVES AND SUBUNIT
REMEDIAL WORKE

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REMEDIAL ACTION RISKS

REMEDIAL ALTERNATIVE	RISK	1. ACTIVE FLYASH PILE	2INACTIVE FLYASH PILE**	3. SOUTH FIELD**	4. LIME SLUDGE POND	5. SOLID WASTE LANDFILL
1 NO ACTION	ILCR					
	HI					
	PI/F					
	p-rem					
2 CONSOLIDATION AND CAPPING	ILCR	7.5×10^{-7}	1.3×10^{-6}	1.3×10^{-6}	1.3×10^{-6}	1.3×10^{-6}
	HI	ND	ND	ND	ND	ND
	PI/F					
	p-rem					
3 EXCAVATION AND OFF-SITE DISPOSAL	ILCR	2.6×10^{-6}	1.6×10^{-6}	1.6×10^{-6}	3.4×10^{-7}	2.1×10^{-6}
	HI	ND	ND	ND	ND	ND
	PI/F					
	p-rem					
6 EXCAVATION AND ON-SITE DISPOSAL WITH OFF-SITE DISPOSAL OF FRACTION EXCEEDING WAC	ILCR	5.3×10^{-7}	1.8×10^{-6}	1.8×10^{-6}	3.4×10^{-7}	2.4×10^{-6}
	HI	ND	ND	ND	ND	ND
	PI/F					
	p-rem					

SOURCES:

- THE RAWPA (DOE 1992) AND PREVIOUS FS RISK ASSESSMENTS DEFINE THE SCOPE OF QUANTITATIVE ANALYSIS FOR SHORT-TERM (REMEDIAL ACTION) AND LONG-TERM (RESIDUAL) RISKS. NOTE THAT CARCINOGENIC AND NONCARCINOGENIC RISKS RESULTING FROM ACCIDENTS ARE NOT INDICATED AND THEREFORE HAVE NOT BEEN CALCULATED.

RISKS

- CARCINOGENIC = INCREMENTAL LIFETIME CANCER RISK (ILCR) FROM CHEMICAL AND ALL RADIOLOGICAL IMPACTS (NCP TARGET RANGE IS 10^{-4} TO 10^{-6})
- NON CARCINOGENIC = HAZARD INDEX (HI) (HI NOT TO EXCEED 1.0)
- PHYSICAL INJURY = INJURIES PREDICTED PER WORK HOUR (PI)
- FATALITIES = DEATHS PREDICTED PER WORK HOUR (F)
- WHOLE BODY DOSE EQUIVALENT (PERSON REM, i.e., p=rem)
- DOE ANNUAL DOSE RATE = 5 REM (10CFR20 835)

ND = NOT DETERMINED

= NOT APPLICABLE

* For residual risk analysis, these subunits are modeled as one combined, southern subunit, due to postremediation commingling.

** For remedial action risks, these subunits are modeled as one combined subunit, because the soil concentration data presented in the RI is for a combined subunit.

TABLE C.9-2
RISK SUMMARY FOR OU2 ALTERNATIVES AND SUBUNITS
NONREMEDIAL WORKER

RESIDUAL RISKS

REMEDIAL ALTERNATIVE	RISK	1. ACTIVE FLYASH PILE*	2. INACTIVE FLYASH PILE*	3. SOUTH FIELD*	4. LIME SLUDGE POND	5. SOLID WASTE LANDFILL	6.DISPOSAL CELL
1 NO ACTION	ILCR	$1.1X10^{-5}$	$7.5X10^{-5}$	$8.7X10^{-5}$	$1.7X10^{-5}$	$6.7X10^{-7}$	
	HI	0.19	1.2	1.1	$2.0X10^{-5}$	$1.8X10^{-6}$	
2 CONSOLIDATION AND CAPPING	ILCR	1.6×10^{-6}	1.6×10^{-6}	1.6×10^{-6}	3.3×10^{-11}	2.3×10^{-9}	
	HI	1.8×10^{-2}	1.8×10^{-2}	1.8×10^{-2}	1.2×10^{-7}	2.5×10^{-5}	
3 EXCAVATION AND OFF-SITE DISPOSAL	ILCR	2.2×10^{-6}	2.2×10^{-6}	2.2×10^{-6}	9.3×10^{-8}	5.3×10^{-7}	
	HI	2.7×10^{-2}	2.7×10^{-2}	2.7×10^{-2}	1.5×10^{-3}	8.6×10^{-3}	
6 EXCAVATION AND ON-SITE DISPOSAL WITH OFF-SITE DISPOSAL OF FRACTION EXCEEDING WAC	ILCR	2.2×10^{-6}	2.2×10^{-6}	2.2×10^{-6}	9.3×10^{-8}	5.3×10^{-7}	1.6×10^{-6}
	HI	2.7×10^{-2}	2.7×10^{-2}	2.7×10^{-2}	1.5×10^{-3}	8.6×10^{-3}	2.6×10^{-2}

SOURCES:

- THE RAWPA (DOE 1992) AND PREVIOUS FS RISK ASSESSMENTS DEFINE THE SCOPE OF QUANTITATIVE ANALYSIS FOR SHORT-TERM (REMEDIAL ACTION) AND LONG-TERM (RESIDUAL) RISKS. NOTE THAT CARCINOGENIC AND NONCARCINOGENIC RISKS RESULTING FROM ACCIDENTS ARE NOT INDICATED AND THEREFORE HAVE NOT BEEN CALCULATED.

RISKS

- CARCINOGENIC = INCREMENTAL LIFETIME CANCER RISK (ILCR) FROM CHEMICAL AND ALL RADIOLOGICAL IMPACTS (NCP TARGET RANGE IS 10^{-4} TO 10^{-6})
- NON CARCINOGENIC = HAZARD INDEX (HI) (HI NOT TO EXCEED 1.0)
- PHYSICAL INJURY = INJURIES PREDICTED PER WORK HOUR (PI)
- FATALITIES = DEATHS PREDICTED PER WORK HOUR (F)
- WHOLE BODY DOSE EQUIVALENT (PERSON REM, i.e., p=rem)
- DOE ANNUAL DOSE RATE = 5 REM (10CFR20 835)

ND = NOT DETERMINED

= NOT APPLICABLE

- For residual risk analysis, these subunits are modeled as one combined, southern subunit, due to postremediation commingling.

TABLE C.9-3
RISK SUMMARY FOR OU2 ALTERNATIVES AND SUBUNITS
OFF-PROPERTY FARMER (ADULT)
FEDERAL OWNERSHIP WITH ACCESS CONTROLS

RESIDUAL RISKS

REMEDIAL ALTERNATIVE	RISK	1. ACTIVE FLYASH PILE*	2.INACTIVE FLYASH PILE*	3. SOUTH FIELD*	4. LIME SLUDGE POND	5. SOLID WASTE LANDFILL	6. DISPOSAL CELL
1 NO ACTION	ILCR	7.2×10^{-7}	4.0×10^{-6}	4.2×10^{-6}	1.6×10^{-8}	3.5×10^{-9}	
	HI	2.5	7.9×10^{-1}	3.1	9.3×10^{-8}	6.4×10^{-6}	
2 CONSOLIDATION AND CAPPING	ILCR	9.3×10^{-8}	9.3×10^{-8}	9.3×10^{-8}	1.7×10^{-12}	1.2×10^{-10}	
	HI	4.9×10^{-2}	4.9×10^{-2}	4.9×10^{-2}	3.3×10^{-7}	6.6×10^{-5}	
3 EXCAVATION AND OFF-SITE DISPOSAL	ILCR	1.6×10^{-7}	1.6×10^{-7}	1.6×10^{-7}	4.6×10^{-9}	2.7×10^{-8}	
	HI	7.2×10^{-2}	7.2×10^{-2}	7.2×10^{-2}	4.1×10^{-3}	2.3×10^{-2}	
6 EXCAVATION AND ON-SITE DISPOSAL WITH OFF-SITE DISPOSAL OF FRACTION EXCEEDING WAC	ILCR	1.6×10^{-7}	1.6×10^{-7}	1.6×10^{-7}	4.6×10^{-9}	2.7×10^{-8}	7.8×10^{-8}
	HI	7.2×10^{-2}	7.2×10^{-2}	7.2×10^{-2}	4.1×10^{-3}	2.3×10^{-2}	6.9×10^{-2}

LEGEND:

SOURCES:

- THE RAWPA (DOE 1992) AND PREVIOUS FS RISK ASSESSMENTS DEFINE THE SCOPE OF QUANTITATIVE ANALYSIS FOR SHORT-TERM (REMEDIAL ACTION) AND LONG-TERM (RESIDUAL) RISKS. NOTE THAT CARCINOGENIC AND NONCARCINOGENIC RISKS RESULTING FROM ACCIDENTS ARE NOT INDICATED AND THEREFORE HAVE NOT BEEN CALCULATED.

RISKS

- CARCINOGENIC = INCREMENTAL LIFETIME CANCER RISK (ILCR) FROM CHEMICAL AND ALL RADIOLOGICAL IMPACTS (NCP TARGET RANGE IS 10^{-4} TO 10^{-6})
- NON CARCINOGENIC = HAZARD INDEX (HI) (HI NOT TO EXCEED 1.0)
- PHYSICAL INJURY = INJURIES PREDICTED PER WORK HOUR (PI)
- FATALITIES = DEATHS PREDICTED PER WORK HOUR (F)
- WHOLE BODY DOSE EQUIVALENT (PERSON REM, i.e., p=rem)
- DOE ANNUAL DOSE RATE = 5 REM (10CFR20 835)

ND = NOT DETERMINED

= NOT APPLICABLE

- For residual risk analysis, these subunits are modeled as one combined, southern subunit, due to postremediation commingling.

TABLE C.9-4
RISK SUMMARY FOR OU2 ALTERNATIVES AND SUBUNITS
OFF-PROPERTY FARMER (CHILD) FEDERAL OWNERSHIP WITH ACCESS CONTROLS

RESIDUAL RISKS

REMEDIAL ALTERNATIVE	RISK	1. ACTIVE FLYASH PILE*	2. INACTIVE FLYASH PILE*	3. SOUTH FIELD*	4. LIME SLUDGE POND	5. SOLID WASTE LANDFILL	6. DISPOSAL CELL
1 NO ACTION	ILCR	1.1×10^{-5}	7.5×10^{-5}	1.1×10^{-4}	1.7×10^{-7}	1.2×10^{-6}	
	HI	1.9×10^{-3}	$1.2 \times 10^{+0}$	1.1×10^{0}	2.0×10^{-5}	5.6×10^{-5}	
2 CONSOLIDATION AND CAPPING	ILCR						
	HI						
3 EXCAVATION AND OFF-SITE DISPOSAL	ILCR	1.4×10^{-7}	1.4×10^{-7}	1.4×10^{-7}	4.9×10^{-9}	2.2×10^{-8}	
	HI	1.3×10^{-3}	1.3×10^{-3}	1.3×10^{-3}	2.9×10^{-6}	1.4×10^{-4}	
6 EXCAVATION AND ON-SITE DISPOSAL WITH OFF-SITE DISPOSAL OF FRACTION EXCEEDING WAC	ILCR	1.4×10^{-7}	1.4×10^{-7}	1.4×10^{-7}	4.9×10^{-9}	2.2×10^{-8}	1.6×10^{-6}
	HI	1.3×10^{-3}	1.3×10^{-3}	1.3×10^{-3}	2.9×10^{-6}	1.4×10^{-4}	2.6×10^{2}

SOURCES:

- THE RAWPA (DOE 1992) AND PREVIOUS FS RISK ASSESSMENTS DEFINE THE SCOPE OF QUANTITATIVE ANALYSIS FOR SHORT-TERM (REMEDIAL ACTION) AND LONG-TERM (RESIDUAL) RISKS. NOTE THAT CARCINOGENIC AND NONCARCINOGENIC RISKS RESULTING FROM ACCIDENTS ARE NOT INDICATED AND THEREFORE HAVE NOT BEEN CALCULATED.

RISKS

- CARCINOGENIC = INCREMENTAL LIFETIME CANCER RISK (ILCR) FROM CHEMICAL AND ALL RADIOLOGICAL IMPACTS (NCP TARGET RANGE IS 10^{-4} TO 10^{-6})
- NON CARCINOGENIC = HAZARD INDEX (HI) (HI NOT TO EXCEED 1.0)
- PHYSICAL INJURY = INJURIES PREDICTED PER WORK HOUR (PI)
- FATALITIES = DEATHS PREDICTED PER WORK HOUR (F)
- WHOLE BODY DOSE EQUIVALENT (PERSON REM, i.e., p=rem)
- DOE ANNUAL DOSE RATE = 5 REM (10CFR20 835)

ND = NOT DETERMINED

= NOT APPLICABLE

* For residual risk analysis, these subunits are modeled as one combined, southern subunit, due to postremediation commingling.

** For remedial action risks, these subunits are modeled as one combined subunit, because the soil concentration data presented in the RI is for a combined subunit.

TABLE C.9-5
RISK SUMMARY FOR OU2 ALTERNATIVES AND SUBUNITS
OFF-PROPERTY FARMER (ADULT) PRIVATE OWNERSHIP WITHOUT ACCESS CONTROLS

RESIDUAL RISKS

REMEDIAL ALTERNATIVE	RISK	1. ACTIVE FLYASH PILE*	2. INACTIVE FLYASH PILE*	3. SOUTH FIELD*	4. LIME SLUDGE POND	5. SOLID WASTE LANDFILL	6. DISPOSAL CELL
1 NO ACTION	ILCR	$7.2X10^{-7}$	$4.0X10^{-6}$	$1.5X10^{-5}$	$1.6X10^{-8}$	$7.0X10^{-8}$	
	HI	0.79	2.5	3.1	$9.3X10^{-5}$	$2.0X10^{-4}$	
2 CONSOLIDATION AND CAPPING	ILCR						
	HI						
3 EXCAVATION AND OFF-SITE DISPOSAL	ILCR	7.3×10^{-9}	7.3×10^{9}	7.3×10^{-9}	2.5×10^{9}	2.1×10^{-9}	
	HI	3.5×10^{-3}	3.5×10^{3}	3.5×10^{-3}	7.6×10^{-6}	1.2×10^{-3}	
6 EXCAVATION AND ON-SITE DISPOSAL WITH OFF-SITE DISPOSAL OF FRACTION EXCEEDING WAC	ILCR	7.3×10^{-9}	7.3×10^{9}	7.3×10^{-9}	2.5×10^{10}	2.1×10^{-9}	7.8×10^{-8}
	HI	3.5×10^{-3}	3.5×10^{3}	3.5×10^{-3}	7.6×10^{-6}	1.2×10^{-3}	6.9×10^{-2}

SOURCES:

- THE RAWPA (DOE 1992) AND PREVIOUS FS RISK ASSESSMENTS DEFINE THE SCOPE OF QUANTITATIVE ANALYSIS FOR SHORT-TERM (REMEDIAL ACTION) AND LONG-TERM (RESIDUAL) RISKS. NOTE THAT CARCINOGENIC AND NONCARCINOGENIC RISKS RESULTING FROM ACCIDENTS ARE NOT INDICATED AND THEREFORE HAVE NOT BEEN CALCULATED.

RISKS

- CARCINOGENIC = INCREMENTAL LIFETIME CANCER RISK (ILCR) FROM CHEMICAL AND ALL RADIOLOGICAL IMPACTS (NCP TARGET RANGE IS 10^{-4} TO 10^{-6})
- NON CARCINOGENIC = HAZARD INDEX (HI) (HI NOT TO EXCEED 1.0)
- PHYSICAL INJURY = INJURIES PREDICTED PER WORK HOUR (PI)
- FATALITIES = DEATHS PREDICTED PER WORK HOUR (F)
- WHOLE BODY DOSE EQUIVALENT (PERSON REM, i.e., p=rem)
- DOE ANNUAL DOSE RATE = 5 REM (10CFR20 835)

ND = NOT DETERMINED

= NOT APPLICABLE

* For residual risk analysis, these subunits are modeled as one combined, southern subunit, due to postremediation commingling.

TABLE C.9-6
RISK SUMMARY FOR OU2 ALTERNATIVES AND SUBUNITS
OFF-PROPERTY FARMER (CHILD) WITH PRIVATE OWNERSHIP WITHOUT ACCESS CONTROLS

REMEDIAL ACTION RISKS

REMEDIAL ALTERNATIVE	RISK	1. ACTIVE FLYASH PILE	2. INACTIVE FLYASH PILE**	3. SOUTH FIELD**	4. LIME SLUDGE POND	5. SOLID WASTE LANDFILL
1 NO ACTION	ILCR					
	HI					
	PI/F					
	p-rem					
2 CONSOLIDATION AND CAPPING	ILCR	$5.7X10^{-7}$	$1.0X10^{-6}$	$1.0X10^{-6}$	$4.4X10^{-8}$	$7.4X10^{-7}$
	HI	ND	ND	ND	ND	ND
	PI/F					
	p-rem					
3 EXCAVATION AND OFF-SITE DISPOSAL	ILCR	2.0×10^{-6}	1.3×10^{-6}	1.3×10^{-6}	1.7×10^{-7}	1.2×10^{-6}
	HI	ND	ND	ND	ND	ND
	PI/F					
	p-rem					
6 EXCAVATION AND ON-SITE DISPOSAL WITH OFF-SITE DISPOSAL OF FRACTION EXCEEDING WAC	ILCR	4.0×10^{-7}	1.5×10^{-6}	1.5×10^{-6}	1.2×10^{-7}	1.3×10^{-6}
	HI	ND	ND	ND	ND	ND
	PI/F					
	p-rem					

SOURCES:

- THE RAWPA (DOE 1992) AND PREVIOUS FS RISK ASSESSMENTS DEFINE THE SCOPE OF QUANTITATIVE ANALYSIS FOR SHORT-TERM (REMEDIAL ACTION) AND LONG-TERM (RESIDUAL) RISKS. NOTE THAT CARCINOGENIC AND NONCARCINOGENIC RISKS RESULTING FROM ACCIDENTS ARE NOT INDICATED AND THEREFORE HAVE NOT BEEN CALCULATED.

* For residual risk analysis, these subunits are modeled as one combined, southern subunit, due to postremediation commingling.

** For remedial action risks, these subunits are modeled as one combined subunit, because the soil concentration data presented in the RI is for a combined subunit.

RISKS

- CARCINOGENIC = INCREMENTAL LIFETIME CANCER RISK (ILCR) FROM CHEMICAL AND ALL RADIOLOGICAL IMPACTS (NCP TARGET RANGE IS 10^{-4} TO 10^{-6})
- NON CARCINOGENIC = HAZARD INDEX (HI) (HI NOT TO EXCEED 1.0)
- PHYSICAL INJURY = INJURIES PREDICTED PER WORK HOUR (PI)
- FATALITIES = DEATHS PREDICTED PER WORK HOUR (F)
- WHOLE BODY DOSE EQUIVALENT (PERSON REM, i.e., p=rem)
- DOE ANNUAL DOSE RATE = 5 REM (10CFR20 835)

ND = NOT DETERMINED

= NOT APPLICABLE

TABLE C.9-7
RISK SUMMARY FOR OU2 ALTERNATIVES AND SUBUNITS
GENERAL PUBLIC

RESIDUAL RISKS

REMEDIAL ALTERNATIVE	RISK	1. ACTIVE FLYASH PILE*	2.INACTIVE FLYASH PILE*	3. SOUTH FIELD*	4. LIME SLUDGE POND	5. SOLID WASTE LANDFILL	6. DISPOSAL CELL
1 NO ACTION	ILCR	$8.4X10^{-8}$	$1.5X10^{-5}$	$3.4X10^{-2}$	$1.3X10^{-6}$	$2.8X10^{-5}$	
	HI	0.99	22	23	$1.7X10^{-3}$	0.29	
2 CONSOLIDATION AND CAPPING	ILCR						
	HI						
3 EXCAVATION AND OFF-SITE DISPOSAL	ILCR	6.4×10^{-6}	6.4×10^{-6}	6.4×10^{-6}	3.4×10^{-6}	3.4×10^{-6}	
	HI	1.7×10^{-2}	1.7×10^{2}	1.7×10^{-2}	7.5×10^{-5}	2.0×10^{-1}	
6 EXCAVATION AND ON-SITE DISPOSAL WITH OFF-SITE DISPOSAL OF FRACTION EXCEEDING WAC	ILCR	6.4×10^{-6}	6.4×10^{-6}	6.4×10^{-6}	3.4×10^{-6}	3.4×10^{-6}	
	HI	1.7×10^{-2}	1.7×10^{2}	1.7×10^{-2}	7.5×10^{-5}	2.0×10^{-1}	

LEGEND:

SOURCES:

- THE RAWPA (DOE 1992) AND PREVIOUS FS RISK ASSESSMENTS DEFINE THE SCOPE OF QUANTITATIVE ANALYSIS FOR SHORT-TERM (REMEDIAL ACTION) AND LONG-TERM (RESIDUAL) RISKS. NOTE THAT CARCINOGENIC AND NONCARCINOGENIC RISKS RESULTING FROM ACCIDENTS ARE NOT INDICATED AND THEREFORE HAVE NOT BEEN CALCULATED.

RISKS

- CARCINOGENIC = INCREMENTAL LIFETIME CANCER RISK (ILCR) FROM CHEMICAL AND ALL RADIOLOGICAL IMPACTS (NCP TARGET RANGE IS 10^{-4} TO 10^{-6})
- NON CARCINOGENIC = HAZARD INDEX (HI) (HI NOT TO EXCEED 1.0)
- PHYSICAL INJURY = INJURIES PREDICTED PER WORK HOUR (PI)
- FATALITIES = DEATHS PREDICTED PER WORK HOUR (F)
- WHOLE BODY DOSE EQUIVALENT (PERSON REM, i.e., p=rem)
- DOE ANNUAL DOSE RATE = 5 REM (10CFR20 835)

ND = NOT DETERMINED

= NOT APPLICABLE

* For residual risk analysis, these subunits are modeled as one combined, southern subunit, due to postremediation comingling.

TABLE C.9-8
RISK SUMMARY FOR OU2 ALTERNATIVES AND SUBUNITS
ON-PROPERTY FARMER (ADULT) PRIVATE OWNERSHIP WITHOUT ACCESS CONTROLS

RESIDUAL RISKS

REMEDIAL ALTERNATIVE	RISK	1. ACTIVE FLYASH PILE*	2. INACTIVE FLYASH PILE*	3. SOUTH FIELD*	4. LIME SLUDGE POND	5. SOLID WASTE LANDFILL	6. DISPOSAL CELL
1 NO ACTION	ILCR	5.7×10^{-4}	7.7×10^{-5}	9.2×10^{-5}	1.2×10^{-6}	6.4×10^{-4}	
	HI	2.8	65	63	7.9×10^{-3}	1	
2 CONSOLIDATION AND CAPPING	ILCR						
	HI						
3 EXCAVATION AND OFF-SITE DISPOSAL	ILCR	4.9×10^{-7}	4.9×10^{-7}	4.9×10^{-7}	2.7×10^{-7}	4.3×10^{-7}	
	HI	5.2×10^{-2}	5.2×10^{-2}	5.2×10^{-2}	2.0×10^{-4}	7.6×10^{-1}	
6 EXCAVATION AND ON-SITE DISPOSAL WITH OFF-SITE DISPOSAL OF FRACTION EXCEEDING WAC	ILCR	4.9×10^{-7}	4.9×10^{-7}	4.9×10^{-7}	2.7×10^{-7}	4.3×10^{-7}	
	HI	5.2×10^{-2}	5.2×10^{-2}	5.2×10^{-2}	2.0×10^{-4}	7.6×10^{-1}	

SOURCES:

- THE RAWPA (DOE 1992) AND PREVIOUS FS RISK ASSESSMENTS DEFINE THE SCOPE OF QUANTITATIVE ANALYSIS FOR SHORT-TERM (REMEDIAL ACTION) AND LONG-TERM (RESIDUAL) RISKS. NOTE THAT CARCINOGENIC AND NONCARCINOGENIC RISKS RESULTING FROM ACCIDENTS ARE NOT INDICATED AND THEREFORE HAVE NOT BEEN CALCULATED.

RISKS

- CARCINOGENIC = INCREMENTAL LIFETIME CANCER RISK (ILCR) FROM CHEMICAL AND ALL RADIOLOGICAL IMPACTS (NCP TARGET RANGE IS 10^{-4} TO 10^{-6})
- NON CARCINOGENIC = HAZARD INDEX (HI) (HI NOT TO EXCEED 1.0)
- PHYSICAL INJURY = INJURIES PREDICTED PER WORK HOUR (PI)
- FATALITIES = DEATHS PREDICTED PER WORK HOUR (F)
- WHOLE BODY DOSE EQUIVALENT (PERSON REM, i.e., p=rem)
- DOE ANNUAL DOSE RATE = 5 REM (10CFR20 835)

ND = NOT DETERMINED

= NOT APPLICABLE

* For residual risk analysis, these subunits are modeled as one combined, southern subunit, due to postremediation comingling.

TABLE C.9-9

RISK SUMMARY FOR OU2 ALTERNATIVES AND SUBUNIT
ON-PROPERTY FARMER (CHILD) PRIVATE OWNERSHIP WITHOUT ACCESS CONTROL

RESIDUAL RISKS

REMEDIAL ALTERNATIVE	RISK	1. ACTIVE FLYASH PILE*	2. INACTIVE FLYASH PILE*	3. SOUTH FIELD*	4. LIME SLUDGE POND	5. SOLID WASTE LANDFILL	6. DISPOSAL CELL
1 NO ACTION	ILCR				$7.7X10^{-5}$	$2.8X10^{-5}$	
	HI				$3.1X10^{-5}$	ND	
2 CONSOLIDATION AND CAPPING	ILCR						
	HI						
3 EXCAVATION AND OFF-SITE DISPOSAL	ILCR				$4.6 X 10^{-6}$	$4.8 X 10^{-6}$	
	HI				$1.7 X 10^{-5}$	$2.0 X 10^{-1}$	
6 EXCAVATION AND ON-SITE DISPOSAL WITH OFF-SITE DISPOSAL OF FRACTION EXCEEDING WAC	ILCR				$4.6 X 10^{-6}$	$4.8 X 10^{-6}$	
	HI				$1.7 X 10^{-5}$	$2.0 X 10^{-1}$	

SOURCES:

- THE RAWPA (DOE 1992) AND PREVIOUS FS RISK ASSESSMENTS DEFINE THE SCOPE OF QUANTITATIVE ANALYSIS FOR SHORT-TERM (REMEDIAL ACTION) AND LONG-TERM (RESIDUAL) RISKS. NOTE THAT CARCINOGENIC AND NONCARCINOGENIC RISKS RESULTING FROM ACCIDENTS ARE NOT INDICATED AND THEREFORE HAVE NOT BEEN CALCULATED.

RISKS

- CARCINOGENIC = INCREMENTAL LIFETIME CANCER RISK (ILCR) FROM CHEMICAL AND ALL RADIOLOGICAL IMPACTS (NCP TARGET RANGE IS 10^{-4} TO 10^{-6})
- NON CARCINOGENIC = HAZARD INDEX (HI) (HI NOT TO EXCEED 1.0)
- PHYSICAL INJURY = INJURIES PREDICTED PER WORK HOUR (PI)
- FATALITIES = DEATHS PREDICTED PER WORK HOUR (F)
- WHOLE BODY DOSE EQUIVALENT (PERSON REM, i.e., p=rem)
- DOE ANNUAL DOSE RATE = 5 REM (10CFR20 835)

ND = NOT DETERMINED

= NOT APPLICABLE

- For residual risk analysis, these subunits are modeled as one combined, southern subunit, due to postremediation comingling.

TABLE C.9-10
RISK SUMMARY FOR OU2 ALTERNATIVES AND SUBUNITS
PERCHED GROUNDWATER USER PRIVATE OWNERSHIP WITHOUT ACCESS CONTROLS

REMEDIAL ACTION RISKS

REMEDIAL ALTERNATIVE	RISK	1. ACTIVE FLYASH PILE	2. INACTIVE FLYASH PILE	3. SOUTH FIELD	4. LIME SLUDGE POND	5. SOLID WASTE LANDFILL
1 NO ACTION	ILCR					
	HI					
	PI/F					
	p-rem					
2 CONSOLIDATION AND CAPPING	ILCR					
	HI					
	PI/F					
	p-rem					
3 EXCAVATION AND OFF-SITE DISPOSAL	ILCR	ND	ND	ND	ND	ND
	HI	ND	ND	ND	ND	ND
	PI/F	$0.13/1.3 \times 10^{-3}$	$0.18/1.8 \times 10^{-3}$	$0.59/5.9 \times 10^{-3}$	$0.14/1.4 \times 10^{-3}$	$0.18/1.8 \times 10^{-3}$
	p-rem	3.2×10^{-5}	4.2×10^{-5}	1.4×10^{-4}	3.4×10^{-5}	4.3×10^{-5}
6 EXCAVATION AND ON-SITE DISPOSAL WITH OFF-SITE DISPOSAL OF FRACTION EXCEEDING WAC	ILCR	ND	ND	ND	ND	ND
	HI	ND	ND	ND	ND	ND
	PI/F		$0.018/1.8 \times 10^{-4}$	$0.018/1.8 \times 10^{-4}$		
	p-rem		1.2×10^{-6}	1.1×10^{-7}		

SOURCES:

- THE RAWPA (DOE 1992) AND PREVIOUS FS RISK ASSESSMENTS DEFINE THE SCOPE OF QUANTITATIVE ANALYSIS FOR SHORT-TERM (REMEDIAL ACTION) AND LONG-TERM (RESIDUAL) RISKS. NOTE THAT CARCINOGENIC AND NONCARCINOGENIC RISKS RESULTING FROM ACCIDENTS ARE NOT INDICATED AND THEREFORE HAVE NOT BEEN CALCULATED.

RISKS

- CARCINOGENIC = INCREMENTAL LIFETIME CANCER RISK (ILCR) FROM CHEMICAL AND ALL RADIOLOGICAL IMPACTS (NCP TARGET RANGE IS 10^{-4} TO 10^{-6})
- NON CARCINOGENIC = HAZARD INDEX (HI) (HI NOT TO EXCEED 1.0)
- PHYSICAL INJURY = INJURIES PREDICTED PER WORK HOUR (PI)
- FATALITIES = DEATHS PREDICTED PER WORK HOUR (F)
- WHOLE BODY DOSE EQUIVALENT (PERSON REM, i.e., p=rem)
- DOE ANNUAL DOSE RATE = 5 REM (10CFR20 835)

ND = NOT DETERMINED

= NOT APPLICABLE

- For residual risk analysis, these subunits are modeled as one combined, southern subunit, due to postremediation commingling.

TABLE C.9-1
RISK SUMMARIES FOR OU2 ALTERNATIVES AND SUBUNI
TRANSPORTATION - RAILWORKERS

REMEDIAL ACTION RISKS

REMEDIAL ALTERATIVE	RISK	1. ACTIVE FLYASH PILE	2. INACTIVE FLYASH PILE	3. SOUTH FIELD	4. LIME POND	5. SOLID WASTE LANDFILL
1 NO ACTION	ILCR					
	HI					
	PI/F					
	p-rem					
2 CONSOLIDATION AND CAPPING	ILCR					
	HI					
	PI/F					
	p-rem					
3 EXCAVATION AND OFF-SITE DISPOSAL	ILCR	ND	ND	ND	ND	ND
	HI	ND	ND	ND	ND	ND
	PI/F	$0.20/5.2 \times 10^{2}$	$0.26/7.0 \times 10^{2}$	$0.87/2.3 \times 10^{1}$	$0.21/5.6 \times 10^{2}$	$0.26/7.0 \times 10^{2}$
	p-rem	8.2×10^{5}	1.1×10^{4}	3.6×19^{4}	8.9×10^{5}	1.1×10^{4}
6 EXCAVATION AND ON-SITE DISPOSAL WITH OFF-SITE DISPOSAL OF FRACTION EXCEEDING WAC	ILCR	ND	ND	ND	ND	ND
	HI	ND	ND	ND	ND	ND
	PI/F	0×10^{0}	6.9×10^{-5}	$0.026/6.9 \times 10^{-5}$		
	p-rem	0×10^{0}	3.0×10^{2}	2.9×10^{1}		

SOURCES:

- THE RAWPA (DOE 1992) AND PREVIOUS FS RISK ASSESSMENTS DEFINE THE SCOPE OF QUANTITATIVE ANALYSIS FOR SHORT-TERM (REMEDIAL ACTION) AND LONG-TERM (RESIDUAL) RISKS. NOTE THAT CARCINOGENIC AND NONCARCINOGENIC RISKS RESULTING FROM ACCIDENTS ARE NOT INDICATED AND THEREFORE HAVE NOT BEEN CALCULATED.

RISKS

- CARCINOGENIC = INCREMENTAL LIFETIME CANCER RISK (ILCR) FROM CHEMICAL AND ALL RADIOLOGICAL IMPACTS (NCP TARGET RANGE IS 10^{-4} TO 10^{-6})
- NON CARCINOGENIC = HAZARD INDEX (HI) (HI NOT TO EXCEED 1.0)
- PHYSICAL INJURY = INJURIES PREDICTED PER WORK HOUR (PI)
- FATALITIES = DEATHS PREDICTED PER WORK HOUR (F)
- WHOLE BODY DOSE EQUIVALENT (PERSON REM, i.e., p=rem)
- DOE ANNUAL DOSE RATE = 5 REM (10CFR20 835)

ND = NOT DETERMINED

= NOT APPLICABLE

- For residual risk analysis, these subunits are modeled as one combined, southern subunit, due to postremediation commingling.

TABLE C.9-12
RISK SUMMARY FOR OU2 ALTERNATIVES AND SUBUNITS
OFF-PROPERTY PUBLIC RECEPTOR ALONG TRANSPORTATION ROUTE FEDERAL OWNERSHIP WITH ACCESS CONTROL

RESIDUAL RISKS

REMEDIAL ALTERNATIVE	RISK	1. ACTIVE FLYASH PILE*	2. INACTIVE FLYASH PILE*	3. SOUTH FIELD*	4. LIME SLUDGE POND	5. SOLID WASTE LANDFILL	6.DISPOSAL CELL
1 NO ACTION	ILCR	4.9×10^{-5}	3.0×1^{-5}	1.4×10^{-4}	2.4×10^{-5}	2.0×10^{-5}	
	HI	4.2×10^{-2}	1.0×10^{-1}	8.0×10^{-2}	2.2×10^{-1}	2.7×10^{-1}	
2 CONSOLIDATION AND CAPPING	ILCR	1.2×10^{-6}	1.2×10^{-6}	1.2×10^{-6}	5.9×10^{-15}	1.0×10^{-14}	
	HI	1.3×10^{-1}	1.3×10^{-1}	1.3×10^{-1}	NA	NA	
3 EXCAVATION AND OFF-SITE DISPOSAL	ILCR	2.5×10^{-6}	2.5×10^{-6}	2.5×10^{-6}	2.6×10^{-8}	4.0×10^{-7}	
	HI	1.3×10^{-2}	1.3×10^{-2}	1.3×10^{-2}	2.8×10^{-2}	2.0×10^{-2}	
6 EXCAVATION AND ON-SITE DISPOSAL WITH OFF-SITE DISPOSAL OF FRACTION EXCEEDING WAC	ILCR	2.5×10^{-6}	2.5×10^{-6}	2.5×10^{-6}	2.6×10^{-8}	4.0×10^{-7}	7.3×10^{-14}
	HI	1.3×10^{-2}	1.3×10^{-2}	1.3×10^{-2}	2.8×10^{-2}	2.0×10^{-2}	ND

LEGEND:

SOURCES:

- THE RAWPA (DOE 1992) AND PREVIOUS FS RISK ASSESSMENTS DEFINE THE SCOPE OF QUANTITATIVE ANALYSIS FOR SHORT-TERM (REMEDIAL ACTION) AND LONG-TERM (RESIDUAL) RISKS. NOTE THAT CARCINOGENIC AND NONCARCINOGENIC RISKS RESULTING FROM ACCIDENTS ARE NOT INDICATED AND THEREFORE HAVE NOT BEEN CALCULATED.

RISKS

- CARCINOGENIC = INCREMENTAL LIFETIME CANCER RISK (ILCR) FROM CHEMICAL AND ALL RADIOLOGICAL IMPACTS (NCP TARGET RANGE IS 10^{-4} TO 10^{-6})
- NON CARCINOGENIC = HAZARD INDEX (HI) (HI NOT TO EXCEED 1.0)
- PHYSICAL INJURY = INJURIES PREDICTED PER WORK HOUR (PI)
- FATALITIES = DEATHS PREDICTED PER WORK HOUR (F)
- WHOLE BODY DOSE EQUIVALENT (PERSON REM, i.e., p=rem)
- DOE ANNUAL DOSE RATE = 5 REM (10CFR20 835)

ND = NOT DETERMINED

= NOT APPLICABLE

- For residual risk analysis, these subunits are modeled as one combined, southern subunit, due to postremediation commingling.

TABLE C.9-13
RISK SUMMARIES FOR OU2 ALTERNATIVES AND SUBUNITS EXPANDED TRESPASSER RECEPTOR FEDERAL OWNERSHIP WITH ACCESS CONTROLS FOR THE ENTIRE FEMP

RESIDUAL RISKS

REMEDIAL ALTERNATIVE	RISK	1. ACTIVE FLYASH PILE*	2.INACTIVE FLYASH PILE*	3. SOUTH FIELD*	4. LIME SLUDGE POND	5. SOLID WASTE LANDFILL	6.DISPOSAL CELL
1 NO ACTION	ILCR						
	HI						
2 CONSOLIDATION AND CAPPING	ILCR						
	HI						
3 EXCAVATION AND OFF-SITE DISPOSAL	ILCR						
	HI						
6 EXCAVATION AND ON-SITE DISPOSAL WITH OFF-SITE DISPOSAL OF FRACTION EXCEEDING WAC	ILCR						1.4×10^{-13}
	HI						ND

SOURCES:

- THE RAWPA (DOE 1992) AND PREVIOUS FS RISK ASSESSMENTS DEFINE THE SCOPE OF QUANTITATIVE ANALYSIS FOR SHORT-TERM (REMEDIAL ACTION) AND LONG-TERM (RESIDUAL) RISKS. NOTE THAT CARCINOGENIC AND NONCARCINOGENIC RISKS RESULTING FROM ACCIDENTS ARE NOT INDICATED AND THEREFORE HAVE NOT BEEN CALCULATED.

RISKS

- CARCINOGENIC =INCREMENTAL LIFETIME CANCER RISK (ILCR) FROM CHEMICAL AND ALL RADIOLOGICAL IMPACTS (NCP TARGET RANGE IS 10^{-4} TO 10^{-6})
- NON CARCINOGENIC = HAZARD INDEX (HI) (HI NOT TO EXCEED 1.0)
- PHYSICAL INJURY = INJURIES PREDICTED PER WORK HOUR (PI)
- FATALITIES = DEATHS PREDICTED PER WORK HOUR (F)
- WHOLE BODY DOSE EQUIVALENT (PERSON REM, i.e., p=rem)
- DOE ANNUAL DOSE RATE = 5 REM (10CFR20 835)

ND = NOT DETERMINED

= NOT APPLICABLE

* For residual risk analysis, these subunits are modeled as one combined, southern subunit, due to postremediation commingling.

TABLE C.9-14
RISK FOR OU2 ALTERNATIVES AND SUBUNITS EXPANDED TRESPASSER RECEPTOR FOR PRIVATE OWNERSHIP WITHOUT ACCESS CONTROLS FOR THE FEMP AND FEDERAL OWNERSHIP WITH ACCESS CONTROLS FOR THE DISPOSAL CELL

TABLE C.9-15

SUMMARY OF GREATEST REMEDIAL ACTION AND RESIDUAL RISKS BY ALTERNATIVE ESTIMATED FOR OPERABLE UNIT 2

RECEPTORS	REMEDIAL ALTERNATIVES							
	Alternative 1: No Action		Alternative 2: Consolidation & Capping		Alternative 3: Excavation & Off-Site Disposal		Alternative 6: Excavation & On-Site Disposal with Off-Site Disposal of Fraction Exceeding WAC	
	ILCR	HI	ILCR	HI	ILCR	HI	ILCR	HI
	REMEDIAL ACTION RISKS							
Remedial Worker	NA	NA	2.9E-5[d]	3.4E-3[e,f]	5.1E-5[d]	8.9E-3[e,f]	3.0E-5[e,f]	3.8E-3[h]
Nonremedial Worker	NA	NA	1.3E-6[h]	ND	2.6E-6[d]	ND	2.4E-6[h]	ND
General Public	NA	NA	1.0E-6[e,f]	ND	2.0E-6[d]	ND	1.5E-6[e,f]	ND
Transportation-Railworkers	NA	NA	NA	NA	ND	ND	ND	ND
Off-Property Public Along Transportation Route	NA	NA	NA	NA	ND	ND	ND	ND
	RESIDUAL RISKS							
	Federal Ownership							
Off-Property Farmer	8.7E-5[f]	1.2[e]	1.6E-6[i]	1.8E-2[i]	2.2E-6[i]	2.7E-2[i]	2.2E-6[i]	2.7E-2[i]
Off-Property Child	4.2E-6[f]	3.1[f]	9.3E-8[i]	4.9E-2[i]	1.6E-7[i]	7.2E-2[i]	1.6E-7[i]	7.2E-2[i]
Expanded Trespasser	1.4E-4[f]	0.27[h]	1.2E-6[i]	0.13[i]	2.5E-6[i]	2.8E-2[g]	2.5E-6[i]	2.8E-2[g]

000392

TABLE C.9-15
(CONTINUED)

RECEPTORS	REMEDIAL ALTERNATIVES							
	Alternative 1: No Action		Alternative 2: Consolidation & Capping		Alternative 3: Excavation & Off-Site Disposal		Alternative 6: Excavation & On-Site Disposal with Off-Site Disposal of Fraction Exceeding WAC	
	ILCR	HI	ILCR	HI	ILCR	HI	ILCR	HI
	Private Ownership							
Off-Property Farmer	1.1E-4[f]	1.2[e]	NA	NA	1.4E-7[i]	1.3E-3[i]	1.6E-6[j]	2.6E-2[j]
Off-Property Child	1.5E-5[f]	3.1[f]	NA	NA	7.3E-9[i]	3.5E-3[i]	7.8E-8[i]	6.9E-2[j]
On-Property Resident Farmer	3.4E-2[f]	23[f]	NA	NA	6.4E-6[i]	0.2[h]	6.4E-6[i]	0.2[h]
On-Property Resident Child	9.2E-3[f]	65[f]	NA	NA	4.9E-7[i]	0.76[h]	4.9E-7[i]	0.76[h]
Perched Water User	2.8E-3[h]	3.1E-3[g]	NA	NA	4.8E-6[h]	0.2[h]	4.8E-6[h]	0.2[h]

[a] The estimated risks and hazards presented in this table represent the greatest risk and hazard calculated for the specified alternative. The subunit which poses the greatest risk and/or hazard is denoted by a footnote.
[b] Incremental Lifetime Cancer Risk
[c] Hazard Index
[d] Active Flyash Pile
[e] Inactive Flyash Pile
[f] South Field
[g] Lime Sludge Ponds
[h] Solid Waste Landfill
[i] Southern Subunit (AFP/IFP/SF)
[j] Disposal Cell
NA - Not Applicable
ND - Not Determined

000393

5860

5860

c.1

RAECOM INPUT FILES

OU2 FS Active Flyash Pile 8/9/94 - Short Term RA
1,0.,0.,0,0.,0.001
300.,0,0.45,0.0000081,17

OU2 FS Lime Sludge Pond 8/9/94 - Short Term RA
1,0.,0.,0,0.,0.001
300.,0,0.45,0.0000024,17

OU2 FS South Field/Inactive Flyash Pile 8/9/94 - Short Term RA
1,0.,0.,0,0.,0.001
300.,0,0.45,0.0000045,17

OU2 FS Solid Waste Landfill 8/9/94 - Short Term RA
1,0.,0.,0,0.,0.001
300.,0,0.45,0.0000024,17

ISCLT2 Input File For the OU2 FSRA

RE GRIDCART NO_1	FLAG 4	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 4	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 4	1.83			
RE GRIDCART NO_1	FLAG 5	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 5	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 5	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 5	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 5	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 5	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 5	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 5	1.83			
RE GRIDCART NO_1	FLAG 6	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 6	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 6	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 6	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 6	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 6	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 6	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 6	1.83			
RE GRIDCART NO_1	FLAG 7	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 7	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 7	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 7	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 7	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 7	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 7	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 7	1.83			
RE GRIDCART NO_1	FLAG 8	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 8	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 8	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 8	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 8	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 8	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 8	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 8	1.83			
RE GRIDCART NO_1	FLAG 9	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 9	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 9	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 9	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 9	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 9	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 9	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 9	1.83			
RE GRIDCART NO_1	FLAG 10	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 10	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 10	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 10	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 10	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 10	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 10	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 10	1.83			
RE GRIDCART NO_1	FLAG 11	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 11	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 11	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 11	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 11	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 11	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 11	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 11	1.83			
RE GRIDCART NO_1	FLAG 12	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 12	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 12	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 12	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 12	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 12	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 12	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 12	1.83			
RE GRIDCART NO_1	FLAG 13	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 13	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 13	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 13	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 13	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 13	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 13	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 13	1.83			
RE GRIDCART NO_1	FLAG 14	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 14	1.83	1.83	1.83	1.83

ISCLT2 Input File For the OU2 FSRA

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*** TRINITY RECEPTOR FILE NAME: C:\MODEL\FENCLINE.REC
CO STARTING
CO TITLEONE OU2 FS - Annual Conc.: 1 g/s (pCi/s) per m2, 1987-92 Met Data
CO TITLETWO OU2 FD No. 04/424331 G.POLLOCK 8/10/94
CO MODELOPT DFAULT CONC RURAL
CO AVERTIME ANNUAL
CO POLLUTID OTHER
CO TERRHGTS FLAT
CO ELEVUNIT METERS
CO FLAGPOLE 1.500000
CO RUNORNOT RUN
CO FINISHED
SO STARTING
SO LOCATION S_WST_LF AREA    975.00   -122.00     0.00
SO SRCPARAM S_WST_LF 1.000000     0.00    30.50
SO LOCATION SOUT_FLD AREA    975.00  -1524.00     0.00
SO SRCPARAM SOUT_FLD 1.000000     0.00    30.50
SO LOCATION NOR_STAG AREA    975.00   -244.00     0.00
SO SRCPARAM NOR_STAG 1.000000     0.00    30.50
SO LOCATION SOU_STAG AREA    792.00  -1402.00     0.00
SO SRCPARAM SOU_STAG 1.000000     0.00    30.50
SO LOCATION NOR_DRIR POINT    975.00   -244.00     0.00
SO SRCPARAM NOR_DRIR 1.000000     5.00   373.00   10.2000    0.500
SO LOCATION SOU_DRIR POINT    792.00  -1402.00     0.00
SO SRCPARAM SOU_DRIR 1.000000     5.00   373.00   10.2000    0.500
SO LOCATION CONS/CAP AREA   1036.00  -1494.00     0.00
SO SRCPARAM CONS/CAP 1.000000     0.00    30.50
SO LOCATION DISP_CEL AREA   1737.00  -1341.00     0.00
SO SRCPARAM DISP_CEL 1.000000     0.00    30.50
SO LOCATION LIME_SLD AREA    945.00   -640.00     0.00
SO SRCPARAM LIME_SLD 1.000000     0.00    30.50
SO LOCATION SILOS AREA    884.00   -457.00     0.00
SO SRCPARAM SILOS 1.000000     0.00    30.50
SO EMISUNIT 1.000000 GRAMS/SEC GRAMS/M**3
SO SRCGROUP SRC1 S_WST_LF
SO SRCGROUP SRC2 SOU_STAG
SO SRCGROUP SRC3 SOU_DRIR
SO SRCGROUP SRC4 SOUT_FLD
SO SRCGROUP SRC5 NOR_STAG
SO SRCGROUP SRC6 NOR_DRIR
SO SRCGROUP SRC7 LIME_SLD
SO SRCGROUP SRC8 SOUT_FLD
SO SRCGROUP SRC9 CONS/CAP
SO SRCGROUP SRC10 SILOS
SO FINISHED
RE STARTING
RE GRIDCART NO_1    STA
RE GRIDCART NO_1    XYINC -300.00 29 100.00 -2400.00 34 100.00
RE GRIDCART NO_1    FLAG 1    1.83    1.83    1.83    1.83
RE GRIDCART NO_1    FLAG 1    1.83    1.83    1.83    1.83
RE GRIDCART NO_1    FLAG 1    1.83    1.83    1.83    1.83
RE GRIDCART NO_1    FLAG 1    1.83    1.83    1.83    1.83
RE GRIDCART NO_1    FLAG 1    1.83    1.83    1.83    1.83
RE GRIDCART NO_1    FLAG 1    1.83    1.83    1.83    1.83
RE GRIDCART NO_1    FLAG 1    1.83    1.83    1.83    1.83
RE GRIDCART NO_1    FLAG 1    1.83
RE GRIDCART NO_1    FLAG 2    1.83    1.83    1.83    1.83
RE GRIDCART NO_1    FLAG 2    1.83    1.83    1.83    1.83
RE GRIDCART NO_1    FLAG 2    1.83    1.83    1.83    1.83
RE GRIDCART NO_1    FLAG 2    1.83    1.83    1.83    1.83
RE GRIDCART NO_1    FLAG 2    1.83    1.83    1.83    1.83
RE GRIDCART NO_1    FLAG 2    1.83    1.83    1.83    1.83
RE GRIDCART NO_1    FLAG 2    1.83    1.83    1.83    1.83
RE GRIDCART NO_1    FLAG 2    1.83
RE GRIDCART NO_1    FLAG 3    1.83    1.83    1.83    1.83
RE GRIDCART NO_1    FLAG 3    1.83    1.83    1.83    1.83
RE GRIDCART NO_1    FLAG 3    1.83    1.83    1.83    1.83
RE GRIDCART NO_1    FLAG 3    1.83    1.83    1.83    1.83
RE GRIDCART NO_1    FLAG 3    1.83    1.83    1.83    1.83
RE GRIDCART NO_1    FLAG 3    1.83    1.83    1.83    1.83
RE GRIDCART NO_1    FLAG 3    1.83    1.83    1.83    1.83
RE GRIDCART NO_1    FLAG 3    1.83
RE GRIDCART NO_1    FLAG 4    1.83    1.83    1.83    1.83
RE GRIDCART NO_1    FLAG 4    1.83    1.83    1.83    1.83
RE GRIDCART NO_1    FLAG 4    1.83    1.83    1.83    1.83
RE GRIDCART NO_1    FLAG 4    1.83    1.83    1.83    1.83
RE GRIDCART NO_1    FLAG 4    1.83    1.83    1.83    1.83
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ISCLT2 Input File For the OU2 FSRA

RE GRIDCART NO_1	FLAG 23	1.83			
RE GRIDCART NO_1	FLAG 24	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 24	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 24	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 24	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 24	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 24	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 24	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 24	1.83			
RE GRIDCART NO_1	FLAG 25	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 25	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 25	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 25	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 25	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 25	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 25	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 25	1.83			
RE GRIDCART NO_1	FLAG 26	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 26	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 26	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 26	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 26	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 26	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 26	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 26	1.83			
RE GRIDCART NO_1	FLAG 27	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 27	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 27	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 27	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 27	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 27	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 27	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 27	1.83			
RE GRIDCART NO_1	FLAG 28	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 28	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 28	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 28	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 28	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 28	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 28	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 28	1.83			
RE GRIDCART NO_1	FLAG 29	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 29	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 29	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 29	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 29	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 29	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 29	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 29	1.83			
RE GRIDCART NO_1	FLAG 30	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 30	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 30	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 30	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 30	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 30	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 30	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 30	1.83			
RE GRIDCART NO_1	FLAG 31	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 31	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 31	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 31	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 31	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 31	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 31	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 31	1.83			
RE GRIDCART NO_1	FLAG 32	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 32	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 32	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 32	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 32	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 32	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 32	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 32	1.83			
RE GRIDCART NO_1	FLAG 33	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 33	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 33	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 33	1.83	1.83	1.83	1.83

RE GRIDCART NO_1	FLAG 14	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 14	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 14	1.83	1.83	1.83	1.83
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RE GRIDCART NO_1	FLAG 14	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 14	1.83			
RE GRIDCART NO_1	FLAG 15	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 15	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 15	1.83	1.83	1.83	1.83
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RE GRIDCART NO_1	FLAG 15	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 15	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 15	1.83			
RE GRIDCART NO_1	FLAG 16	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 16	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 16	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 16	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 16	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 16	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 16	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 16	1.83			
RE GRIDCART NO_1	FLAG 17	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 17	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 17	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 17	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 17	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 17	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 17	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 17	1.83			
RE GRIDCART NO_1	FLAG 18	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 18	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 18	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 18	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 18	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 18	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 18	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 18	1.83			
RE GRIDCART NO_1	FLAG 19	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 19	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 19	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 19	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 19	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 19	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 19	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 19	1.83			
RE GRIDCART NO_1	FLAG 20	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 20	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 20	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 20	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 20	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 20	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 20	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 20	1.83			
RE GRIDCART NO_1	FLAG 21	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 21	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 21	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 21	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 21	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 21	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 21	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 21	1.83			
RE GRIDCART NO_1	FLAG 22	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 22	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 22	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 22	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 22	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 22	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 22	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 22	1.83			
RE GRIDCART NO_1	FLAG 23	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 23	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 23	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 23	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 23	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 23	1.83	1.83	1.83	1.83
RE GRIDCART NO_1	FLAG 23	1.83	1.83	1.83	1.83

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RE DISCCART 2060.00 -147.00 0.000
RE DISCCART 2061.00 -196.00 0.000
RE DISCCART 2063.00 -245.00 0.000
RE DISCCART 2064.00 -294.00 0.000
RE DISCCART 2065.00 -343.00 0.000
RE DISCCART 2066.00 -392.00 0.000
RE DISCCART 2067.00 -441.00 0.000
RE DISCCART 2068.00 -490.00 0.000
RE DISCCART 2069.00 -539.00 0.000
RE DISCCART 2070.00 -588.00 0.000
RE DISCCART 2071.00 -637.00 0.000
RE DISCCART 2073.00 -686.00 0.000
RE DISCCART 2074.00 -735.00 0.000
RE DISCCART 2075.00 -784.00 0.000
RE DISCCART 2076.00 -833.00 0.000
RE DISCCART 2077.00 -882.00 0.000
RE DISCCART 2078.00 -931.00 0.000
RE DISCCART 2079.00 -980.00 0.000
RE DISCCART 2080.00 -1029.00 0.000
RE DISCCART 2081.00 -1078.00 0.000
RE DISCCART 2083.00 -1127.00 0.000
RE DISCCART 2084.00 -1176.00 0.000
RE DISCCART 2085.00 -1225.00 0.000
RE DISCCART 2086.00 -1274.00 0.000
RE DISCCART 2087.00 -1323.00 0.000
RE DISCCART 2088.00 -1372.00 0.000
RE DISCCART 2090.00 -1422.00 0.000
RE DISCCART 2092.00 -1471.00 0.000
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RE DISCCART 2099.00 -1669.00 0.000
RE DISCCART 2101.00 -1719.00 0.000
RE DISCCART 2103.00 -1768.00 0.000
RE DISCCART 2059.00 -1778.00 0.000
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RE DISCCART 1927.00 -1808.00 0.000
RE DISCCART 1883.00 -1819.00 0.000
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RE DISCCART 1795.00 -1839.00 0.000
RE DISCCART 1751.00 -1849.00 0.000
RE DISCCART 1707.00 -1859.00 0.000
RE DISCCART 1661.00 -1872.00 0.000
RE DISCCART 1616.00 -1885.00 0.000
RE DISCCART 1570.00 -1898.00 0.000
RE DISCCART 1524.00 -1911.00 0.000
RE DISCCART 1478.00 -1924.00 0.000
RE DISCCART 1433.00 -1937.00 0.000
RE DISCCART 1387.00 -1950.00 0.000
RE DISCCART 1341.00 -1964.00 0.000
RE DISCCART 1296.00 -1977.00 0.000
RE DISCCART 1250.00 -1990.00 0.000
RE DISCCART 1204.00 -2003.00 0.000
RE DISCCART 1158.00 -2016.00 0.000
RE DISCCART 1113.00 -2029.00 0.000
RE DISCCART 1067.00 -2042.00 0.000
RE DISCCART 1021.00 -2032.00 0.000
RE DISCCART 975.00 -2022.00 0.000
RE DISCCART 930.00 -2011.00 0.000
RE DISCCART 884.00 -2001.00 0.000
RE DISCCART 838.00 -1991.00 0.000
RE DISCCART 792.00 -1981.00 0.000
RE DISCCART 762.00 -1961.00 0.000
RE DISCCART 731.00 -1940.00 0.000
RE DISCCART 701.00 -1920.00 0.000
RE DISCCART 691.00 -1879.00 0.000
RE DISCCART 681.00 -1839.00 0.000
RE DISCCART 671.00 -1798.00 0.000
RE DISCCART 653.00 -1761.00 0.000
RE DISCCART 634.00 -1725.00 0.000
RE DISCCART 616.00 -1688.00 0.000
RE DISCCART 597.00 -1652.00 0.000
RE DISCCART 579.00 -1615.00 0.000
RE DISCCART 552.00 -1574.00 0.000
RE DISCCART 525.00 -1534.00 0.000
RE DISCCART 498.00 -1493.00 0.000
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RE GRIDCART NO_1   FLAG 33   1.83   1.83   1.83   1.83
RE GRIDCART NO_1   FLAG 33   1.83   1.83   1.83   1.83
RE GRIDCART NO_1   FLAG 33   1.83   1.83   1.83   1.83
RE GRIDCART NO_1   FLAG 33   1.83
RE GRIDCART NO_1   FLAG 34   1.83   1.83   1.83   1.83
RE GRIDCART NO_1   FLAG 34   1.83   1.83   1.83   1.83
RE GRIDCART NO_1   FLAG 34   1.83   1.83   1.83   1.83
RE GRIDCART NO_1   FLAG 34   1.83   1.83   1.83   1.83
RE GRIDCART NO_1   FLAG 34   1.83   1.83   1.83   1.83
RE GRIDCART NO_1   FLAG 34   1.83   1.83   1.83   1.83
RE GRIDCART NO_1   FLAG 34   1.83   1.83   1.83   1.83
RE GRIDCART NO_1   FLAG 34   1.83
RE GRIDCART NO_1   END
RE DISCCART 0.00 366.00 1.830
RE DISCCART 50.00 366.00 1.830
RE DISCCART 99.00 366.00 1.830
RE DISCCART 149.00 366.00 1.830
RE DISCCART 199.00 366.00 1.830
RE DISCCART 248.00 366.00 1.830
RE DISCCART 298.00 366.00 1.830
RE DISCCART 348.00 366.00 1.830
RE DISCCART 397.00 366.00 1.830
RE DISCCART 447.00 366.00 1.830
RE DISCCART 497.00 366.00 1.830
RE DISCCART 546.00 366.00 1.830
RE DISCCART 596.00 366.00 1.830
RE DISCCART 646.00 366.00 0.000
RE DISCCART 695.00 366.00 0.000
RE DISCCART 745.00 366.00 0.000
RE DISCCART 795.00 366.00 0.000
RE DISCCART 844.00 366.00 0.000
RE DISCCART 894.00 366.00 0.000
RE DISCCART 944.00 366.00 0.000
RE DISCCART 993.00 366.00 0.000
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RE DISCCART 1093.00 366.00 0.000
RE DISCCART 1142.00 366.00 0.000
RE DISCCART 1192.00 366.00 0.000
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RE DISCCART 1341.00 412.00 0.000
RE DISCCART 1341.00 457.00 0.000
RE DISCCART 1387.00 450.00 0.000
RE DISCCART 1433.00 442.00 0.000
RE DISCCART 1478.00 435.00 0.000
RE DISCCART 1524.00 427.00 0.000
RE DISCCART 1567.00 433.00 0.000
RE DISCCART 1609.00 439.00 0.000
RE DISCCART 1652.00 445.00 0.000
RE DISCCART 1694.00 451.00 0.000
RE DISCCART 1737.00 457.00 0.000
RE DISCCART 1779.00 474.00 0.000
RE DISCCART 1822.00 491.00 0.000
RE DISCCART 1864.00 508.00 0.000
RE DISCCART 1906.00 525.00 0.000
RE DISCCART 1949.00 542.00 0.000
RE DISCCART 1991.00 559.00 0.000
RE DISCCART 2033.00 576.00 0.000
RE DISCCART 2076.00 593.00 0.000
RE DISCCART 2118.00 610.00 0.000
RE DISCCART 2116.00 563.00 0.000
RE DISCCART 2113.00 516.00 0.000
RE DISCCART 2111.00 469.00 0.000
RE DISCCART 2109.00 422.00 0.000
RE DISCCART 2106.00 375.00 0.000
RE DISCCART 2104.00 328.00 0.000
RE DISCCART 2102.00 282.00 0.000
RE DISCCART 2100.00 235.00 0.000
RE DISCCART 2097.00 188.00 0.000
RE DISCCART 2095.00 141.00 0.000
RE DISCCART 2093.00 94.00 0.000
RE DISCCART 2090.00 47.00 0.000
RE DISCCART 2088.00 0.00 0.000
RE DISCCART 2057.00 0.00 0.000
RE DISCCART 2058.00 -49.00 0.000
RE DISCCART 2059.00 -98.00 0.000
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ISCLT2 Input File For the OU2 FSRA

RE GRIDCART NO_2	FLAG 5	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 5	1.83	1.83	1.83	1.83
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RE GRIDCART NO_2	FLAG 5	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 6	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 6	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 6	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 6	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 6	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 6	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 6	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 7	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 7	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 7	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 7	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 7	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 7	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 7	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 8	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 8	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 8	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 8	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 8	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 8	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 8	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 9	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 9	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 9	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 9	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 9	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 9	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 9	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 10	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 10	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 10	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 10	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 10	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 10	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 10	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 11	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 11	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 11	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 11	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 11	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 11	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 11	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 12	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 12	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 12	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 12	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 12	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 12	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 12	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 13	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 13	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 13	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 13	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 13	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 13	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 13	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 14	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 14	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 14	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 14	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 14	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 14	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 14	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 15	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 15	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 15	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 15	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 15	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 15	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 15	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 16	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 16	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 16	1.83	1.83	1.83	1.83

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RE DISCCART 471.00 -1453.00 0.000
RE DISCCART 443.00 -1412.00 0.000
RE DISCCART 416.00 -1372.00 0.000
RE DISCCART 389.00 -1331.00 0.000
RE DISCCART 362.00 -1291.00 0.000
RE DISCCART 335.00 -1250.00 0.000
RE DISCCART 305.00 -1219.00 0.000
RE DISCCART 305.00 -1181.00 0.000
RE DISCCART 305.00 -1143.00 0.000
RE DISCCART 305.00 -1105.00 0.000
RE DISCCART 305.00 -1067.00 0.000
RE DISCCART 290.00 -1021.00 0.000
RE DISCCART 274.00 -975.00 0.000
RE DISCCART 270.00 -937.00 0.000
RE DISCCART 267.00 -899.00 0.000
RE DISCCART 263.00 -861.00 0.000
RE DISCCART 259.00 -823.00 0.000
RE DISCCART 247.00 -775.00 0.000
RE DISCCART 236.00 -726.00 0.000
RE DISCCART 224.00 -678.00 0.000
RE DISCCART 212.00 -629.00 0.000
RE DISCCART 201.00 -581.00 0.000
RE DISCCART 189.00 -533.00 0.000
RE DISCCART 177.00 -484.00 0.000
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RE DISCCART 154.00 -387.00 0.000
RE DISCCART 143.00 -339.00 0.000
RE DISCCART 131.00 -290.00 0.000
RE DISCCART 119.00 -242.00 0.000
RE DISCCART 108.00 -194.00 0.000
RE DISCCART 96.00 -145.00 0.000
RE DISCCART 84.00 -97.00 0.000
RE DISCCART 73.00 -48.00 0.000
RE DISCCART 61.00 0.00 0.000
RE DISCCART 31.00 0.00 0.000
RE DISCCART 0.00 0.00 0.000
RE DISCCART 0.00 46.00 0.000
RE DISCCART 0.00 92.00 0.000
RE DISCCART 0.00 137.00 0.000
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RE DISCCART 0.00 229.00 0.000
RE DISCCART 0.00 275.00 0.000
RE DISCCART 0.00 320.00 0.000
RE DISCCART 0.00 366.00 0.000
RE GRIDCART NO_2   STA
RE GRIDCART NO_2   XYINC -250.00 28 100.00 -2350.00 33 100.00
RE GRIDCART NO_2   FLAG 1   1.83   1.83   1.83   1.83
RE GRIDCART NO_2   FLAG 1   1.83   1.83   1.83   1.83
RE GRIDCART NO_2   FLAG 1   1.83   1.83   1.83   1.83
RE GRIDCART NO_2   FLAG 1   1.83   1.83   1.83   1.83
RE GRIDCART NO_2   FLAG 1   1.83   1.83   1.83   1.83
RE GRIDCART NO_2   FLAG 1   1.83   1.83   1.83   1.83
RE GRIDCART NO_2   FLAG 1   1.83   1.83   1.83   1.83
RE GRIDCART NO_2   FLAG 2   1.83   1.83   1.83   1.83
RE GRIDCART NO_2   FLAG 2   1.83   1.83   1.83   1.83
RE GRIDCART NO_2   FLAG 2   1.83   1.83   1.83   1.83
RE GRIDCART NO_2   FLAG 2   1.83   1.83   1.83   1.83
RE GRIDCART NO_2   FLAG 2   1.83   1.83   1.83   1.83
RE GRIDCART NO_2   FLAG 2   1.83   1.83   1.83   1.83
RE GRIDCART NO_2   FLAG 2   1.83   1.83   1.83   1.83
RE GRIDCART NO_2   FLAG 3   1.83   1.83   1.83   1.83
RE GRIDCART NO_2   FLAG 3   1.83   1.83   1.83   1.83
RE GRIDCART NO_2   FLAG 3   1.83   1.83   1.83   1.83
RE GRIDCART NO_2   FLAG 3   1.83   1.83   1.83   1.83
RE GRIDCART NO_2   FLAG 3   1.83   1.83   1.83   1.83
RE GRIDCART NO_2   FLAG 3   1.83   1.83   1.83   1.83
RE GRIDCART NO_2   FLAG 3   1.83   1.83   1.83   1.83
RE GRIDCART NO_2   FLAG 4   1.83   1.83   1.83   1.83
RE GRIDCART NO_2   FLAG 4   1.83   1.83   1.83   1.83
RE GRIDCART NO_2   FLAG 4   1.83   1.83   1.83   1.83
RE GRIDCART NO_2   FLAG 4   1.83   1.83   1.83   1.83
RE GRIDCART NO_2   FLAG 4   1.83   1.83   1.83   1.83
RE GRIDCART NO_2   FLAG 4   1.83   1.83   1.83   1.83
RE GRIDCART NO_2   FLAG 4   1.83   1.83   1.83   1.83
RE GRIDCART NO_2   FLAG 5   1.83   1.83   1.83   1.83
RE GRIDCART NO_2   FLAG 5   1.83   1.83   1.83   1.83
RE GRIDCART NO_2   FLAG 5   1.83   1.83   1.83   1.83
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ISCLT2 Input File For the OU2 FSRA

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RE GRIDCART NO_2  FLAG 27  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 27  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 27  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 27  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 28  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 28  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 28  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 28  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 28  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 28  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 28  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 29  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 29  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 29  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 29  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 29  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 29  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 29  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 30  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 30  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 30  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 30  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 30  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 30  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 30  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 31  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 31  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 31  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 31  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 31  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 31  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 31  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 32  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 32  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 32  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 32  1.83  1.83  1.83  1.83
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RE GRIDCART NO_2  FLAG 32  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 33  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 33  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 33  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 33  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 33  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 33  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  FLAG 33  1.83  1.83  1.83  1.83
RE GRIDCART NO_2  END
RE FINISHED
ME STARTING
ME INPUTFIL C:\MODEL\JFD8792.STR (7X,6F7.5)
ME ANEMHGHT  10.000 METERS
ME SURFDATA 93814 1987 FERNALD
ME UAIRDATA 13840 1987 DAYTON
ME AVETEMPS ANNUAL 290.00 289.00 288.00 283.00 283.00 283.00
ME AVEMIXHT ANNUAL A 1823.00 1991.00 1791.00 1695.00 1629.00 2313.00
ME AVEMIXHT ANNUAL B 1215.00 1327.00 1194.00 1130.00 1086.00 1542.00
ME AVEMIXHT ANNUAL C 1215.00 1327.00 1194.00 1130.00 1086.00 1542.00
ME AVEMIXHT ANNUAL D 1215.00 1327.00 1194.00 1130.00 1086.00 1542.00
ME AVEMIXHT ANNUAL E 5000.00 5000.00 5000.00 5000.00 5000.00 5000.00
ME AVEMIXHT ANNUAL F 5000.00 5000.00 5000.00 5000.00 5000.00 5000.00
ME FINISHED
OU STARTING
OU RECTABLE SRCGRP
OU MAXTABLE 10 SRCGRP SOCONT
OU PLOTFILE ANNUAL SRC1 C:\MODEL\OU2.GPH 70
OU FINISHED
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RE GRIDCART NO_2	FLAG 16	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 16	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 16	1.83	1.83	1.83	1.83
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RE GRIDCART NO_2	FLAG 17	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 17	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 17	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 17	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 17	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 17	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 17	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 18	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 18	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 18	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 18	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 18	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 18	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 18	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 19	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 19	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 19	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 19	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 19	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 19	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 19	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 20	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 20	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 20	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 20	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 20	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 20	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 20	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 21	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 21	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 21	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 21	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 21	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 21	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 21	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 22	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 22	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 22	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 22	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 22	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 22	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 22	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 23	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 23	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 23	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 23	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 23	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 23	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 23	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 24	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 24	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 24	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 24	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 24	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 24	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 24	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 25	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 25	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 25	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 25	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 25	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 25	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 25	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 26	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 26	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 26	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 26	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 26	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 26	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 26	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 27	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 27	1.83	1.83	1.83	1.83
RE GRIDCART NO_2	FLAG 27	1.83	1.83	1.83	1.83

0882

* ISCLT2 Output (93109): OU2 FS – Annual Conc.: 1 g/s (pCi/s) per m2

X	Y	N Dryer (g/m3)/(g/s)	S Dryer (g/m3)/(g/s)
150	-1650	0.003536	0.004637
50	-1650	0.003433	0.005123
2450	-1350	0.002794	0.004087
2350	-1350	0.002923	0.004399
450	-1650	0.003659	0.008816
-250	-1250	0.003314	0.006672
-50	-1650	0.003328	0.005149
-150	-1650	0.003221	0.005039
-250	-1650	0.003115	0.004852
-150	-1250	0.003648	0.007322
2250	-1450	0.002914	0.004747
2150	-1550	0.002805	0.004907
550	-1650	0.003424	0.012451
50	-1250	0.004253	0.009
2150	-1650	0.002613	0.004636
-150	-1550	0.00338	0.006364
-250	-1550	0.00326	0.005928
2450	-1650	0.002483	0.003763
2350	-1650	0.002557	0.004022
2250	-1650	0.002588	0.004312
-50	-1450	0.003685	0.008552
2350	-1450	0.002801	0.004394
450	-1450	0.004406	0.01692
2150	-1350	0.003181	0.005163
50	-1450	0.003827	0.009556
150	-1450	0.003972	0.010788
250	-1450	0.004117	0.012371
350	-1450	0.004262	0.014432
-50	-1250	0.004022	0.008084
250	-1250	0.004661	0.011551
150	-1250	0.004453	0.010124
650	-1850	0.00267	0.011338
1850	-1850	0.002236	0.004882
2450	-1850	0.002228	0.003394
2350	-1850	0.002246	0.003597
2250	-1850	0.002259	0.003817
2150	-1850	0.002265	0.004054
1950	-1850	0.002254	0.004579
350	-1350	0.004559	0.016401
1750	-1850	0.002211	0.005283
-150	-1750	0.003069	0.003803
2250	-1550	0.002766	0.00454
2350	-1550	0.002684	0.004217
2450	-1450	0.002687	0.004083
-250	-1350	0.003358	0.007251
-150	-1350	0.003677	0.008028
-250	-1750	0.002976	0.003827
50	-1750	0.003251	0.004209
-50	-1750	0.003161	0.003636
2450	-1750	0.00237	0.003583
150	-1550	0.003747	0.00767
2350	-1750	0.002397	0.003814
2250	-1750	0.002419	0.004069
2150	-1750	0.002433	0.00435
-50	-1550	0.003503	0.006816
50	-1550	0.003625	0.007269
350	-1550	0.003987	0.007719
250	-1550	0.003868	0.007918
150	-1750	0.003339	0.004977
650	-1750	0.002691	0.016874
550	-1750	0.003128	0.012491
450	-1750	0.003333	0.009629
350	-1750	0.003503	0.0075
250	-1750	0.003423	0.006016
450	-1550	0.004047	0.007007
-300	-2400	0.002184	0.003764
2150	-1150	0.003527	0.004707
1750	550	0.004698	0.001723
2350	550	0.003526	0.001989
2250	550	0.003746	0.001966
2150	550	0.003971	0.001935
1950	550	0.004402	0.001848
1850	550	0.004585	0.00179
1650	550	0.004667	0.001646
-250	650	0.002538	0.001695

* ISCLT2 Output (93109): OU2 FS – Annual Conc.: 1 g/s (pCi/s) per m2

5860

X	Y	N Dryer (g/m3)/(g/s)	S Dryer (g/m3)/(g/s)
-150	-1850	0.002923	0.003524
-50	-1850	0.003003	0.004052
-250	-1450	0.003378	0.007014
2250	-1250	0.003199	0.004573
250	-1850	0.003225	0.00659
2350	-1250	0.003051	0.004243
150	-1850	0.003154	0.005518
2450	-1250	0.002905	0.003951
-250	-1150	0.003241	0.006052
250	-1350	0.004382	0.013601
50	-1850	0.00308	0.004698
2450	-1550	0.002583	0.003931
1450	-1950	0.001998	0.006091
2150	-1250	0.003349	0.004949
1950	-1950	0.002083	0.004297
-250	-1850	0.002841	0.003083
2450	-1950	0.002093	0.003201
2350	-1950	0.002103	0.003375
2250	-1950	0.002108	0.003561
2050	-1950	0.002099	0.004005
1850	-1950	0.002059	0.004612
150	-1350	0.004208	0.011605
1750	-1950	0.002028	0.00495
1650	-1950	0.002005	0.005314
1550	-1950	0.002007	0.005691
-50	-1350	0.003872	0.008963
50	-1350	0.004038	0.010124
2150	-1950	0.002107	0.003757
650	-1950	0.00248	0.008182
-150	-1150	0.003587	0.00657
1050	-2050	0.001745	0.007159
1750	-2050	0.001863	0.00463
1650	-2050	0.001862	0.004923
1550	-2050	0.001868	0.005223
1450	-2050	0.001864	0.005519
1350	-2050	0.001851	0.005899
1250	-2050	0.001826	0.006341
1150	-2050	0.001791	0.006823
950	-2050	0.001755	0.006022
1950	-2050	0.001927	0.004079
850	-2050	0.001953	0.004472
750	-2050	0.00214	0.004347
650	-2050	0.002314	0.006345
550	-2050	0.002472	0.007957
450	-2050	0.002613	0.007727
350	-2050	0.002736	0.007056
250	-2050	0.00284	0.006497
1850	-2050	0.001899	0.004348
2150	-2050	0.001961	0.003586
2050	-2050	0.001948	0.003825
-50	-1150	0.003979	0.007151
350	-1950	0.002956	0.007579
50	-1150	0.004422	0.007817
150	-1150	0.004703	0.008586
250	-1150	0.004952	0.009396
-150	-1450	0.003544	0.007721
450	-1850	0.003056	0.00925
550	-1950	0.00266	0.009709
450	-1950	0.002819	0.008497
250	-1950	0.003042	0.006859
2250	-2050	0.001968	0.003363
150	-1950	0.002983	0.005865
50	-1950	0.00292	0.005047
-50	-1950	0.002854	0.004383
-150	-1950	0.002784	0.003826
-250	-1950	0.002711	0.003362
2450	-2050	0.001965	0.003005
2350	-2050	0.00197	0.003156
350	-1850	0.00321	0.007961
2050	-1850	0.002263	0.004309
550	-1850	0.002876	0.011154
2250	-1350	0.003053	0.004754
2150	-1450	0.003007	0.005153
350	-1650	0.003734	0.006556
250	-1650	0.003637	0.005143

Max N Dryer (g/m3)/(g/s) 0.009178

Max S Dryer (g/m3)/(g/s) 0.020842

* ISCLT2 Output (93109): OU2 FS – Annual Conc.: 1 g/s (pCi/s) per m2

X	Y	N Dryer (g/m3)/(g/s)	S Dryer (g/m3)/(g/s)
2150	750	0.003653	0.001683
1850	850	0.003564	0.001423
2350	850	0.003203	0.001638
2250	850	0.003359	0.001608
2150	850	0.003511	0.001572
2050	850	0.003627	0.001529
1950	850	0.003607	0.00148
1750	850	0.003495	0.00136
1150	850	0.003537	0.001523
1650	850	0.003398	0.001371
1550	850	0.003275	0.001406
1450	850	0.003129	0.00144
1350	850	0.003229	0.001471
1250	850	0.003392	0.001498
2250	750	0.003481	0.001718
2050	750	0.003817	0.001641
1750	650	0.00426	0.00159
2450	650	0.003223	0.001882
150	750	0.002557	0.001804
50	750	0.002268	0.001805
-50	750	0.002117	0.001801
-150	750	0.002189	0.001747
-250	750	0.002226	0.001651
2350	650	0.003414	0.001863
350	750	0.003233	0.001788
2250	650	0.003609	0.001837
2150	650	0.003806	0.001804
2050	650	0.003996	0.001763
1950	650	0.004171	0.001714
1850	650	0.00429	0.001656
250	750	0.002879	0.001799
550	750	0.004019	0.001749
450	750	0.003616	0.001771
1950	750	0.003937	0.001592
1350	750	0.003498	0.001549
1850	750	0.003912	0.001534
1750	750	0.003859	0.001469
1650	750	0.003776	0.001436
1550	750	0.003662	0.001476
1450	750	0.003521	0.001514
1250	750	0.003699	0.001581
650	750	0.004141	0.001722
1150	750	0.003879	0.00161
1050	750	0.004029	0.001634
950	750	0.004138	0.001654
850	750	0.004183	0.001668
750	750	0.004185	0.00169
50	450	0.003406	0.002133
-150	450	0.003346	0.001905
2250	-1150	0.003354	0.004368
2350	-750	0.003845	0.003261
50	-650	0.003456	0.002921
-50	-650	0.003255	0.003013
-150	-650	0.003304	0.003089
-250	-650	0.003289	0.003107
2450	-750	0.003634	0.003088
2250	-750	0.004067	0.003493
2150	-650	0.004703	0.003614
2150	-750	0.004335	0.003741
150	-750	0.004359	0.003446
50	-750	0.003795	0.003565
-50	-750	0.003324	0.003652
-150	-750	0.002931	0.003657
150	-650	0.00398	0.003395
2350	-650	0.004134	0.00318
2250	-650	0.004408	0.003391
2450	-850	0.003384	0.003274
2250	-550	0.004745	0.003294
-50	-450	0.005351	0.002516
-150	-450	0.005054	0.002221
-250	-450	0.004767	0.002278
2450	-550	0.004124	0.002919
2350	-550	0.004418	0.003102
2150	-550	0.005109	0.003495
2450	-650	0.003882	0.002982

* ISCLT2 Output (93109): OU2 FS – Annual Conc.: 1 g/s (pCi/s) per m2

5860

X	Y	N Dryer (g/m3)/(g/s)	S Dryer (g/m3)/(g/s)
1550	550	0.004592	0.00163
1450	550	0.004476	0.00168
1350	550	0.004335	0.001727
1250	550	0.004428	0.00177
1150	550	0.004708	0.001808
2450	550	0.003315	0.002004
-50	650	0.002485	0.001898
-150	650	0.002529	0.001799
950	550	0.005129	0.001869
750	650	0.004643	0.001797
1250	650	0.004039	0.001672
1150	650	0.004262	0.001705
1050	650	0.004454	0.001733
950	650	0.004593	0.001756
850	650	0.004649	0.001773
650	650	0.004583	0.00183
50	650	0.002397	0.001906
550	650	0.004272	0.001858
450	650	0.003792	0.00188
350	650	0.003345	0.001896
250	650	0.002941	0.001905
150	650	0.002581	0.001908
1050	550	0.004949	0.001841
850	550	0.005221	0.00189
1450	650	0.003973	0.001594
750	450	0.005985	0.002046
1250	450	0.004898	0.001677
1150	450	0.005246	0.001921
1050	450	0.005537	0.00196
950	450	0.005772	0.001993
850	450	0.005965	0.002018
650	450	0.005617	0.002081
1450	450	0.005049	0.001773
550	450	0.004833	0.002109
450	450	0.004131	0.002129
350	450	0.003523	0.002142
250	450	0.003221	0.002146
150	450	0.003357	0.002143
1350	450	0.004946	0.001827
2150	450	0.00415	0.002078
1550	450	0.005128	0.001716
750	550	0.005214	0.001915
150	550	0.002753	0.002021
650	550	0.005127	0.00195
550	550	0.004536	0.001978
450	550	0.003964	0.001999
350	550	0.003447	0.002013
250	550	0.002986	0.002021
50	550	0.002862	0.002015
2250	450	0.003893	0.002105
-50	550	0.00291	0.001968
-150	550	0.002914	0.001852
-250	550	0.002885	0.001739
2450	450	0.003411	0.002135
2350	450	0.003646	0.002124
1350	650	0.003817	0.001635
1650	650	0.004198	0.001515
1550	650	0.004102	0.001551
-50	450	0.003397	0.002032
150	850	0.002519	0.001708
650	850	0.003767	0.001624
550	850	0.003713	0.00165
450	850	0.003448	0.001672
350	850	0.003118	0.001689
250	850	0.002807	0.001701
50	850	0.002255	0.001711
850	850	0.003786	0.001573
-50	850	0.002017	0.00171
-150	850	0.001891	0.001696
-250	850	0.001949	0.001608
2450	750	0.003133	0.001768
2350	750	0.003306	0.001746
750	850	0.003792	0.001592
1050	850	0.003659	0.001544
950	850	0.003746	0.00156

* ISCLT2 Output (93109): OU2 FS – Annual Conc.: 1 g/s (pCi/s) per m2

0086

X	Y	N Dryer (g/m3)/(g/s)	S Dryer (g/m3)/(g/s)
2150	-350	0.005878	0.003274
-150	-250	0.006882	0.002202
-250	-250	0.006283	0.001978
2450	-350	0.004569	0.002795
2350	-350	0.004945	0.00295
2250	-350	0.005376	0.00311
50	-2050	0.00277	0.005269
50	-250	0.008439	0.002714
50	-350	0.007033	0.002785
-50	-350	0.006475	0.002488
-150	-350	0.005974	0.002218
-250	-350	0.005531	0.001976
2450	-450	0.004355	0.002857
-50	-250	0.007593	0.002447
2250	-250	0.00565	0.003023
2150	-250	0.006213	0.00317
50	-50	0.007118	0.002558
2250	-150	0.005452	0.002937
-50	-50	0.006511	0.002343
-150	-50	0.00598	0.00214
-250	-50	0.005521	0.001951
2450	-150	0.004619	0.00267
2350	-150	0.005005	0.002803
2150	-150	0.005973	0.003071
2350	-250	0.005172	0.002876
50	-150	0.007876	0.002837
-50	-150	0.00713	0.002398
-150	-150	0.006495	0.002175
-250	-150	0.005954	0.001969
2450	-250	0.004761	0.002733
150	-2050	0.002824	0.006026
2057	0	0.005936	0.002864
-50	-2050	0.002712	0.00461
-150	-2050	0.002651	0.004053
-300	-900	0.002753	0.004374
2300	-1000	0.003495	0.003899
2400	-1000	0.003294	0.003658
2500	-1000	0.003104	0.00344
-100	-900	0.00346	0.004747
-200	-900	0.00308	0.004571
2100	-1000	0.003926	0.004461
0	-900	0.003905	0.004871
100	-900	0.00443	0.004915
200	-900	0.005052	0.004835
2200	-1000	0.003706	0.004166
200	-1000	0.005166	0.006286
2200	-900	0.003892	0.003909
2400	-1100	0.003165	0.003842
2100	-1100	0.003715	0.004754
2200	-1100	0.003527	0.004414
2300	-1100	0.003343	0.004112
-300	-1000	0.00291	0.004948
2500	-1100	0.002994	0.0036
100	-1000	0.004572	0.006119
-200	-1000	0.003241	0.005267
-100	-1000	0.003622	0.005583
0	-1000	0.004062	0.005871
2100	-900	0.004148	0.00416
2300	-900	0.003651	0.003678
200	-1100	0.004962	0.008033
100	-700	0.003897	0.003165
-200	-700	0.002931	0.003362
-100	-700	0.002979	0.003349
0	-700	0.003395	0.003269
2100	-700	0.004636	0.003799
200	-700	0.0045	0.003706
2500	-800	0.003417	0.003098
2200	-700	0.004367	0.003557
2300	-700	0.004111	0.003329
2400	-700	0.003872	0.003115
-300	-700	0.002945	0.003329
2400	-800	0.003603	0.003268
2400	-900	0.003425	0.003466
-100	-800	0.003246	0.004
2500	-900	0.003214	0.003271

* ISCLT2 Output (93109): OU2 FS – Annual Conc.: 1 g/s (pCi/s) per m2

5860

X	Y	N Dryer (g/m3)/(g/s)	S Dryer (g/m3)/(g/s)
150	-550	0.004222	0.003314
50	-550	0.004308	0.002895
-50	-550	0.004265	0.002527
-150	-550	0.004154	0.0028
-250	-550	0.004012	0.002684
-250	-750	0.002612	0.003609
2350	-850	0.003608	0.003464
150	-450	0.00587	0.003215
150	-1050	0.004895	0.006968
2450	-1050	0.003138	0.003633
2350	-1050	0.003322	0.003876
2250	-1050	0.003516	0.004145
2150	-1050	0.003717	0.004446
250	-1050	0.005247	0.007254
50	-1050	0.004359	0.006606
-150	-950	0.00335	0.005037
-50	-1050	0.003894	0.006221
-150	-1050	0.003489	0.00581
-250	-1050	0.003136	0.005418
2450	-1150	0.00302	0.003799
2350	-1150	0.003184	0.004067
-250	-950	0.002995	0.004789
50	-950	0.00424	0.005434
-50	-950	0.003761	0.005261
2250	-850	0.003856	0.00367
-150	-850	0.003164	0.004307
2150	-850	0.004123	0.003892
250	-850	0.005315	0.004191
150	-850	0.004632	0.004326
50	-850	0.004055	0.004418
-50	-850	0.003572	0.004402
-250	-850	0.002816	0.004171
150	-950	0.004803	0.005524
2450	-950	0.003257	0.003457
2350	-950	0.003464	0.003673
2250	-950	0.003684	0.003911
2150	-950	0.003916	0.004172
250	-950	0.005465	0.005474
50	-450	0.005633	0.002847
2250	-450	0.005071	0.003201
2150	-450	0.005505	0.003382
-250	450	0.003269	0.001781
2350	50	0.004542	0.002657
2150	150	0.004933	0.00258
-50	150	0.00521	0.002222
-150	150	0.004892	0.002054
-250	150	0.004598	0.001896
2450	50	0.004225	0.002544
2250	50	0.004899	0.002771
2350	150	0.004282	0.002586
2150	50	0.005303	0.002775
-50	50	0.005861	0.002283
-150	50	0.005439	0.002099
-250	50	0.005064	0.001926
2450	-50	0.004432	0.002607
2250	150	0.004591	0.002591
-250	250	0.004137	0.001861
2450	150	0.004003	0.002481
2250	-50	0.005189	0.002854
-150	350	0.003826	0.001957
2450	350	0.003534	0.002275
2350	350	0.003772	0.002269
2250	350	0.004052	0.002255
2150	350	0.004348	0.002232
-50	350	0.003947	0.002096
-250	350	0.003688	0.001823
-150	250	0.00435	0.002007
2450	250	0.003771	0.002419
2350	250	0.004011	0.002425
2250	250	0.004273	0.002417
2150	250	0.004566	0.002399
-50	250	0.004558	0.002159
2350	-50	0.004786	0.00273
2150	-50	0.005654	0.002975
2350	-450	0.004691	0.003025

* ISCLT2 Output (93109): OU2 FS – Annual Conc.: 1 g/s (pCi/s) per m2

X	Y	N Dryer (g/m3)/(g/s)	S Dryer (g/m3)/(g/s)
2300	0	0.00485	0.002753
-100	200	0.004754	0.00211
2500	-100	0.004361	0.002576
2200	-100	0.005562	0.002959
2300	-100	0.005104	0.002831
2400	-100	0.004707	0.002702
-200	0	0.005496	0.002028
-300	0	0.005104	0.001854
2200	0	0.005257	0.002871
-100	0	0.005942	0.002215
0	0	0.006451	0.002414
2100	0	0.005723	0.002873
-200	200	0.004492	0.001954
2100	200	0.00491	0.002477
0	-100	0.007152	0.002483
300	400	0.003511	0.002213
0	400	0.003693	0.002132
100	400	0.003714	0.002202
200	400	0.003666	0.002211
500	400	0.004587	0.002191
400	400	0.003865	0.002206
-200	400	0.00353	0.001866
600	400	0.005433	0.002167
700	400	0.006379	0.002136
800	400	0.006491	0.002098
-100	400	0.003626	0.001997
-300	400	0.003416	0.00174
2200	200	0.004585	0.002496
-300	300	0.003822	0.001775
2300	200	0.004287	0.002506
2400	200	0.004014	0.0025
2500	200	0.003767	0.002401
-100	300	0.004166	0.002054
-200	300	0.003997	0.001911
2500	300	0.003548	0.002343
2200	300	0.004293	0.002325
2300	300	0.003992	0.002341
2400	300	0.003762	0.002348
2100	-100	0.006097	0.003085
-100	-100	0.006523	0.002263
0	-600	0.003733	0.002711
2500	-500	0.004097	0.002804
2200	-500	0.005104	0.003342
2300	-500	0.004728	0.003154
2400	-500	0.004395	0.002974
-200	-400	0.005327	0.002092
-300	-400	0.004979	0.002143
100	-500	0.005005	0.003064
-100	-400	0.005708	0.002359
0	-400	0.006118	0.002656
100	-400	0.006539	0.002986
2100	-500	0.005527	0.003535
0	-500	0.004889	0.002693
2200	-400	0.005453	0.003241
2200	-600	0.004738	0.003447
100	-600	0.003605	0.003127
200	-600	0.004041	0.003602
2100	-600	0.005082	0.003663
2400	-600	0.004138	0.003044
2300	-600	0.004424	0.00324
-100	-500	0.004702	0.002365
2500	-600	0.003877	0.002859
-300	-500	0.00428	0.002489
-200	-500	0.004494	0.00243
2100	-400	0.005957	0.003414
2300	-400	0.005017	0.003071
-200	-100	0.005983	0.002058
2100	-200	0.006427	0.00319
-100	-200	0.007062	0.002304
0	-200	0.007807	0.002548
100	-200	0.008695	0.002809
2300	-200	0.005328	0.002909
2200	-200	0.005831	0.00305
-300	-200	0.005901	0.001875
2400	-200	0.004897	0.00277

* ISCLT2 Output (93109): OU2 FS – Annual Conc.: 1 g/s (pCi/s) per m2

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X	Y	N Dryer (g/m3)/(g/s)	S Dryer (g/m3)/(g/s)
-300	-800	0.002561	0.003826
-200	-800	0.002876	0.003932
100	-800	0.00421	0.003911
0	-800	0.003684	0.004005
2300	-800	0.00381	0.003452
200	-800	0.004835	0.003782
2100	-800	0.004379	0.003946
2200	-800	0.004083	0.003674
300	-1100	0.005244	0.008529
100	-1100	0.004648	0.007504
-300	-600	0.003596	0.002883
2100	-1400	0.003142	0.005494
200	-1400	0.004168	0.01329
300	-1400	0.004327	0.015978
400	-1400	0.004488	0.019876
2300	-1400	0.002922	0.004645
2200	-1400	0.003042	0.005038
0	-1400	0.003855	0.009959
2400	-1400	0.002801	0.004303
2500	-1400	0.00268	0.004003
-300	-1300	0.003189	0.006651
100	-1400	0.00401	0.011396
-100	-1400	0.003702	0.008831
-100	-1300	0.003843	0.008089
2100	-1500	0.002926	0.005249
300	-1500	0.004056	0.010563
400	-1500	0.004187	0.011271
500	-1500	0.004133	0.010833
2300	-1500	0.002795	0.004471
2200	-1500	0.002882	0.004833
-200	-1400	0.003522	0.007916
2400	-1500	0.002688	0.004154
2500	-1500	0.002581	0.003873
-300	-1400	0.003226	0.00715
-200	-1300	0.003499	0.007313
0	-1300	0.004055	0.009027
0	-1100	0.004162	0.006951
2300	-1200	0.003196	0.00431
300	-1200	0.004924	0.011158
2100	-1200	0.003517	0.005029
2200	-1200	0.003356	0.004646
2500	-1200	0.002887	0.003749
2400	-1200	0.003039	0.004013
100	-1200	0.004469	0.008861
-300	-1100	0.003034	0.005526
-200	-1100	0.003363	0.005957
-100	-1100	0.003736	0.00643
200	-1200	0.00469	0.009893
0	-1200	0.004214	0.007998
100	-1300	0.004237	0.010192
2200	-1300	0.003194	0.004856
200	-1300	0.004424	0.011677
300	-1300	0.004617	0.01368
2100	-1300	0.003332	0.005278
2400	-1300	0.002917	0.004168
2300	-1300	0.003056	0.004489
-100	-1200	0.003808	0.007272
2500	-1300	0.002782	0.003884
-300	-1200	0.003126	0.006102
-200	-1200	0.003447	0.006649
2500	-700	0.003649	0.002922
-100	-600	0.003743	0.002792
-200	-600	0.003688	0.002863
100	-1500	0.003792	0.0088
2100	100	0.005323	0.002668
-300	100	0.004676	0.001832
-200	100	0.004994	0.001993
-100	100	0.005345	0.002164
2300	100	0.004575	0.002676
2200	100	0.004928	0.00268
2400	0	0.004493	0.002634
2400	100	0.00426	0.002567
2500	100	0.003978	0.002459
-300	200	0.004245	0.001806
2500	0	0.004178	0.002517

* ISCLT2 Output (93109): OU2 FS – Annual Conc.: 1 g/s (pCi/s) per m2

X	Y	N Dryer (g/m3)/(g/s)	S Dryer (g/m3)/(g/s)
1700	-2400	0.001484	0.003709
1600	-2400	0.001499	0.003802
1000	-2400	0.001475	0.003514
1800	-2400	0.001465	0.003609
1900	-2400	0.001461	0.003463
2000	-2400	0.001494	0.003313
1100	-2400	0.001494	0.003857
900	-2400	0.001567	0.003079
2200	-2400	0.001545	0.003013
200	-2400	0.002257	0.004979
-100	-2400	0.002263	0.004337
0	-2400	0.002298	0.004542
100	-2400	0.002315	0.004756
400	-2400	0.002108	0.005296
300	-2400	0.002188	0.005211
800	-2400	0.001692	0.002563
500	-2400	0.002018	0.004735
600	-2400	0.001918	0.004059
700	-2400	0.001809	0.003284
2100	-2400	0.001522	0.003162
2300	-2400	0.001562	0.002867
1800	-2300	0.001554	0.003836
1200	-2300	0.001584	0.004688
900	-2300	0.001643	0.003455
1000	-2300	0.001541	0.004055
1100	-2300	0.001566	0.004516
1400	-2300	0.0016	0.004419
1300	-2300	0.001595	0.004556
700	-2300	0.001915	0.003848
1500	-2300	0.001597	0.004281
1600	-2300	0.001588	0.004144
1700	-2300	0.001574	0.004006
800	-2300	0.001783	0.002738
600	-2300	0.002037	0.004619
2400	-2400	0.001575	0.002726
-100	-2300	0.002373	0.004563
2500	-2400	0.001583	0.00259
-300	-2300	0.002283	0.003705
-200	-2300	0.00233	0.004115
100	-2300	0.002452	0.005063
0	-2300	0.002414	0.004805
500	-2300	0.002148	0.005455
200	-2300	0.002411	0.005339
300	-2300	0.002335	0.005633
400	-2300	0.002248	0.005944
1200	-2100	0.00176	0.006142
1500	-2100	0.001806	0.005134
1400	-2100	0.0018	0.005432
-200	-1500	0.003397	0.006751
2400	-1800	0.00231	0.003595
2100	-1800	0.002349	0.004341
2200	-1800	0.002343	0.00407
2300	-1800	0.00233	0.003822
-300	-1700	0.002995	0.00427
2500	-1800	0.002285	0.003388
600	-1800	0.00289	0.013457
-200	-1700	0.003095	0.004379
-100	-1700	0.003194	0.004406
0	-1700	0.003292	0.004288
2000	-1800	0.002348	0.004634
500	-1800	0.003097	0.010577
200	-1700	0.003482	0.005078
-200	-1800	0.002951	0.0033
2400	-1900	0.002167	0.00339
2500	-1900	0.00215	0.003209
-300	-1800	0.002864	0.003365
0	-1800	0.003123	0.004142
-100	-1800	0.003038	0.003586
400	-1800	0.003274	0.008691
100	-1800	0.003205	0.004845
200	-1800	0.003284	0.005768
300	-1800	0.003359	0.007007
100	-1700	0.003388	0.004244
300	-1700	0.003572	0.006279
2200	-1900	0.002184	0.003796

* ISCLT2 Output (93109): OU2 FS – Annual Conc.: 1 g/s (pCi/s) per m2

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X	Y	N Dryer (g/m3)/(g/s)	S Dryer (g/m3)/(g/s)
2500	-200	0.004523	0.002634
-300	-100	0.005517	0.001868
-200	-200	0.006435	0.00208
2500	-300	0.004491	0.002691
2400	-400	0.004637	0.002906
-100	-300	0.006723	0.002337
2500	-400	0.004303	0.002748
-300	-300	0.005676	0.001871
-200	-300	0.006161	0.002092
100	-300	0.008134	0.0029
0	-300	0.007376	0.002607
2400	-300	0.004858	0.002838
2100	-300	0.006354	0.003299
2200	-300	0.005773	0.003144
2300	-300	0.005281	0.002989
200	-1500	0.003924	0.009647
-100	-1500	0.003527	0.007353
0	-1500	0.003659	0.008033
1000	400	0.00599	0.002043
900	-2200	0.001723	0.003984
800	-2200	0.002168	0.005382
700	-2200	0.002031	0.004149
800	-2200	0.001882	0.002977
1100	-2200	0.001643	0.005429
1000	-2200	0.001609	0.004813
400	-2200	0.002404	0.006474
1200	-2200	0.001668	0.00536
1300	-2200	0.001685	0.00513
1400	-2200	0.001694	0.004911
500	-2200	0.002293	0.006409
300	-2200	0.002501	0.006074
1600	-2200	0.001689	0.004498
2500	-2300	0.001683	0.002671
2200	-2300	0.001653	0.00314
2300	-2300	0.001666	0.002976
2400	-2300	0.001678	0.00282
-200	-2200	0.002441	0.004032
-300	-2200	0.002388	0.003608
200	-2200	0.002584	0.005712
-100	-2200	0.002491	0.004521
0	-2200	0.002539	0.005067
100	-2200	0.002583	0.005376
1500	-2200	0.001695	0.004698
1700	-2200	0.001676	0.004293
2000	-2300	0.001607	0.003484
600	-2100	0.002315	0.006478
300	-2100	0.002688	0.006533
400	-2100	0.00258	0.007062
500	-2100	0.002456	0.00768
800	-2100	0.00199	0.003337
700	-2100	0.002159	0.004886
100	-2100	0.002723	0.005678
900	-2100	0.001809	0.004766
1000	-2100	0.001681	0.005913
1100	-2100	0.001725	0.006523
200	-2100	0.002771	0.006077
0	-2100	0.002672	0.005
1800	-2200	0.001665	0.004082
2200	-2200	0.001771	0.003271
1900	-2200	0.001701	0.003872
2000	-2200	0.001731	0.003664
2100	-2200	0.001754	0.003463
2400	-2200	0.001788	0.002915
2300	-2200	0.001782	0.003088
-100	-2100	0.002616	0.004404
2500	-2200	0.001789	0.002752
-300	-2100	0.002498	0.003465
-200	-2100	0.002558	0.003898
2100	-2300	0.001633	0.003309
1900	-2300	0.001576	0.00366
1300	-2100	0.001785	0.005771
1500	-2400	0.001509	0.003891
1200	-2400	0.001507	0.004105
1300	-2400	0.001514	0.004051
1400	-2400	0.001514	0.003975

* ISCLT2 Output (93109): OU2 FS – Annual Conc.: 1 g/s (pCi/s) per m2

X	Y	N Dryer (g/m3)/(g/s)	S Dryer (g/m3)/(g/s)	
900	400	0.006324	0.002075	
1100	400	0.005733	0.002004	
-250	-2050	0.002588	0.003584	
671	-1798	0.002725	0.012965	
701	-1920	0.002426	0.007465	
691	-1879	0.002519	0.008891	
681	-1839	0.002618	0.010657	
634	-1725	0.002987	0.01681	
653	-1761	0.002851	0.015898	
762	-1961	0.002236	0.004887	
616	-1688	0.003132	0.016432	
597	-1652	0.003287	0.015268	
579	-1615	0.003454	0.013307	
731	-1940	0.002331	0.006137	
792	-1981	0.002146	0.003815	
525	-1534	0.003907	0.00895	
1113	-2029	0.001792	0.007219	
1250	-1990	0.001891	0.0068	
1204	-2003	0.001858	0.006965	
1158	-2016	0.001825	0.007108	
1021	-2032	0.00174	0.00717	
1067	-2042	0.001757	0.007304	
838	-1991	0.002039	0.004785	
975	-2022	0.00172	0.006778	
930	-2011	0.001825	0.006284	
884	-2001	0.001931	0.00561	
552	-1574	0.003674	0.0112	
498	-1493	0.004162	0.01171	
1341	-1964	0.001953	0.006443	
247	-775	0.005078	0.004074	
267	-899	0.005505	0.004648	
263	-861	0.005411	0.004295	
259	-823	0.005299	0.004222	
224	-678	0.004554	0.003808	
236	-726	0.004832	0.003939	
274	-975	0.005526	0.005834	
212	-629	0.004248	0.003683	
201	-581	0.003932	0.003573	
189	-533	0.004413	0.003459	
270	-937	0.005575	0.005209	
290	-1021	0.005443	0.006693	
471	-1453	0.004418	0.016933	
362	-1291	0.004756	0.014887	
443	-1412	0.004508	0.020842	**********
416	-1372	0.004594	0.019524	
389	-1331	0.004679	0.017042	
305	-1219	0.004862	0.011658	
335	-1250	0.004832	0.013024	
305	-1067	0.005347	0.007716	
305	-1181	0.004981	0.010656	
305	-1143	0.005102	0.009627	
305	-1105	0.005224	0.008641	
1296	-1977	0.001922	0.006623	
1387	-1950	0.001984	0.006324	
166	-436	0.006132	0.003251	
2078	-931	0.004126	0.004313	
2075	-784	0.00449	0.003988	
2076	-833	0.004366	0.004065	
2077	-882	0.004245	0.004162	
2080	-1029	0.003899	0.004609	
2079	-980	0.004011	0.004462	
2073	-686	0.00477	0.003842	
2081	-1078	0.003791	0.004753	
2083	-1127	0.003684	0.004889	
2084	-1176	0.003583	0.005023	
2074	-735	0.004616	0.003913	
2071	-637	0.005005	0.003775	
2086	-1274	0.003392	0.005272	
2064	-294	0.006599	0.003344	
2060	-147	0.0065	0.003182	
2061	-196	0.006663	0.003235	
2063	-245	0.006797	0.003288	
2066	-392	0.00617	0.003459	
2065	-343	0.006389	0.0034	
2070	-588	0.00524	0.003708	

* ISCLT2 Output (93109): OU2 FS – Annual Conc.: 1 g/s (pCi/s) per m2

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X	Y	N Dryer (g/m3)/(g/s)	S Dryer (g/m3)/(g/s)
2100	-1600	0.002721	0.004964
300	-1600	0.003805	0.005492
400	-1600	0.003911	0.00681
500	-1600	0.003724	0.009646
2300	-1600	0.002658	0.00427
2200	-1600	0.002693	0.004596
100	-1600	0.003584	0.006216
2400	-1600	0.002581	0.003981
2500	-1600	0.002484	0.003723
-300	-1500	0.003242	0.006211
200	-1600	0.003696	0.006105
0	-1600	0.003471	0.006082
400	-1700	0.003585	0.008097
2200	-1700	0.002513	0.004339
500	-1700	0.003384	0.010855
600	-1700	0.003147	0.015364
2100	-1700	0.002529	0.004659
2400	-1700	0.002461	0.003793
2300	-1700	0.00249	0.004052
-100	-1600	0.003357	0.005836
2500	-1700	0.00239	0.00356
-300	-1600	0.003131	0.005229
-200	-1600	0.003243	0.005544
2300	-1900	0.002178	0.003586
2100	-1900	0.002183	0.004018
1600	-2100	0.001803	0.004871
400	-2000	0.00278	0.007697
100	-2000	0.002873	0.005554
200	-2000	0.002929	0.006416
300	-2000	0.0029	0.006989
600	-2000	0.002481	0.008116
500	-2000	0.00264	0.00857
-100	-2000	0.00275	0.004216
700	-2000	0.002303	0.006036
800	-2000	0.00211	0.003906
900	-2000	0.001903	0.005967
0	-2000	0.002813	0.004826
-200	-2000	0.002683	0.003704
1400	-2000	0.001921	0.005976
2000	-2100	0.001866	0.003853
1700	-2100	0.001792	0.004607
1800	-2100	0.001806	0.004348
1900	-2100	0.00184	0.004096
2200	-2100	0.001898	0.003405
2100	-2100	0.001885	0.003623
-300	-2000	0.002614	0.003274
2300	-2100	0.001905	0.003201
2400	-2100	0.001906	0.00301
2500	-2100	0.001902	0.002842
1300	-2000	0.001898	0.006469
1500	-2000	0.001933	0.005622
2000	-1900	0.002174	0.004252
400	-1900	0.003009	0.008296
100	-1900	0.003033	0.005277
200	-1900	0.0031	0.006208
300	-1900	0.003142	0.007373
600	-1900	0.00267	0.01077
500	-1900	0.002851	0.009584
-100	-1900	0.00289	0.003946
1700	-1900	0.0021	0.005313
1800	-1900	0.002132	0.004927
1900	-1900	0.002157	0.004573
0	-1900	0.002963	0.004542
-200	-1900	0.002815	0.003447
1600	-2000	0.001934	0.005284
2000	-2000	0.002014	0.004049
1700	-2000	0.001925	0.004949
1800	-2000	0.001961	0.004631
1900	-2000	0.001991	0.004331
2200	-2000	0.002036	0.003541
2100	-2000	0.002028	0.003786
-300	-1900	0.002736	0.003032
2300	-2000	0.002037	0.003348
2400	-2000	0.002032	0.003182
2500	-2000	0.002022	0.003026

• ISCLT2 Output (93109): OU2 FS – Annual Conc.: 1 g/s (pCi/s) per m2

X	Y	N Dryer (g/m3)/(g/s)	S Dryer (g/m3)/(g/s)	
550	−2150	0.002308	0.006481	
850	−2150	0.001851	0.003758	
750	−2150	0.002015	0.003707	
1250	−2150	0.001724	0.005588	
950	−2150	0.001678	0.004854	
1050	−2150	0.001665	0.005698	
1150	−2150	0.001699	0.005886	
450	−2250	0.002273	0.006287	
250	−2250	0.002457	0.005687	
131	−290	0.008539	0.002978	
−250	−2350	0.002255	0.003933	
0	275	0.004478	0.002218	
0	320	0.00418	0.002186	
0	366	0.00389	0.002154	
−50	−2350	0.002337	0.00456	
−150	−2350	0.002297	0.004343	
0	183	0.005129	0.002282	
50	−2350	0.002373	0.004789	
150	−2350	0.002363	0.00503	
250	−2350	0.002297	0.005285	
0	229	0.004797	0.00225	
0	137	0.00546	0.002315	
450	−2350	0.00213	0.0054	
84	−97	0.007712	0.00267	
119	−242	0.009178	0.002895	**********
108	−194	0.008699	0.002819	
96	−145	0.008199	0.002742	
61	0	0.006772	0.002536	
73	−48	0.007234	0.002603	
0	92	0.005779	0.002346	
31	0	0.006603	0.002474	
0	0	0.006436	0.002411	
0	46	0.006107	0.002379	
350	−2350	0.002219	0.005553	
550	−2350	0.00203	0.004712	
150	−2250	0.002529	0.00537	
2350	−2350	0.00162	0.002846	
2050	−2350	0.001564	0.003316	
2150	−2350	0.001588	0.003155	
2250	−2350	0.001606	0.002998	
−250	−2250	0.00236	0.003864	
2450	−2350	0.001629	0.002701	
1850	−2350	0.001499	0.00364	
−150	−2250	0.002408	0.00431	
−50	−2250	0.002454	0.004803	
50	−2250	0.002496	0.005075	
1950	−2350	0.001534	0.003479	
1750	−2350	0.001519	0.003797	
650	−2350	0.00192	0.003898	
1050	−2350	0.001519	0.003976	
750	−2350	0.0018	0.002991	
850	−2350	0.001671	0.00296	
950	−2350	0.001536	0.003521	
1250	−2350	0.00155	0.004345	
1150	−2350	0.001538	0.004314	
1650	−2350	0.001536	0.003914	
1350	−2350	0.001555	0.004244	
1450	−2350	0.001555	0.004137	
1550	−2350	0.001548	0.004026	
2059	−98	0.006323	0.003084	
2088	0	0.005775	0.002869	
−200	−2400	0.002225	0.00414	
1200	400	0.00538	0.001958	
600	700	0.004313	0.001789	
300	700	0.003096	0.001846	
400	700	0.003492	0.001833	
500	700	0.003921	0.001814	
800	700	0.00441	0.001726	
700	700	0.004384	0.001759	
100	700	0.002415	0.001855	
900	700	0.004387	0.001712	
1000	700	0.004305	0.001694	
1100	700	0.004153	0.00167	
200	700	0.002737	0.001854	
0	700	0.002249	0.001852	

* ISCLT2 Output (93109): OU2 FS – Annual Conc.: 1 g/s (pCi/s) per m2

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X	Y	N Dryer (g/m3)/(g/s)	S Dryer (g/m3)/(g/s)
2067	-441	0.005943	0.003518
2068	-490	0.005712	0.00358
2069	-539	0.005476	0.003643
2085	-1225	0.003486	0.005151
2087	-1323	0.003301	0.005384
1433	-1937	0.002012	0.006212
1707	-1859	0.002179	0.005423
1839	-1829	0.002272	0.004993
1795	-1839	0.002243	0.005124
1751	-1849	0.002212	0.005273
1616	-1885	0.002112	0.005706
1661	-1872	0.002138	0.005569
1927	-1808	0.002326	0.004821
1570	-1898	0.002089	0.005843
1524	-1911	0.002065	0.005974
1478	-1924	0.002039	0.006098
1883	-1819	0.002299	0.004908
1971	-1798	0.002348	0.004726
2088	-1372	0.003206	0.005487
2096	-1570	0.002779	0.005062
2090	-1422	0.003094	0.00549
2092	-1471	0.002987	0.005355
2094	-1521	0.002881	0.00521
2099	-1669	0.002585	0.004753
2097	-1620	0.002679	0.00491
2015	-1788	0.002369	0.004628
2101	-1719	0.002491	0.004591
2103	-1768	0.002403	0.00443
2059	-1778	0.002387	0.004529
177	-484	0.005283	0.003349
143	-339	0.007777	0.003066
154	-387	0.006978	0.003154
2058	-49	0.006134	0.002972
2150	-2250	0.001702	0.003294
1850	-2250	0.001619	0.003861
1950	-2250	0.001653	0.003668
2050	-2250	0.001681	0.003479
2350	-2250	0.001728	0.002948
2250	-2250	0.001718	0.003117
1650	-2250	0.001631	0.004238
2450	-2250	0.001734	0.002788
-250	-2150	0.002471	0.003749
-150	-2150	0.002526	0.004212
1750	-2250	0.001614	0.004052
1550	-2250	0.001642	0.004403
50	-2150	0.002628	0.005357
850	-2250	0.001758	0.003286
550	-2250	0.002162	0.005455
650	-2250	0.002038	0.00444
750	-2250	0.001903	0.003285
1050	-2250	0.00159	0.00469
950	-2250	0.001606	0.004068
1450	-2250	0.001646	0.004572
1150	-2250	0.001616	0.005099
1250	-2250	0.001633	0.004923
1350	-2250	0.001644	0.004747
-50	-2150	0.002579	0.00475
150	-2150	0.002674	0.005709
350	-2250	0.002372	0.006023
1950	-2150	0.001784	0.003869
1650	-2150	0.001739	0.004563
1750	-2150	0.001723	0.004329
1850	-2150	0.001752	0.004097
2150	-2150	0.001826	0.003439
2050	-2150	0.001808	0.003649
1450	-2150	0.001748	0.00504
2250	-2150	0.001838	0.00324
2350	-2150	0.001845	0.003052
2450	-2150	0.001846	0.002876
1550	-2150	0.001747	0.004794
1350	-2150	0.001741	0.005303
250	-2150	0.002637	0.006093
650	-2150	0.002168	0.005207
350	-2150	0.002543	0.006524
450	-2150	0.002433	0.007014

* ISCLT2 Output (93109): OU2 FS – Annual Conc.: 1 g/s (pCi/s) per m2

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X	Y	N Dryer (g/m3)/(g/s)	S Dryer (g/m3)/(g/s)
1300	700	0.003758	0.001609
2200	600	0.003782	0.001685
1800	600	0.004486	0.001689
1900	600	0.004369	0.001752
2000	600	0.00419	0.001605
2400	600	0.003368	0.001934
2300	600	0.003572	0.001913
−100	700	0.002329	0.001824
2500	600	0.003171	0.001948
−300	700	0.002379	0.001624
−200	700	0.002369	0.001723
1200	700	0.003967	0.001641
1400	700	0.003663	0.001573
1600	600	0.00439	0.001566
300	800	0.003006	0.001744
0	800	0.002136	0.001756
100	800	0.002398	0.001757
200	800	0.002688	0.001753
500	800	0.003715	0.00171
400	800	0.00335	0.00173
−200	800	0.002063	0.001675
600	800	0.003916	0.001686
700	800	0.003967	0.001656
800	800	0.003983	0.001625
−100	800	0.001998	0.001751
−300	800	0.002098	0.001584
1500	700	0.003811	0.001533
1900	700	0.004108	0.001624
1600	700	0.003932	0.001491
1700	700	0.004022	0.001492
1800	700	0.00408	0.001562
2100	700	0.003818	0.001723
2000	700	0.003987	0.001677
2500	700	0.003089	0.001832
2200	700	0.003637	0.00176
2300	700	0.003452	0.001791
2400	700	0.003268	0.001814
1700	600	0.004455	0.001618
1500	600	0.004284	0.001613
1000	800	0.003893	0.001597
800	500	0.00558	0.001961
500	500	0.004355	0.002053
600	500	0.005019	0.002029
700	500	0.005527	0.001997
1000	500	0.005336	0.001915
900	500	0.005518	0.001941
300	500	0.003235	0.00208
1100	500	0.005104	0.001882
1200	500	0.00481	0.001843
1300	500	0.004562	0.0018
400	500	0.003758	0.00207
200	500	0.00297	0.002063
1500	500	0.004807	0.001699
2400	400	0.003582	0.002201
1300	400	0.005256	0.001907
2200	400	0.004108	0.002167
2300	400	0.003838	0.002188
−300	500	0.003038	0.001703
2500	400	0.003343	0.002206
100	500	0.003091	0.002078
−200	500	0.003101	0.001819
−100	500	0.003139	0.001939
0	500	0.003141	0.002062
1400	500	0.004692	0.001751
1600	500	0.004891	0.001674
1400	600	0.004143	0.001659
800	600	0.004923	0.001837
500	600	0.004135	0.001928
600	600	0.004672	0.001903
700	600	0.004881	0.001872
1000	600	0.004781	0.001799
900	600	0.004894	0.001821
300	600	0.003175	0.001958
1100	600	0.004589	0.001771
1200	600	0.004354	0.001738

* ISCLT2 Output (93109): OU2 FS – Annual Conc.: 1 g/s (pCi/s) per m2

X	Y	N Dryer (g/m3)/(g/s)	S Dryer (g/m3)/(g/s)
1300	600	0.004093	0.0017
400	600	0.003635	0.001947
200	600	0.00277	0.001963
1700	500	0.004928	0.001757
2400	500	0.003472	0.002063
1800	500	0.004822	0.00183
2200	500	0.003938	0.002021
2300	500	0.003701	0.002046
-300	600	0.002693	0.001664
2500	500	0.003255	0.002073
100	600	0.002563	0.001962
-200	600	0.002715	0.001771
-100	600	0.002708	0.001881
0	600	0.002662	0.001955
900	800	0.003961	0.001613
1200	800	0.003624	0.001553
1100	800	0.003774	0.001577
2090	47	0.005576	0.002771
1341	366	0.005507	0.001922
1192	366	0.005619	0.002004
1242	366	0.005474	0.001977
1291	366	0.005487	0.00195
1341	457	0.004865	0.001824
1341	412	0.00517	0.001871
1093	366	0.005981	0.002051
1387	450	0.004958	0.001807
1433	442	0.005053	0.00179
1478	435	0.005133	0.001771
1142	366	0.005813	0.002028
1043	366	0.006123	0.002072
1567	433	0.005202	0.001743
695	366	0.006547	0.002188
546	366	0.005073	0.002231
596	366	0.005551	0.002219
646	366	0.006026	0.002204
795	366	0.006861	0.00215
745	366	0.006863	0.002169
993	366	0.006227	0.002092
844	366	0.006796	0.002138
894	366	0.006856	0.002125
944	366	0.006434	0.002109
1524	427	0.005212	0.001751
1609	439	0.005188	0.001772
447	366	0.004239	0.00225
2104	328	0.004534	0.002253
2111	469	0.004207	0.002036
2109	422	0.004309	0.002106
2106	375	0.00442	0.002178
2100	235	0.004781	0.002412
2102	282	0.004652	0.00233
2116	563	0.004017	0.001905
2097	188	0.004966	0.002497
2095	141	0.005168	0.002585
2093	94	0.00537	0.002677
2113	516	0.004111	0.001969
2118	610	0.003929	0.001843
1652	445	0.005171	0.0018
1822	491	0.004798	0.001857
1694	451	0.005128	0.001825
1737	457	0.005053	0.001849
1779	474	0.004927	0.001854
1906	525	0.004541	0.001859
1864	508	0.004669	0.001859
2076	593	0.004045	0.001848
1949	542	0.004413	0.001858
1991	559	0.004288	0.001856
2033	576	0.004166	0.001853
497	366	0.004641	0.002241
397	366	0.003873	0.002255
1300	800	0.003452	0.001525
100	900	0.002367	0.001666
-200	900	0.001793	0.001628
-100	900	0.001909	0.001665
0	900	0.002127	0.001667
300	900	0.002911	0.00165

* ISCLT2 Output (93109): OU2 FS – Annual Conc.: 1 g/s (pCi/s) per m2

5860

X	Y	N Dryer (g/m3)/(g/s)	S Dryer (g/m3)/(g/s)
200	900	0.002629	0.00166
2500	800	0.003009	0.001723
400	900	0.003212	0.001635
500	900	0.003525	0.001615
600	900	0.003583	0.001591
-300	900	0.001846	0.001544
2400	800	0.003172	0.001703
800	900	0.003619	0.001533
1700	800	0.003631	0.001383
1400	800	0.003265	0.001493
1500	800	0.003393	0.001459
1600	800	0.003525	0.001422
1900	800	0.003755	0.001507
1800	800	0.003707	0.001446
2300	800	0.003337	0.001677
2000	800	0.003777	0.00156
2100	800	0.003659	0.001606
2200	800	0.003501	0.001645
700	900	0.003614	0.001563
900	900	0.003595	0.001523
348	366	0.003704	0.002259
50	366	0.00393	0.002227
2400	900	0.003079	0.001599
2500	900	0.00293	0.001621
0	366	0.003897	0.002156
149	366	0.003952	0.002253
99	366	0.003949	0.002247
2200	900	0.003373	0.001538
199	366	0.003932	0.002258
248	366	0.003888	0.00226
298	366	0.003813	0.002261
2300	900	0.003227	0.001572
2100	900	0.003486	0.001499
1000	900	0.003537	0.00151
1400	900	0.003029	0.001419
1100	900	0.003441	0.001492
1200	900	0.003321	0.001471
1300	900	0.003182	0.001447
1600	900	0.003166	0.001357
1500	900	0.003029	0.001389
2000	900	0.003469	0.001453
1700	900	0.003279	0.001322
1800	900	0.003368	0.001341
1900	900	0.00343	0.0014
2450	850	0.003047	0.001661

Attachment C.II

Remedial Action Risk Quantification

Table C.II-1 Inhalation – Remedial and Nonremedial Worker
Alternative 2: Excavation Scenario
Active Flyash Pile

	Risk Factors							Intake Results		Risk Results
COC	Soil Conc units	Soil Conc	Dust Load mg/m^3	IR m^3/hr	Risk Risk/pCi	Risk 1/mg/kg/d	ETxEFxED hr	Intake pCi	Intake mg/kg-day	Risk
Antimony	mg/kg	2.000E+00	0.60	2.00		NA	2607.0		3.498E-09	
Arsenic	mg/kg	6.427E+01	0.60	2.00		1.500E+01	2607.0		1.124E-07	1.686E-06
Beryllium	mg/kg	3.375E+00	0.60	2.00		8.400E+00	2607.0		5.903E-09	4.959E-08
U-total	mg/kg	2.996E+01	0.60	2.00		NA	2607.0		5.241E-08	
Aroclor-1254	mg/kg	NA	0.60	2.00		NA	2607.0			
Aroclor-1260	mg/kg	NA	0.60	2.00		NA	2607.0			
Carbzole	mg/kg	NA	0.60	2.00		NA	2607.0			
Dieldrin	mg/kg	NA	0.60	2.00		1.600E+01	2607.0			
PAH	TE	NA	0.60	2.00		6.100E+00	2607.0			
							Total Risk From Chemicals=			1.736E-06
Sr-90	pCi/g	9.640E-01	0.60	2.00	6.200E-11		2607.0	3.016E+00		1.870E-10
Tc-99	pCi/g	NA	0.60	2.00	8.300E-12		2607.0			
Cs-137	pCi/g	NA	0.60	2.00	1.900E-11		2607.0			
Rn-222	pCi/g	5.240E+00	0.60	2.00	7.700E-12		2607.0	1.639E+01		1.262E-10
Ra-226	pCi/g	5.240E+00	0.60	2.00	3.000E-09		2607.0	1.639E+01		4.918E-08
Ra-228	pCi/g	4.336E+00	0.60	2.00	6.900E-10		2607.0	1.356E+01		9.360E-09
Th-228	pCi/g	5.790E+00	0.60	2.00	7.800E-08		2607.0	1.811E+01		1.413E-06
Th-230	pCi/g	5.717E+00	0.60	2.00	2.900E-08		2607.0	1.789E+01		5.187E-07
Th-232	pCi/g	3.866E+00	0.60	2.00	2.800E-08		2607.0	1.209E+01		3.386E-07
U-234	pCi/g	8.903E+00	0.60	2.00	2.600E-08		2607.0	2.785E+01		7.242E-07
U-235	pCi/g	4.720E+00	0.60	2.00	2.500E-08		2607.0	1.477E+01		3.692E-07
U-238	pCi/g	6.911E+00	0.60	2.00	2.400E-08		2607.0	2.162E+01		5.189E-07
Np-237	pCi/g	4.500E-01	0.60	2.00	2.900E-08		2607.0	1.408E+00		4.083E-08
Pu-238	pCi/g	1.230E-01	0.60	2.00	3.900E-08		2607.0	3.848E-01		1.501E-08
							Total Risk from Radionuclides=			3.997E-06

Formulas Radioactive Materials:

Intake/hr = CA (pCi/g) x IR x 10^{-3}
Total Intake (pCi) = Intake/hr x ETx EF x ED
Intake = CA x IR x ET x ED x EF x 10^{-6} / [BW x AT]

Hazardous Chemicals:

Parameters IR 2.0 m^3/hr
BW 70.0 kg
AT 25550.0 days

Notes: TE is the toxic equivalent as calculated in Table C.4-3

Table C.II-2 Inhalation – Remedial and Nonremedial Worker
Alternative 2: Excavation Scenario
Lime Sludge Pond

	Risk Factors							Intake Results		Risk Results
COC	Soil Conc units	Soil Conc	Dust Load mg/m^3	IR m^3/hr	Risk Risk/pCi	Risk 1/mg/kg/d	ETxEFxED hr	Intake pCi	Intake mg/kg-day	Risk
Antimony	mg/kg	2.320E+01	0.60	2.00		NA	987.0		1.536E-08	
Arsenic	mg/kg	6.777E+00	0.60	2.00		1.500E+01	987.0		4.488E-09	6.732E-08
Beryllium	mg/kg	1.267E+00	0.60	2.00		8.400E+00	987.0		8.390E-10	7.048E-09
U-total	mg/kg	2.220E+01	0.60	2.00		NA	987.0		1.470E-08	
Aroclor-1254	mg/kg	4.300E-02	0.60	2.00		NA	987.0		2.848E-11	
Aroclor-1260	mg/kg	NA	0.60	2.00		NA	987.0			
Carbzole	mg/kg	NA	0.60	2.00		NA	987.0			
Dieldrin	mg/kg	NA	0.60	2.00		1.600E+01	987.0			
PAH	TE	3.775E-01	0.60	2.00		6.100E+00	987.0		2.500E-10	1.525E-09
							Total Risk From Chemicals=			7.589E-08
Sr-90	pCi/g	8.410E-01	0.60	2.00	6.200E-11		987.0	9.961E-01		6.176E-11
Tc-99	pCi/g	1.050E+00	0.60	2.00	8.300E-12		987.0	1.244E+00		1.032E-11
Cs-137	pCi/g	1.680E-01	0.60	2.00	1.900E-11		987.0	1.990E-01		3.781E-12
Rn-222	pCi/g	1.562E+00	0.60	2.00	7.700E-12		987.0	1.850E+00		1.425E-11
Ra-226	pCi/g	1.562E+00	0.60	2.00	3.000E-09		987.0	1.850E+00		5.550E-09
Ra-228	pCi/g	1.800E+00	0.60	2.00	6.900E-10		987.0	2.132E+00		1.471E-09
Th-228	pCi/g	1.540E+00	0.60	2.00	7.800E-08		987.0	1.824E+00		1.423E-07
Th-230	pCi/g	8.381E+00	0.60	2.00	2.900E-08		987.0	9.926E+00		2.879E-07
Th-232	pCi/g	1.070E+00	0.60	2.00	2.800E-08		987.0	1.267E+00		3.548E-08
U-234	pCi/g	6.176E+00	0.60	2.00	2.600E-08		987.0	7.315E+00		1.902E-07
U-235	pCi/g	4.350E-01	0.60	2.00	2.500E-08		987.0	5.152E-01		1.288E-08
U-238	pCi/g	7.468E+00	0.60	2.00	2.400E-08		987.0	8.845E+00		2.123E-07
Np-237	pCi/g	3.230E-01	0.60	2.00	2.900E-08		987.0	3.826E-01		1.109E-08
Pu-238	pCi/g	1.990E-01	0.60	2.00	3.900E-08		987.0	2.357E-01		9.192E-09
							Total Risk from Radionuclides=			9.084E-07

Formulas Radioactive Materials: Intake/hr = CA (pCi/g) x IR x 10^{-3}
Total Intake (pCi) = Intake/hr x ETx EF x ED
Hazardous Chemicals: Intake = CA x IR x ET x ED x EF x 10^{-6} / [BW x AT]

Parameters IR 2.0 m^3/hr
BW 70.0 kg
AT 25550.0 days

Notes: TE is the toxic equivalent as calculated in Table C.4-3

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Table C.II-3 Inhalation – Remedial and Nonremedial Worker
Alternative 2: Excavation Scenario
South Field and Inactive Flyash Pond

	Risk Factors							Intake Results		
COC	Soil Conc units	Soil Conc	Dust Load mg/m^3	IR m^3/hr	Risk Risk/pCi	Risk 1/mg/kg/d	ETxEFxED hr	Intake pCi	Intake mg/kg-d	Risk
Antimony	mg/kg	1.206E+01	0.60	2.00		NA	2694.0		2.180E-08	
Arsenic	mg/kg	1.438E+00	0.60	2.00		1.500E+01	2694.0		2.599E-09	3.899E-08
Beryllium	mg/kg	1.044E+02	0.60	2.00		8.400E+00	2694.0		1.887E-07	1.585E-06
U-total	mg/kg	1.870E+01	0.60	2.00		NA	2694.0		3.380E-08	
Aroclor-1254	mg/kg	4.300E-01	0.60	2.00		NA	2694.0		7.772E-10	
Aroclor-1260	mg/kg	8.900E-02	0.60	2.00		NA	2694.0		1.609E-10	
Carbzole	mg/kg	1.000E-03	0.60	2.00		NA	2694.0		1.808E-12	
Dieldrin	mg/kg	1.600E-02	0.60	2.00		1.600E+01	2694.0		2.892E-11	4.627E-10
PAH	TE	3.505E-01	0.60	2.00		6.100E+00	2694.0		6.336E-10	3.865E-09
							Total Risk From Chemicals=			1.628E-06
Sr-90	pCi/g	1.360E+00	0.60	2.00	6.200E-11		2694.0	4.397E+00		2.726E-10
Tc-99	pCi/g	9.000E-01	0.60	2.00	8.300E-12		2694.0	2.910E+00		2.415E-11
Cs-137	pCi/g	2.370E-01	0.60	2.00	1.900E-11		2694.0	7.662E-01		1.456E-11
Rn-222	pCi/g	2.919E+00	0.60	2.00	7.700E-12		2694.0	9.437E+00		7.266E-11
Ra-226	pCi/g	2.919E+00	0.60	2.00	3.000E-09		2694.0	9.437E+00		2.831E-08
Ra-228	pCi/g	1.656E+00	0.60	2.00	6.900E-10		2694.0	5.354E+00		3.694E-09
Th-228	pCi/g	1.704E+00	0.60	2.00	7.800E-08		2694.0	5.509E+00		4.297E-07
Th-230	pCi/g	4.263E+00	0.60	2.00	2.900E-08		2694.0	1.378E+01		3.997E-07
Th-232	pCi/g	1.531E+00	0.60	2.00	2.800E-08		2694.0	4.949E+00		1.386E-07
U-234	pCi/g	3.019E+01	0.60	2.00	2.600E-08		2694.0	9.760E+01		2.538E-06
U-235	pCi/g	1.846E+01	0.60	2.00	2.500E-08		2694.0	5.968E+01		1.492E-06
U-238	pCi/g	3.230E+01	0.60	2.00	2.400E-08		2694.0	1.044E+02		2.506E-06
Np-237	pCi/g	3.000E-01	0.60	2.00	2.900E-08		2694.0	9.698E-01		2.813E-08
Pu-238	pCi/g	4.000E-02	0.60	2.00	3.900E-08		2694.0	1.293E-01		5.043E-09
							Total Risk from Radionuclides=			7.569E-06

Formulas Radioactive Materials: Intake/hr = CA (pCi/g) x IR x 10^{-3}
Total Intake (pCi) = Intake/hr x ETx EF x ED
Intake = CA x IR x ET x ED x EF x 10^{-6} / [BW x AT]

Hazardous Chemicals:

Parameters IR 2.0 m^3/hr
BW 70.0 kg
AT 25550.0 days

Notes: TE is the toxic equivalent as calculated in Table C.4-3

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Table C.II-4 Inhalation – Remedial and Nonremedial Worker
Alternative 2: Excavation Scenario
Solid Waste Landfill

	Risk Factors							Intake Results		Risk Results
COC	Soil Conc units	Soil Conc	Dust Load mg/m^3	IR m^3/hr	Risk Risk/pCi	Risk 1/mg/kg/d	ETxEFxED hr	Intake pCi	Intake mg/kg-day	Risk Risk
Antimony	mg/kg	2.200E+01	0.60	2.00		NA	1095.0		1.616E-08	
Arsenic	mg/kg	1.380E+01	0.60	2.00		1.500E+01	1095.0		1.014E-08	1.521E-07
Beryllium	mg/kg	1.075E+00	0.60	2.00		8.400E+00	1095.0		7.898E-10	6.634E-09
U-total	mg/kg	4.460E+02	0.60	2.00		NA	1095.0		3.277E-07	
Aroclor-1254	mg/kg	4.800E-02	0.60	2.00		NA	1095.0		3.527E-11	
Aroclor-1260	mg/kg	7.700E-02	0.60	2.00		NA	1095.0		5.657E-11	
Carbzole	mg/kg	4.200E+00	0.60	2.00		NA	1095.0		3.086E-09	
Dieldrin	mg/kg	NA	0.60	2.00		1.600E+01	1095.0			
PAH	TE	1.072E+01	0.60	2.00		6.100E+00	1095.0		7.876E-09	4.804E-08
							Total Risk From Chemicals=			2.068E-07
Sr-90	pCi/g	1.580E+00	0.60	2.00	6.200E-11		1095.0	2.076E+00		1.287E-10
Tc-99	pCi/g	7.540E-01	0.60	2.00	8.300E-12		1095.0	9.908E-01		8.223E-12
Cs-137	pCi/g	2.500E-01	0.60	2.00	1.900E-11		1095.0	3.285E-01		6.241E-12
Rn-222	pCi/g	1.550E+00	0.60	2.00	7.700E-12		1095.0	2.037E+00		1.568E-11
Ra-226	pCi/g	1.550E+00	0.60	2.00	3.000E-09		1095.0	2.037E+00		6.110E-09
Ra-228	pCi/g	2.560E+00	0.60	2.00	6.900E-10		1095.0	3.364E+00		2.321E-09
Th-228	pCi/g	3.390E+00	0.60	2.00	7.800E-08		1095.0	4.454E+00		3.474E-07
Th-230	pCi/g	1.230E+01	0.60	2.00	2.900E-08		1095.0	1.616E+01		4.687E-07
Th-232	pCi/g	3.590E+00	0.60	2.00	2.800E-08		1095.0	4.717E+00		1.321E-07
U-234	pCi/g	9.700E+01	0.60	2.00	2.600E-08		1095.0	1.275E+02		3.314E-06
U-235	pCi/g	9.930E+00	0.60	2.00	2.500E-08		1095.0	1.305E+01		3.262E-07
U-238	pCi/g	1.700E+02	0.60	2.00	2.400E-08		1095.0	2.234E+02		5.361E-06
Np-237	pCi/g	3.510E-01	0.60	2.00	2.900E-08		1095.0	4.612E-01		1.338E-08
Pu-238	pCi/g	3.280E-01	0.60	2.00	3.900E-08		1095.0	4.310E-01		1.681E-08
							Total Risk from Radionuclides=			9.988E-06

Formulas Radioactive Materials: Intake/hr = CA (pCi/g) x IR x 10^{-3}
Total Intake (pCi) = Intake/hr x ETx EF x ED

Hazardous Chemicals: Intake = CA x IR x ET x ED x EF x 10^{-6} / [BW x AT]

Parameters IR 2.0 m^3/hr
BW 70.0 kg
AT 25550.0 days

Notes: TE is the toxic equivalent as calculated in Table C.4-3

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Estimation of the risks to the public due to inhalation

The impact of dispersion on a contaminated dust cloud released during excavation activities can be estimated by the following method. The basic formula for Gaussian air dispersion to a receptor located at ground level is given by

$$\frac{\bar{\chi}}{Q'} = (2\Pi\sigma_y\sigma_z\bar{u})^{-1}\exp\{-(\frac{y^2}{2\sigma_y^2}+\frac{h^2}{2\sigma_z^2})\}$$

where

χ	=	ave. concentration (pCi/m³)
Q'	=	source strength (pCi/sec)
σ	=	standard deviation of the distribution of material in the y and z directions (m)
h	=	stack height (h)
u	=	component of wind in the x direction (m/sec)

using standard Figures for σ_y and σ_z values, it can be seen that regardless of Pasquill stability class, σ_y increases in value by a factor of 10 for every factor of 10 increase in distance from the source. In contrast, σ_z varies with the stability class, increasing by a factor of 6 for class F and by a factor of 40 for class A (the two bounding stability classes) over the distances 100 m to 1000 m. For case with the **least** impact on the total dispersion, for stability class F and at a distance of 1000 m from the release point,

$\sigma_y = 40$
$\sigma_z = 12$

and the equation becomes

$$\bar{\chi} = \frac{Q'}{2\pi(40)(12)(\bar{u})}\exp\{-(\frac{y^2}{2(40^2)}+\frac{h^2}{2(12^2)})\}$$

At 100 m,

$\sigma_y = 4$
$\sigma_z = 2$

As can be seen, the decrease in χ will be at least a factor of 100 as the distance increases from 100 m to 1000 m. (The exponential term will be less than 1 in both cases.)

The risk to the public, based on the intake for remediation workers, will then be at least one order of magnitude below that for the remediation workers, based on the effects of dispersion. The calculations for remediation workers were also extremely conservative, so that the overall risk to the public will be much less than 10^{-6}.

Table C.II-5 Inhalation – Remedial and Nonremedial Worker
Alternative 3: Excavation Scenario
Active Flyash Pile

	Risk Factors							Intake Results		Risk Results
COC	Soil Conc units	Soil Conc	Dust Load mg/m^3	IR m^3/hr	Risk Risk/pCi	Risk 1/mg/kg/d	ETxEFxED hr	Intake pCi	Intake mg/kg-day	Risk
Antimony	mg/kg	2.000E+00	0.60	2.00		NA	3439.0		4.615E-09	
Arsenic	mg/kg	6.427E+01	0.60	2.00		1.500E+01	3439.0		1.483E-07	2.224E-06
Beryllium	mg/kg	3.375E+00	0.60	2.00		8.400E+00	3439.0		7.788E-09	6.542E-08
U-total	mg/kg	2.996E+01	0.60	2.00		NA	3439.0		6.913E-08	
Aroclor-1254	mg/kg	NA	0.60	2.00		NA	3439.0			
Aroclor-1260	mg/kg	NA	0.60	2.00		NA	3439.0			
Carbzole	mg/kg	NA	0.60	2.00		NA	3439.0			
Dieldrin	mg/kg	NA	0.60	2.00		1.600E+01	3439.0			
PAH	TE	NA		2.00		6.100E+00	3439.0			
							Total Risk From Chemicals=			2.290E-06
Sr-90	pCi/g	9.640E-01	0.60	2.00	6.200E-11		3439.0	3.978E+00		2.467E-10
Tc-99	pCi/g	NA	0.60	2.00	8.300E-12		3439.0			
Cs-137	pCi/g	NA	0.60	2.00	1.900E-11		3439.0			
Rn-222	pCi/g	5.240E+00	0.60	2.00	7.700E-12		3439.0	2.162E+01		1.665E-10
Ra-226	pCi/g	5.240E+00	0.60	2.00	3.000E-09		3439.0	2.162E+01		6.487E-08
Ra-228	pCi/g	4.336E+00	0.60	2.00	6.900E-10		3439.0	1.789E+01		1.235E-08
Th-228	pCi/g	5.790E+00	0.60	2.00	7.800E-08		3439.0	2.389E+01		1.864E-06
Th-230	pCi/g	5.717E+00	0.60	2.00	2.900E-08		3439.0	2.359E+01		6.842E-07
Th-232	pCi/g	3.866E+00	0.60	2.00	2.800E-08		3439.0	1.595E+01		4.467E-07
U-234	pCi/g	8.903E+00	0.60	2.00	2.600E-08		3439.0	3.674E+01		9.553E-07
U-235	pCi/g	4.720E+00	0.60	2.00	2.500E-08		3439.0	1.948E+01		4.870E-07
U-238	pCi/g	6.911E+00	0.60	2.00	2.400E-08		3439.0	2.852E+01		6.845E-07
Np-237	pCi/g	4.500E-01	0.60	2.00	2.900E-08		3439.0	1.857E+00		5.385E-08
Pu-238	pCi/g	1.230E-01	0.60	2.00	3.900E-08		3439.0	5.076E-01		1.980E-08
							Total Risk from Radionuclides=			5.273E-06

Formulas Radioactive Materials: Intake/hr = CA (pCi/g) x IR x 10^{-3}
Total Intake (pCi) = Intake/hr x ETx EF x ED

Hazardous Chemicals: Intake = CA x IR x ET x ED x EF x 10^{-6} / [BW x AT]

Parameters IR 2.0 m^3/hr
BW 70.0 kg
AT 25550.0 days

Notes: TE is the toxic equivalent as calculated in Table C.4-3

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Table C.II-6 Inhalation – Remedial and Nonremedial Worker
Alternative 3: Excavation Scenario
Lime Sludge Pond

COC	Risk Factors: Soil Conc units	Soil Conc	Dust Load mg/m^3	IR m^3/hr	Risk Risk/pCi	Risk 1/mg/kg/d	ETxEFxED hr	Intake Results: Intake pCi	Intake mg/kg-day	Risk Results: Risk
Antimony	mg/kg	2.320E+01	0.60	2.00		NA	2100.0		3.269E-08	
Arsenic	mg/kg	6.777E+00	0.60	2.00		1.500E+01	2100.0		9.549E-09	1.432E-07
Beryllium	mg/kg	1.267E+00	0.60	2.00		8.400E+00	2100.0		1.785E-09	1.500E-08
U-total	mg/kg	2.220E+01	0.60	2.00		NA	2100.0		3.128E-08	
Aroclor-1254	mg/kg	4.300E-02	0.60	2.00		NA	2100.0		6.059E-11	
Aroclor-1260	mg/kg	NA	0.60	2.00		NA	2100.0			
Carbzole	mg/kg	NA	0.60	2.00		NA	2100.0			
Dieldrin	mg/kg	NA	0.60	2.00		1.600E+01	2100.0			
PAH	TE	3.775E-01	0.60	2.00		6.100E+00	2100.0		5.319E-10	3.244E-09
							Total Risk From Chemicals=			1.615E-07
Sr-90	pCi/g	8.410E-01	0.60	2.00	6.200E-11		2100.0		2.119E+00	1.314E-10
Tc-99	pCi/g	1.050E+00	0.60	2.00	8.300E-12		2100.0		2.646E+00	2.196E-11
Cs-137	pCi/g	1.680E-01	0.60	2.00	1.900E-11		2100.0		4.234E-01	8.044E-12
Rn-222	pCi/g	1.562E+00	0.60	2.00	7.700E-12		2100.0		3.936E+00	3.031E-11
Ra-226	pCi/g	1.562E+00	0.60	2.00	3.000E-09		2100.0		3.936E+00	1.181E-08
Ra-228	pCi/g	1.800E+00	0.60	2.00	6.900E-10		2100.0		4.536E+00	3.130E-09
Th-228	pCi/g	1.540E+00	0.60	2.00	7.800E-08		2100.0		3.881E+00	3.027E-07
Th-230	pCi/g	8.381E+00	0.60	2.00	2.900E-08		2100.0		2.112E+01	6.125E-07
Th-232	pCi/g	1.070E+00	0.60	2.00	2.800E-08		2100.0		2.696E+00	7.550E-08
U-234	pCi/g	6.176E+00	0.60	2.00	2.600E-08		2100.0		1.556E+01	4.047E-07
U-235	pCi/g	4.350E-01	0.60	2.00	2.500E-08		2100.0		1.096E+00	2.740E-08
U-238	pCi/g	7.468E+00	0.60	2.00	2.400E-08		2100.0		1.882E+01	4.517E-07
Np-237	pCi/g	3.230E-01	0.60	2.00	2.900E-08		2100.0		8.140E-01	2.360E-08
Pu-238	pCi/g	1.990E-01	0.60	2.00	3.900E-08		2100.0		5.015E-01	1.956E-08
							Total Risk from Radionuclides=			1.933E-06

Formulas Radioactive Materials: Intake/hr = CA (pCi/g) x IR x 10^{-3}
Total Intake (pCi) = Intake/hr x ETx EF x ED
Intake = CA x IR x ET x ED x EF x 10^{-6} / [BW x AT]

Hazardous Chemicals:

Parameters IR 2.0 m^3/hr
BW 70.0 kg
AT 25550.0 days

Notes: TE is the toxic equivalent as calculated in Table C.4-3

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Table C.II-7 Inhalation – Remedial and Nonremedial Worker
Alternative 3: Excavation Scenario
South Field and Inactive Sludge Pond

	Risk Factors							Intake Results		Risk Results
COC	Soil Conc units	Soil Conc	Dust Load mg/m^3	IR m^3/hr	Risk Risk/pCi	Risk 1/mg/kg/d	ETxEFxED hr	Intake pCi	Intake mg/kg-day	Risk
Antimony	mg/kg	1.870E+01	0.60	2.00		NA	3838.0		4.815E-08	
Arsenic	mg/kg	1.206E+01	0.60	2.00		1.500E+01	3838.0		3.106E-08	4.658E-07
Beryllium	mg/kg	1.438E+00	0.60	2.00		8.400E+00	3838.0		3.703E-09	3.111E-08
U-total	mg/kg	1.044E+02	0.60	2.00		NA	3838.0		2.688E-07	
Aroclor-1254	mg/kg	4.300E-01	0.60	2.00		NA	3838.0		1.107E-09	
Aroclor-1260	mg/kg	8.900E-02	0.60	2.00		NA	3838.0		2.292E-10	
Carbzole	mg/kg	1.000E-03	0.60	2.00		NA	3838.0		2.575E-12	
Dieldrin	mg/kg	1.600E-02	0.60	2.00		1.600E+01	3838.0		4.120E-11	6.592E-10
PAH	TE	3.505E-01	0.60	2.00		6.100E+00	3838.0		9.027E-10	5.506E-09
									Total Risk From Chemicals=	5.031E-07
Sr-90	pCi/g	1.360E+00	0.60	2.00	6.200E-11		3838.0	6.264E+00		3.883E-10
Tc-99	pCi/g	9.000E-01	0.60	2.00	8.300E-12		3838.0	4.145E+00		3.440E-11
Cs-137	pCi/g	2.370E-01	0.60	2.00	1.900E-11		3838.0	1.092E+00		2.074E-11
Rn-222	pCi/g	2.919E+00	0.60	2.00	7.700E-12		3838.0	1.344E+01		1.035E-10
Ra-226	pCi/g	2.919E+00	0.60	2.00	3.000E-09		3838.0	1.344E+01		4.033E-08
Ra-228	pCi/g	1.656E+00	0.60	2.00	6.900E-10		3838.0	7.627E+00		5.263E-09
Th-228	pCi/g	1.704E+00	0.60	2.00	7.800E-08		3838.0	7.848E+00		6.121E-07
Th-230	pCi/g	4.263E+00	0.60	2.00	2.900E-08		3838.0	1.963E+01		5.694E-07
Th-232	pCi/g	1.531E+00	0.60	2.00	2.800E-08		3838.0	7.051E+00		1.974E-07
U-234	pCi/g	3.019E+01	0.60	2.00	2.600E-08		3838.0	1.390E+02		3.615E-06
U-235	pCi/g	1.846E+01	0.60	2.00	2.500E-08		3838.0	8.502E+01		2.125E-06
U-238	pCi/g	3.230E+01	0.60	2.00	2.400E-08		3838.0	1.488E+02		3.570E-06
Np-237	pCi/g	3.000E-01	0.60	2.00	2.900E-08		3838.0	1.382E+00		4.007E-08
Pu-238	pCi/g	4.000E-02	0.60	2.00	3.900E-08		3838.0	1.842E-01		7.185E-09
									Total Risk from Radionuclides=	1.078E-05

Formulas Radioactive Materials: Intake/hr = CA (pCi/g) x IR x 10^{-3}
Total Intake (pCi) = Intake/hr x ETx EF x ED
Hazardous Chemicals: Intake = CA x IR x ET x ED x EF x 10^{-6} / [BW x AT]

Parameters: IR 2.0 m^3/hr
BW 70.0 kg
AT 25550.0 days

Notes: TE is the toxic equivalent as calculated in Table C.4-3

Table C.II-8 Inhalation – Remedial and Nonremedial Worker
Alternative 3: Excavation Scenario
Solid Waste Landfill

	Risk Factors							Intake Results		Risk Results
COC	Soil Conc units	Soil Conc	Dust Load mg/m^3	IR m^3/hr	Risk Risk/pCi	Risk 1/mg/kg/d	ETxEFxED hr	Intake pCi	Intake mg/kg-day	Risk
Antimony	mg/kg	2.200E+01	0.60	2.00		NA	2186.0		3.227E-08	
Arsenic	mg/kg	1.380E+01	0.60	2.00		1.500E+01	2186.0		2.024E-08	3.036E-07
Beryllium	mg/kg	1.075E+00	0.60	2.00		8.400E+00	2186.0		1.577E-09	1.324E-08
U-total	mg/kg	4.460E+02	0.60	2.00		NA	2186.0		6.541E-07	
Aroclor-1254	mg/kg		0.60	2.00		NA	2186.0			
Aroclor-1260	mg/kg		0.60	2.00		NA	2186.0			
Carbzole	mg/kg	4.200E+00	0.60	2.00		NA	2186.0		6.160E-09	
Dieldrin	mg/kg	NA	0.60	2.00		1.600E+01	2186.0			
PAH	TE	1.072E+01	0.60	2.00		6.100E+00	2186.0		1.572E-08	9.591E-08

Total Risk From Chemicals= 4.128E-07

Sr-90	pCi/g	1.580E+00	0.60	2.00	6.200E-11	2186.0	4.145E+00		2.570E-10
Tc-99	pCi/g	7.540E-01	0.60	2.00	8.300E-12	2186.0	1.978E+00		1.642E-11
Cs-137	pCi/g	2.500E-01	0.60	2.00	1.900E-11	2186.0	6.558E-01		1.246E-11
Rn-222	pCi/g	1.550E+00	0.60	2.00	7.700E-12	2186.0	4.066E+00		3.131E-11
Ra-226	pCi/g	1.550E+00	0.60	2.00	3.000E-09	2186.0	4.066E+00		1.220E-08
Ra-228	pCi/g	2.560E+00	0.60	2.00	6.900E-10	2186.0	6.715E+00		4.634E-09
Th-228	pCi/g	3.390E+00	0.60	2.00	7.800E-08	2186.0	8.893E+00		6.936E-07
Th-230	pCi/g	1.230E+01	0.60	2.00	2.900E-08	2186.0	3.227E+01		9.357E-07
Th-232	pCi/g	3.590E+00	0.60	2.00	2.800E-08	2186.0	9.417E+00		2.637E-07
U-234	pCi/g	9.700E+01	0.60	2.00	2.600E-08	2186.0	2.545E+02		6.616E-06
U-235	pCi/g	9.930E+00	0.60	2.00	2.500E-08	2186.0	2.605E+01		6.512E-07
U-238	pCi/g	1.700E+02	0.60	2.00	2.400E-08	2186.0	4.459E+02		1.070E-05
Np-237	pCi/g	3.510E-01	0.60	2.00	2.900E-08	2186.0	9.207E-01		2.670E-08
Pu-238	pCi/g	3.280E-01	0.60	2.00	3.900E-08	2186.0	8.604E-01		3.356E-08

Total Risk from Radionuclides= 1.994E-05

Formulas Radioactive Materials: Intake/hr = CA (pCi/g) x IR x 10^{-3}
Total Intake (pCi) = Intake/hr x ETx EF x ED
Hazardous Chemicals: Intake = CA x IR x ET x ED x EF x 10^{-6} / [BW x AT]

Parameters IR 2.0 m^3/hr
BW 70.0 kg
AT 25550.0 days

Notes: TE is the toxic equivalent as calculated in Table C.4-3

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Table C.II-9 Inhalation – Remedial and Nonremedial Worker
Alternative 6: Excavation Scenario
Active Flyash Pile

	Risk Factors							Intake Results		Risk Results
COC	Soil Conc units	Soil Conc	Dust Load mg/m^3	IR m^3/hr	Risk Risk/pCi	Risk 1/mg/kg/d	ETxEFxED hr	Intake pCi	Intake mg/kg-day	Risk
Antimony	mg/kg	2.000E+00	0.60	2.00		NA	1818.0		2.440E-09	
Arsenic	mg/kg	6.427E+01	0.60	2.00		1.500E+01	1818.0		7.840E-08	1.176E-06
Beryllium	mg/kg	3.375E+00	0.60	2.00		8.400E+00	1818.0		4.117E-09	3.458E-08
U-total	mg/kg	2.996E+01	0.60	2.00		NA	1818.0		3.655E-08	
Aroclor-1254	mg/kg	NA	0.60	2.00		NA	1818.0			
Aroclor-1260	mg/kg	NA	0.60	2.00		NA	1818.0			
Carbzole	mg/kg	NA	0.60	2.00		NA	1818.0			
Dieldrin	mg/kg	NA	0.60	2.00		1.600E+01	1818.0			
PAH	TE	NA		2.00		6.100E+00	1818.0			

Total Risk From Chemicals= 1.211E-06

Sr-90	pCi/g	9.640E-01	0.60	2.00	6.200E-11	1818.0	2.103E+00		1.304E-10
Tc-99	pCi/g	NA	0.60	2.00	8.300E-12	1818.0			
Cs-137	pCi/g	NA	0.60	2.00	1.900E-11	1818.0			
Rn-222	pCi/g	5.240E+00	0.60	2.00	7.700E-12	1818.0	1.143E+01		8.802E-11
Ra-226	pCi/g	5.240E+00	0.60	2.00	3.000E-09	1818.0	1.143E+01		3.429E-08
Ra-228	pCi/g	4.336E+00	0.60	2.00	6.900E-10	1818.0	9.459E+00		6.527E-09
Th-228	pCi/g	5.790E+00	0.60	2.00	7.800E-08	1818.0	1.263E+01		9.853E-07
Th-230	pCi/g	5.717E+00	0.60	2.00	2.900E-08	1818.0	1.247E+01		3.617E-07
Th-232	pCi/g	3.866E+00	0.60	2.00	2.800E-08	1818.0	8.434E+00		2.362E-07
U-234	pCi/g	8.903E+00	0.60	2.00	2.600E-08	1818.0	1.942E+01		5.050E-07
U-235	pCi/g	4.720E+00	0.60	2.00	2.500E-08	1818.0	1.030E+01		2.574E-07
U-238	pCi/g	6.911E+00	0.60	2.00	2.400E-08	1818.0	1.508E+01		3.618E-07
Np-237	pCi/g	4.500E-01	0.60	2.00	2.900E-08	1818.0	9.817E-01		2.847E-08
Pu-238	pCi/g	1.230E-01	0.60	2.00	3.900E-08	1818.0	2.683E-01		1.047E-08

Total Risk from Radionuclides= 2.787E-06

Formulas Radioactive Materials:

Intake/hr = CA (pCi/g) x IR x 10^{-3}
Total Intake (pCi) = Intake/hr x ETx EF x ED
Intake = CA x IR x ET x ED x EF x 10^{-6} / [BW x AT]

Hazardous Chemicals:

Parameters IR 2.0 m^3/hr
BW 70.0 kg
AT 25550.0 days

Notes: TE is the toxic equivalent as calculated in Table C.4-3

Table C.II-10 Inhalation – Remedial and Nonremedial Worker
Alternative 6: Excavation Scenario
Lime Sludge Pond

	Risk Factors							Intake Results		Risk Results
COC	Soil Conc units	Soil Conc	Dust Load mg/m^3	IR m^3/hr	Risk Risk/pCi	Risk 1/mg/kg/d	ETxEFxED hr	Intake pCi	Intake mg/kg-day	Risk
Antimony	mg/kg	2.320E+01	0.60	2.00		NA	2397.0		3.731E-08	
Arsenic	mg/kg	6.777E+00	0.60	2.00		1.500E+01	2397.0		1.090E-08	1.635E-07
Beryllium	mg/kg	1.267E+00	0.60	2.00		8.400E+00	2397.0		2.038E-09	1.712E-08
U-total	mg/kg	2.220E+01	0.60	2.00		NA	2397.0		3.570E-08	
Aroclor-1254	mg/kg	4.300E-02	0.60	2.00		NA	2397.0		6.916E-11	
Aroclor-1260	mg/kg	NA	0.60	2.00		NA	2397.0			
Carbzole	mg/kg	NA	0.60	2.00		NA	2397.0			
Dieldrin	mg/kg	NA	0.60	2.00		1.600E+01	2397.0			
PAH	TE	3.775E-01	0.60	2.00		6.100E+00	2397.0		6.071E-10	3.703E-09

Total Risk From Chemicals= 1.843E-07

Sr-90	pCi/g	8.410E-01	0.60	2.00	6.200E-11	2397.0	2.419E+00		1.500E-10
Tc-99	pCi/g	1.050E+00	0.60	2.00	8.300E-12	2397.0	3.020E+00		2.507E-11
Cs-137	pCi/g	1.680E-01	0.60	2.00	1.900E-11	2397.0	4.832E-01		9.181E-12
Rn-222	pCi/g	1.562E+00	0.60	2.00	7.700E-12	2397.0	4.493E+00		3.460E-11
Ra-226	pCi/g	1.562E+00	0.60	2.00	3.000E-09	2397.0	4.493E+00		1.348E-08
Ra-228	pCi/g	1.800E+00	0.60	2.00	6.900E-10	2397.0	5.178E+00		3.572E-09
Th-228	pCi/g	1.540E+00	0.60	2.00	7.800E-08	2397.0	4.430E+00		3.455E-07
Th-230	pCi/g	8.381E+00	0.60	2.00	2.900E-08	2397.0	2.411E+01		6.991E-07
Th-232	pCi/g	1.070E+00	0.60	2.00	2.800E-08	2397.0	3.078E+00		8.618E-08
U-234	pCi/g	6.176E+00	0.60	2.00	2.600E-08	2397.0	1.776E+01		4.619E-07
U-235	pCi/g	4.350E-01	0.60	2.00	2.500E-08	2397.0	1.251E+00		3.128E-08
U-238	pCi/g	7.468E+00	0.60	2.00	2.400E-08	2397.0	2.148E+01		5.155E-07
Np-237	pCi/g	3.230E-01	0.60	2.00	2.900E-08	2397.0	9.291E-01		2.694E-08
Pu-238	pCi/g	1.990E-01	0.60	2.00	3.900E-08	2397.0	5.724E-01		2.232E-08

Total Risk from Radionuclides= 2.206E-06

Formulas Radioactive Materials: Intake/hr = CA (pCi/g) x IR x 10^{-3}
Total Intake (pCi) = Intake/hr x ETx EF x ED
Hazardous Chemicals: Intake = CA x IR x ET x ED x EF x 10^{-6} / [BW x AT]

Parameters IR 2.0 m^3/hr
BW 70.0 kg
AT 25550.0 days

Notes: TE is the toxic equivalent as calculated in Table C.4-3

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Table C.II-11 Inhalation – Remedial and Nonremedial Worker
Alternative 6: Excavation Scenario
South Field and Inactive Flyash Pond

	Risk Factors							Intake Results		Risk Results
COC	Soil Conc units	Soil Conc	Dust Load mg/m^3	IR m^3/hr	Risk Risk/pCi	Risk 1/mg/kg/d	ETxEFxED hr	Intake pCi	Intake mg/kg-day	Risk
Antimony	mg/kg	1.870E+01	0.60	2.00		NA	3536.0		4.437E-08	
Arsenic	mg/kg	1.206E+01	0.60	2.00		1.500E+01	3536.0		2.861E-08	4.292E-07
Beryllium	mg/kg	1.438E+00	0.60	2.00		8.400E+00	3536.0		3.412E-09	2.866E-08
U-total	mg/kg	1.044E+02	0.60	2.00		NA	3536.0		2.477E-07	
Aroclor-1254	mg/kg	4.300E-01	0.60	2.00		NA	3536.0		1.020E-09	
Aroclor-1260	mg/kg	8.900E-02	0.60	2.00		NA	3536.0		2.112E-10	
Carbzole	mg/kg	1.000E-03	0.60	2.00		NA	3536.0		2.372E-12	
Dieldrin	mg/kg	1.600E-02	0.60	2.00		1.600E+01	3536.0		3.796E-11	6.074E-10
PAH	TE	3.505E-01	0.60	2.00		6.100E+00	3536.0		8.316E-10	5.073E-09
							Total Risk From Chemicals=			4.635E-07
Sr-90	pCi/g	1.360E+00	0.60	2.00	6.200E-11		3536.0	5.771E+00		3.578E-10
Tc-99	pCi/g	9.000E-01	0.60	2.00	8.300E-12		3536.0	3.819E+00		3.170E-11
Cs-137	pCi/g	2.370E-01	0.60	2.00	1.900E-11		3536.0	1.006E+00		1.911E-11
Rn-222	pCi/g	2.919E+00	0.60	2.00	7.700E-12		3536.0	1.239E+01		9.537E-11
Ra-226	pCi/g	2.919E+00	0.60	2.00	3.000E-09		3536.0	1.239E+01		3.716E-08
Ra-228	pCi/g	1.656E+00	0.60	2.00	6.900E-10		3536.0	7.027E+00		4.848E-09
Th-228	pCi/g	1.704E+00	0.60	2.00	7.800E-08		3536.0	7.230E+00		5.640E-07
Th-230	pCi/g	4.263E+00	0.60	2.00	2.900E-08		3536.0	1.809E+01		5.246E-07
Th-232	pCi/g	1.531E+00	0.60	2.00	2.800E-08		3536.0	6.496E+00		1.819E-07
U-234	pCi/g	3.019E+01	0.60	2.00	2.600E-08		3536.0	1.281E+02		3.331E-06
U-235	pCi/g	1.846E+01	0.60	2.00	2.500E-08		3536.0	7.833E+01		1.958E-06
U-238	pCi/g	3.230E+01	0.60	2.00	2.400E-08		3536.0	1.371E+02		3.289E-06
Np-237	pCi/g	3.000E-01	0.60	2.00	2.900E-08		3536.0	1.273E+00		3.692E-08
Pu-238	pCi/g	4.000E-02	0.60	2.00	3.900E-08		3536.0	1.697E-01		6.619E-09
							Total Risk from Radionuclides=			9.935E-06

Formulas Radioactive Materials: Intake/hr = CA (pCi/g) x IR x 10^{-3}
Total Intake (pCi) = Intake/hr x ETx EF x ED
Hazardous Chemicals: Intake = CA x IR x ET x ED x EF x 10^{-6} / [BW x AT]

Parameters IR 2.0 m^3/hr
BW 70.0 kg
AT 25550.0 days

Notes: TE is the toxic equivalent as calculated in Table C.4-3

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Table C.II-12 Inhalation – Remedial and Nonremedial Worker
Alternative 6: Excavation Scenario
Solid Waste Landfill

	Risk Factors							Intake Results		Risk Results
COC	Soil Conc units	Soil Conc	Dust Load mg/m^3	IR m^3/hr	Risk Risk/pCi	Risk 1/mg/kg/d	ETxEFxED hr	Intake pCi	Intake mg/kg-day	Risk
Antimony	mg/kg	2.200E+01	0.60	2.00		NA	2000.0		2.952E-08	
Arsenic	mg/kg	1.380E+01	0.60	2.00		1.500E+01	2000.0		1.852E-08	2.778E-07
Beryllium	mg/kg	1.075E+00	0.60	2.00		8.400E+00	2000.0		1.443E-09	1.212E-08
U-total	mg/kg	4.460E+02	0.60	2.00		NA	2000.0		5.985E-07	
Aroclor-1254	mg/kg	4.800E-02	0.60	2.00		NA	2000.0		6.441E-11	
Aroclor-1260	mg/kg	7.700E-02	0.60	2.00		NA	2000.0		1.033E-10	
Carbzole	mg/kg	4.200E+00	0.60	2.00		NA	2000.0		5.636E-09	
Dieldrin	mg/kg	NA	0.60	2.00		1.600E+01	2000.0			
PAH	TE	1.072E+01	0.60	2.00		6.100E+00	2000.0		1.439E-08	8.775E-08
							Total Risk From Chemicals=			3.776E-07
Sr-90	pCi/g	1.580E+00	0.60	2.00	6.200E-11		2000.0	3.792E+00		2.351E-10
Tc-99	pCi/g	7.540E-01	0.60	2.00	8.300E-12		2000.0	1.810E+00		1.502E-11
Cs-137	pCi/g	2.500E-01	0.60	2.00	1.900E-11		2000.0	6.000E-01		1.140E-11
Rn-222	pCi/g	1.550E+00	0.60	2.00	7.700E-12		2000.0	3.720E+00		2.864E-11
Ra-226	pCi/g	1.550E+00	0.60	2.00	3.000E-09		2000.0	3.720E+00		1.116E-08
Ra-228	pCi/g	2.560E+00	0.60	2.00	6.900E-10		2000.0	6.144E+00		4.239E-09
Th-228	pCi/g	3.390E+00	0.60	2.00	7.800E-08		2000.0	8.136E+00		6.346E-07
Th-230	pCi/g	1.230E+01	0.60	2.00	2.900E-08		2000.0	2.952E+01		8.561E-07
Th-232	pCi/g	3.590E+00	0.60	2.00	2.800E-08		2000.0	8.616E+00		2.412E-07
U-234	pCi/g	9.700E+01	0.60	2.00	2.600E-08		2000.0	2.328E+02		6.053E-06
U-235	pCi/g	9.930E+00	0.60	2.00	2.500E-08		2000.0	2.383E+01		5.958E-07
U-238	pCi/g	1.700E+02	0.60	2.00	2.400E-08		2000.0	4.080E+02		9.792E-06
Np-237	pCi/g	3.510E-01	0.60	2.00	2.900E-08		2000.0	8.424E-01		2.443E-08
Pu-238	pCi/g	3.280E-01	0.60	2.00	3.900E-08		2000.0	7.872E-01		3.070E-08
							Total Risk from Radionuclides=			1.824E-05

Formulas Radioactive Materials:

Intake/hr = CA (pCi/g) x IR x 10^{-3}
Total Intake (pCi) = Intake/hr x ETx EF x ED
Intake = CA x IR x ET x ED x EF x 10^{-6} / [BW x AT]

Hazardous Chemicals:

Parameters IR 2.0 m^3/hr
BW 70.0 kg
AT 25550.0 days

Notes: TE is the toxic equivalent as calculated in Table C.4-3

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Table C.II-13 Radon Inhalation Exposure Evaluations
Alternative 2, 3, and 6
Excavation

	Ca	IR	Exposure	Intake	CSF	Risk per
	pCi/m3	m3/hr	hr/person	pCi	1/pCi	Worker
Alternative 2						
Active Flyash Pile	4.65E+01	2.5	2607	3.03E+05	7.7E-12	2.33E-06
Lime Sludge Pile	4.77E+00	2.5	987	1.18E+04	7.7E-12	9.06E-08
South Field/Inactive Flyash Pile	5.61E+00	2.5	2694	3.78E+04	7.7E-12	2.91E-07
Solid Waste Landfill	4.65E+01	2.5	1095	1.27E+05	7.7E-12	9.80E-07
Total						3.70E-06
Alternative 3						
Active Flyash Pile	4.65E+01	2.5	3439	4.00E+05	7.7E-12	3.08E-06
Lime Sludge Pile	4.77E+00	2.5	2100	2.50E+04	7.7E-12	1.93E-07
South Field/Inactive Flyash Pile	5.61E+00	2.5	3838	5.38E+04	7.7E-12	4.14E-07
Solid Waste Landfill	4.65E+01	2.5	2186	2.54E+05	7.7E-12	1.96E-06
Total						5.64E-06
Alternative 6						
Active Flyash Pile	4.65E+01	2.5	1818	2.11E+05	7.7E-12	1.63E-06
Lime Sludge Pile	4.77E+00	2.5	2397	2.86E+04	7.7E-12	2.20E-07
South Field/Inactive Flyash Pile	5.61E+00	2.5	3536	4.96E+04	7.7E-12	3.82E-07
Solid Waste Landfill	4.65E+01	2.5	2000	2.33E+05	7.7E-12	1.79E-06
Total						4.02E-06

CSF - cancer slope factor from Section C.4.2

Table C.II-14 Dermal Exposure Pathways
Alternative 2
Excavation

COC	SF 1/(mg/kg-d)	RfD mg/kg-d	soil conc mg/kg	ABS	ED*EF	Intake mg/kg-d	Cancer Risks	Non-Carcin. HI
Active Flyash Pile								
Antimony	NA	6.00E-05	2.00E+00	1.0E-02	1.18E+02	7.57E-09	0.00E+00	1.26E-04
Arsenic	1.90E+00	2.85E-04	6.43E+01	1.0E-03	1.18E+02	2.43E-08	4.62E-08	8.54E-05
Beryllium	4.30E+00	5.00E-03	3.38E+00	1.0E-02	1.18E+02	1.28E-08	5.50E-08	2.56E-06
U-total	NA	1.50E-04	3.00E+01	1.0E-03	1.18E+02	1.13E-08	0.00E+00	7.56E-05
Aroclor-1254	1.03E+01	5.30E-05	NA	6.0E-02	1.18E+02	0.00E+00	0.00E+00	0.00E+00
Aroclor-1260	1.03E+01	5.30E-05	NA	6.0E-02	1.18E+02	0.00E+00	0.00E+00	0.00E+00
Carbazole	2.22E-02	NA	NA	3.0E-01	1.18E+02	0.00E+00	0.00E+00	--
Dieldrin	1.78E+01	4.5E-05	NA	3.0E-01	1.18E+02	0.00E+00	0.00E+00	0.00E+00
PAH	NA	NA	NA	NA	1.18E+02	0.00E+00	0.00E+00	--
Total							1.01E-07	2.90E-04
Lime Sludge Pond								
Antimony	NA	6.00E-05	2.32E+01	1.0E-02	9.50E+01	7.09E-08	0.00E+00	1.18E-03
Arsenic	1.90E+00	2.85E-04	6.78E+00	1.0E-03	9.50E+01	2.07E-09	3.93E-09	7.26E-06
Beryllium	4.30E+00	5.00E-03	1.27E+00	1.0E-02	9.50E+01	3.87E-09	1.66E-08	7.74E-07
U-total	NA	1.50E-04	2.22E+01	1.0E-03	9.50E+01	6.78E-09	0.00E+00	4.52E-05
Aroclor-1254	1.03E+01	5.30E-05	4.30E-02	6.0E-02	9.50E+01	7.88E-10	8.12E-09	1.49E-05
Aroclor-1260	1.03E+01	5.30E-05	NA	6.0E-02	9.50E+01	0.00E+00	0.00E+00	0.00E+00
Carbazole	2.22E-02	NA	NA	3.0E-01	9.50E+01	0.00E+00	0.00E+00	--
Dieldrin	1.78E+01	4.5E-05	NA	3.0E-01	9.50E+01	0.00E+00	0.00E+00	0.00E+00
PAH	NA	NA	1.90E-01	NA	9.50E+01	0.00E+00	0.00E+00	--
Total							2.87E-08	1.25E-03
South Field and Inactive Flyash Pile								
Antimony	NA	6.00E-05	1.87E+01	1.0E-02	2.58E+02	1.55E-07	0.00E+00	2.59E-03
Arsenic	1.90E+00	2.85E-04	1.21E+01	1.0E-03	2.58E+02	1.00E-08	1.90E-08	3.51E-05
Beryllium	4.30E+00	5.00E-03	1.44E+00	1.0E-02	2.58E+02	1.19E-08	5.14E-08	2.39E-06
U-total	NA	1.50E-04	1.04E+02	1.0E-03	2.58E+02	8.68E-08	0.00E+00	5.77E-04
Aroclor-1254	1.03E+01	5.30E-05	0.043	6.0E-02	2.58E+02	2.14E-09	2.20E-08	4.04E-05
Aroclor-1260	1.03E+01	5.30E-05	0.089	6.0E-02	2.58E+02	4.43E-09	4.56E-08	8.36E-05
Carbazole	2.22E-02	NA	0.001	3.0E-01	2.58E+02	2.49E-10	5.52E-12	--
Dieldrin	1.78E+01	4.5E-05	0.016	3.0E-01	2.58E+02	3.98E-09	7.09E-08	8.85E-05
PAH	NA	NA	0.18	NA	2.58E+02	0.00E+00	0.00E+00	--
Total							2.09E-07	3.41E-03
Solid Waste Landfill								
Antimony	NA	6.00E-05	2.20E+01	1.0E-02	1.05E+02	7.44E-08	0.00E+00	1.24E-03
Arsenic	1.90E+00	2.85E-04	1.38E+01	1.0E-03	1.05E+02	4.67E-09	8.87E-09	1.64E-05
Beryllium	4.30E+00	5.00E-03	1.08E+00	1.0E-02	1.05E+02	3.64E-09	1.56E-08	7.27E-07
U-total	NA	1.50E-04	4.46E+02	1.0E-03	1.05E+02	1.51E-07	0.00E+00	1.01E-03
Aroclor-1254	1.03E+01	5.30E-05	4.80E-02	6.0E-02	1.05E+02	9.74E-10	1.00E-08	1.84E-05
Aroclor-1260	1.03E+01	5.30E-05	7.70E-02	6.0E-02	1.05E+02	1.56E-09	1.61E-08	2.95E-05
Carbazole	2.22E-02	NA	4.20E+00	3.0E-01	1.05E+02	4.26E-07	9.46E-09	--
Dieldrin	1.78E+01	4.5E-05	NA	3.0E-01	1.05E+02	0.00E+00	0.00E+00	0.00E+00
PAH	NA	NA	NA	NA	1.05E+02	0.00E+00	0.00E+00	--
Total							6.01E-08	2.31E-03
Grand Total							3.99E-07	7.26E-03

Soil concentrations and dust loading from Tables C.II-2-5
Dermal Slope Factors (SF) from Table C.4-4
Dermal Reference Doses (RfD) from Table C.4-4
Formula (ref EPA RAGS): CS*AF*SA*ABS*CF*ED*EF/BW*AT
Dermal Absorption Coefficients (ABS) from Table C.3-4

CF = 10e-6 kg/mg
AF = 1 mg/cm2
SA assumed at 5750 cm^2 (Adult male)

BW = 70 kg
AT = 25550 days
EF = 200 events/yr

ED = 5.89E-01 Yr - AFP
4.75E-01 Yr - LSP
1.29E+00 Yr - SF/IFP
5.26E-01 Yr - SWL

Table C.II-15 Dermal Exposure Pathways
Alternative 3
Excavation

COC	SF 1/(mg/kg-d)	RfD mg/kg-d	soil conc mg/kg	ABS	ED*EF	Intake mg/kg-d	Cancer Risks	Non-Carcin. HI
Active Flyash Pile								
Antimony	NA	6.00E-05	2.00E+00	1.0E-02	3.30E+02	2.12E-08	0.00E+00	3.54E-04
Arsenic	1.90E+00	2.85E-04	6.43E+01	1.0E-03	3.30E+02	6.82E-08	1.30E-07	2.39E-04
Beryllium	4.30E+00	5.00E-03	3.38E+00	1.0E-02	3.30E+02	3.58E-08	1.54E-07	7.16E-06
U-total	NA	1.50E-04	3.00E+01	1.0E-03	3.30E+02	3.18E-08	0.00E+00	2.12E-04
Aroclor-1254	1.03E+01	5.30E-05	0	6.0E-02	3.30E+02	0.00E+00	0.00E+00	0.00E+00
Aroclor-1260	1.03E+01	5.30E-05	0	6.0E-02	3.30E+02	0.00E+00	0.00E+00	0.00E+00
Carbazole	2.22E-02	NA	0	3.0E-01	3.30E+02	0.00E+00	0.00E+00	--
Dieldrin	1.78E+01	4.5E-05	0	3.0E-01	3.30E+02	0.00E+00	0.00E+00	0.00E+00
PAH	NA	NA	0	NA	3.30E+02	0.00E+00	0.00E+00	--
Total							2.84E-07	8.12E-04
Lime Sludge Pond								
Antimony	NA	6.00E-05	2.32E+01	1.0E-02	2.02E+02	1.51E-07	0.00E+00	2.51E-03
Arsenic	1.90E+00	2.85E-04	6.78E+00	1.0E-03	2.02E+02	4.40E-09	8.36E-09	1.54E-05
Beryllium	4.30E+00	5.00E-03	1.27E+00	1.0E-02	2.02E+02	8.23E-09	3.54E-08	1.65E-06
U-total	NA	1.50E-04	2.22E+01	1.0E-03	2.02E+02	1.44E-08	0.00E+00	9.61E-05
Aroclor-1254	1.03E+01	5.30E-05	4.30E-02	6.0E-02	2.02E+02	1.68E-09	1.73E-08	3.16E-05
Aroclor-1260	1.03E+01	5.30E-05	NA	6.0E-02	2.02E+02	0.00E+00	0.00E+00	0.00E+00
Carbazole	2.22E-02	NA	NA	3.0E-01	2.02E+02	0.00E+00	0.00E+00	--
Dieldrin	1.78E+01	4.5E-05	NA	3.0E-01	2.02E+02	0.00E+00	0.00E+00	0.00E+00
PAH	NA	NA	1.90E-01	NA	2.02E+02	0.00E+00	0.00E+00	--
Total							6.10E-08	2.66E-03
South Field and Inactive Flyash Pile								
Antimony	NA	6.00E-05	1.87E+01	1.0E-02	6.72E+02	4.04E-07	0.00E+00	6.73E-03
Arsenic	1.90E+00	2.85E-04	1.21E+01	1.0E-03	6.72E+02	2.61E-08	4.95E-08	9.14E-05
Beryllium	4.30E+00	5.00E-03	1.44E+00	1.0E-02	6.72E+02	3.11E-08	1.34E-07	6.22E-06
U-total	NA	1.50E-04	1.04E+02	1.0E-03	6.72E+02	2.26E-07	0.00E+00	1.50E-03
Aroclor-1254	1.03E+01	5.30E-05	0.043	6.0E-02	6.72E+02	5.57E-09	5.74E-08	1.05E-04
Aroclor-1260	1.03E+01	5.30E-05	0.089	6.0E-02	6.72E+02	1.15E-08	1.19E-07	2.18E-04
Carbazole	2.22E-02	NA	0.001	3.0E-01	6.72E+02	6.48E-10	1.44E-11	--
Dieldrin	1.78E+01	4.5E-05	0.016	3.0E-01	6.72E+02	1.04E-08	1.85E-07	2.30E-04
PAH	NA	NA	0.18	NA	6.72E+02	0.00E+00	0.00E+00	--
Total							5.44E-07	8.89E-03
Solid Waste Landfill								
Antimony	NA	6.00E-05	2.20E+01	1.0E-02	2.10E+02	1.49E-07	0.00E+00	2.48E-03
Arsenic	1.90E+00	2.85E-04	1.38E+01	1.0E-03	2.10E+02	9.32E-09	1.77E-08	3.27E-05
Beryllium	4.30E+00	5.00E-03	1.08E+00	1.0E-02	2.10E+02	7.26E-09	3.12E-08	1.45E-06
U-total	NA	1.50E-04	4.46E+02	1.0E-03	2.10E+02	3.01E-07	0.00E+00	2.01E-03
Aroclor-1254	1.03E+01	5.30E-05	4.80E-02	6.0E-02	2.10E+02	1.94E-09	2.00E-08	3.67E-05
Aroclor-1260	1.03E+01	5.30E-05	7.70E-02	6.0E-02	2.10E+02	3.12E-09	3.21E-08	5.89E-05
Carbazole	2.22E-02	NA	4.20E+00	3.0E-01	2.10E+02	8.51E-07	1.89E-08	--
Dieldrin	1.78E+01	4.5E-05	NA	3.0E-01	2.10E+02	0.00E+00	0.00E+00	0.00E+00
PAH	NA	NA	NA	NA	2.10E+02	0.00E+00	0.00E+00	--
Total							1.20E-07	4.61E-03
Grand Total							1.01E-06	1.70E-02

Soil concentrations and dust loading from Tables C.II-2-5
Dermal Slope Factors (SF) from Table C.4-4
Dermal Reference Doses (RfD) from Table C.4-4
Formula (ref EPA RAGS): CS*AF*SA*ABS*CF*ED*EF/BW*AT
Dermal Absorption Coefficients (ABS) from Table C.3-4

CF = 10e-6 kg/mg
AF = 1 mg/cm2
SA assumed at 5750 cm^2 (Adult male)
BW = 70 kg
AT = 25550 days
EF = 200 events/yr

ED = 1.65E+00 Yr - AFP
1.01E+00 Yr - LSP
3.36E+00 Yr - SF/IFP
1.05E+00 Yr - SWL

Table C.II-16 Dermal Exposure Pathways
Alternative 6
Excavation

COC	SF 1/(mg/kg-d)	RfD mg/kg-d	soil conc mg/kg	ABS	ED*EF	Intake mg/kg-d	Cancer Risks	Non-Carcin. HI
Active Flyash Pile								
Antimony	NA	6.00E-05	2.00E+00	1.0E-02	1.18E+02	7.57E-09	0.00E+00	1.26E-04
Arsenic	1.90E+00	2.85E-04	6.43E+01	1.0E-03	1.18E+02	2.43E-08	4.62E-08	8.54E-05
Beryllium	4.30E+00	5.00E-03	3.38E+00	1.0E-02	1.18E+02	1.28E-08	5.50E-08	2.56E-06
U-total	NA	1.50E-04	3.00E+01	1.0E-03	1.18E+02	1.13E-08	0.00E+00	7.56E-05
Aroclor-1254	1.03E+01	5.30E-05	0	6.0E-02	1.18E+02	0.00E+00	0.00E+00	0.00E+00
Aroclor-1260	1.03E+01	5.30E-05	0	6.0E-02	1.18E+02	0.00E+00	0.00E+00	0.00E+00
Carbazole	2.22E-02	NA	0	3.0E-01	1.18E+02	0.00E+00	0.00E+00	--
Dieldrin	1.78E+01	4.5E-05	0	3.0E-01	1.18E+02	0.00E+00	0.00E+00	0.00E+00
PAH	NA	NA	0	NA	1.18E+02	0.00E+00	0.00E+00	--
Total							1.012E-07	2.90E-04
Lime Sludge Pond								
Antimony	NA	6.00E-05	2.32E+01	1.0E-02	9.50E+01	7.09E-08	0.00E+00	1.18E-03
Arsenic	1.90E+00	2.85E-04	6.78E+00	1.0E-03	9.50E+01	2.07E-09	3.93E-09	7.26E-06
Beryllium	4.30E+00	5.00E-03	1.27E+00	1.0E-02	9.50E+01	3.87E-09	1.66E-08	7.74E-07
U-total	NA	1.50E-04	2.22E+01	1.0E-03	9.50E+01	6.78E-09	0.00E+00	4.52E-05
Aroclor-1254	1.03E+01	5.30E-05	4.30E-02	6.0E-02	9.50E+01	7.88E-10	8.12E-09	1.49E-05
Aroclor-1260	1.03E+01	5.30E-05	NA	6.0E-02	9.50E+01	0.00E+00	0.00E+00	0.00E+00
Carbazole	2.22E-02	NA	NA	3.0E-01	9.50E+01	0.00E+00	0.00E+00	--
Dieldrin	1.78E+01	4.5E-05	NA	3.0E-01	9.50E+01	0.00E+00	0.00E+00	0.00E+00
PAH	NA	NA	1.90E-01	NA	9.50E+01	0.00E+00	0.00E+00	--
Total							2.869E-08	1.25E-03
South Field and Inactive Flyash Pile								
Antimony	NA	6.00E-05	1.87E+01	1.0E-02	2.30E+02	1.38E-07	0.00E+00	2.30E-03
Arsenic	1.90E+00	2.85E-04	1.21E+01	1.0E-03	2.30E+02	8.92E-09	1.69E-08	3.13E-05
Beryllium	4.30E+00	5.00E-03	1.44E+00	1.0E-02	2.30E+02	1.06E-08	4.58E-08	2.13E-06
U-total	NA	1.50E-04	1.04E+02	1.0E-03	2.30E+02	7.72E-08	0.00E+00	5.15E-04
Aroclor-1254	1.03E+01	5.30E-05	0.043	6.0E-02	2.30E+02	1.91E-09	1.97E-08	3.60E-05
Aroclor-1260	1.03E+01	5.30E-05	0.089	6.0E-02	2.30E+02	3.95E-09	4.07E-08	7.45E-05
Carbazole	2.22E-02	NA	0.001	3.0E-01	2.30E+02	2.22E-10	4.92E-12	--
Dieldrin	1.78E+01	4.5E-05	0.016	3.0E-01	2.30E+02	3.55E-09	6.32E-08	7.89E-05
PAH	NA	NA	0.18	NA	2.30E+02	0.00E+00	0.00E+00	--
Total							1.862E-07	3.04E-03
Solid Waste Landfill								
Antimony	NA	6.00E-05	2.20E+01	1.0E-02	1.75E+02	1.24E-07	0.00E+00	2.06E-03
Arsenic	1.90E+00	2.85E-04	1.38E+01	1.0E-03	1.75E+02	7.76E-09	1.47E-08	2.72E-05
Beryllium	4.30E+00	5.00E-03	1.08E+00	1.0E-02	1.75E+02	6.04E-09	2.60E-08	1.21E-06
U-total	NA	1.50E-04	4.46E+02	1.0E-03	1.75E+02	2.51E-07	0.00E+00	1.67E-03
Aroclor-1254	1.03E+01	5.30E-05	4.80E-02	6.0E-02	1.75E+02	1.62E-09	1.67E-08	3.05E-05
Aroclor-1260	1.03E+01	5.30E-05	7.70E-02	6.0E-02	1.75E+02	2.60E-09	2.67E-08	4.90E-05
Carbazole	2.22E-02	NA	4.20E+00	3.0E-01	1.75E+02	7.08E-07	1.57E-08	--
Dieldrin	1.78E+01	4.5E-05	NA	3.0E-01	1.75E+02	0.00E+00	0.00E+00	0.00E+00
PAH	NA	NA	NA	NA	1.75E+02	0.00E+00	0.00E+00	--
Total							9.98E-08	3.84E-03
Grand Total							4.16E-07	8.42E-03

Soil concentrations and dust loading from Tables C.II-2-5
Dermal Slope Factors (SF) from Table C.4-4
Dermal Reference Doses (RfD) from Table C.4-4
Formula (ref EPA RAGS): CS*AF*SA*ABS*CF*ED*EF/BW*AT
Dermal Absorption Coefficients (ABS) from Table C.3-4

CF = 10e-6 kg/mg
AF = 1 mg/cm2
SA assumed at 5750 cm^2 (Adult male)

BW = 70 kg
AT = 25550 days
EF = 200 events/yr

ED = 8.74E-01 Yr - AFP
1.15E+00 Yr - LSP
4.16E+03 Yr - SF/IFP
4.20E+02 Yr - SWL

Table C.II–17 VOC risks from the Dryer – to Nonremediation Workers and Offsite Persons
Alternative 3

	Max air conc	IR	Exp Duration	BW	AT	Intake	Inhalation Risks CSF	Inhalation Risks Risk	Dermal Risks DSF	Dermal Risks Risk
	g/m³	m³/hr	hrs	kg	days		1/mg/kg–d		1/mg/kg–d	
Active Flyash Pile										
Aloclor–1254	NA	2	830	70	25550	0	NA	0	1.03E+01	0
Aroclor–1260	NA	2	830	70	25550	0	NA	0	1.03E+01	0
Carbzole	NA	2	830	70	25550	0	NA	0	2.22E–02	0
Dieldrin	NA	2	830	70	25550	0	1.60E+01	0	1.78E+01	0
PAH	NA	2	830	70	25550	0	6.10E+00	0	NA	0
Total								0		0
Lime Sludge Pond										
Aroclor–1254	2.07E–10	2	1660	70	25550	3.843E–10	NA	0	1.03E+01	3.958E–09
Aroclor–1260		2	1660	70	25550	0	NA	0	1.03E+01	0
Carbazole		2	1660	70	25550	0	NA	0	2.22E–02	0
Dieldrin		2	1660	70	25550	0	1.60E+01	0	1.78E+01	0
PAH	1.31E–13	2	1660	70	25550	2.432E–13	6.10E+00	1.483E–12	NA	0
Total								1.483E–12		3.958E–09
South Field/Inactive Flyash Pile										
Aroclor–1254	1.42E–10	2	3570	70	25550	5.669E–10	NA	0	1.03E+01	5.839E–09
Aroclor–1260	1.08E–10	2	3570	70	25550	4.312E–10	NA	0	1.03E+01	4.441E–09
Carbazole	NA	2	3570	70	25550	0	NA	0	2.22E–02	0
Dieldrin	4.73E–13	2	3570	70	25550	1.888E–12	1.60E+01	3.021E–11	1.78E+01	3.361E–11
PAH	9.22E–14	2	3570	70	25550	3.681E–13	6.10E+00	2.245E–12	NA	0
Total								3.246E–11		1.031E–08
Solid Waste Landfill										
Aroclor–1254	2.31E–10	2	740	70	25550	1.912E–10	NA	0	1.03E+01	1.969E–09
Aroclor–1260	1.78E–10	2	740	70	25550	1.473E–10	NA	0	1.03E+01	1.517E–09
Carbazole	NA	2	740	70	25550	0	NA	0	2.22E–02	0
Dieldrin	NA	2	740	70	25550	0	1.60E+01	0	1.78E+01	0
PAH	1.49E–14	2	740	70	25550	1.23E–14	6.10E+00	7.52E–14	NA	0
Total								7.52E–14		3.486E–09

Intake (mg/kg/d) = CA*IR*ET*EF*ED/BW*AT
Exp Duration = ET*EF*ED
CA = Air Conc g/m³
IR = Inhalation Rate

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Table C.II–18 Immersion Doses
Alternative 2

			Immersion	
		Total Exp hr/person	Dose mrem/hr	Total Dose mrem
Active Flyash Pile				
Excavation	All Receptors	2607.00	1.13E–09	2.95E–06
Shred/Crush	RemedW	2530.00	1.13E–09	2.86E–06
Waste Staging	RemedW	2607.00	1.13E–09	2.95E–06
Load Rail Cars	RemedW		NA	
On–Site Transp.	RemedW	317.00	NA	
Total	RemedW			8.75E–06
Inactive Flyash/South Field				
Excavation	All Receptors	2690.00	6.51E–10	1.75E–06
Shred/Crush	RemedW	1940.00	6.51E–10	1.26E–06
Waste Staging	RemedW	2690.00	6.51E–10	1.75E–06
Load Rail Cars	RemedW		NA	
On–Site Transp.	RemedW	0.00	NA	
Total	RemedW			4.77E–06
Lime Sludge Ponds				
Excavation	All Receptors	990.00	3.52E–10	3.48E–07
Shred/Crush	RemedW	1482.00	3.52E–10	5.22E–07
Waste Staging	RemedW	990.00	3.52E–10	3.48E–07
Load Rail Cars	RemedW		NA	
On–Site Transp.	RemedW	20.40	NA	
Total	RemedW			1.22E–06
Solid Waste Landfill				
Excavation	All Receptors	1095.00	7.10E–10	7.77E–07
Shred/Crush	RemedW	1917.00	7.10E–10	1.36E–06
Waste Staging	RemedW	1095.00	7.10E–10	7.77E–07
Load Rail Cars	RemedW		NA	
On–Site Transp.	RemedW	15.00	NA	
Total	RemedW			2.92E–06

Table C.II–19 Immersion Doses
Alternative 3

		Total Exp hr/person	Immersion Dose mrem/hr	Immersion Total Dose mrem
Active Flyash Pile				
Excavation	All Receptors	3439.00	1.13E–09	3.89E–06
Shred/Crush	RemedW		NA	
Waste Staging	RemedW		NA	
Load Rail Cars	RemedW	1972.00	NA	
On–Site Transp.	RemedW	1570.00	NA	
Total	RemedW			3.89E–06
Inactive Flyash/South Field				
Excavation	All Receptors	3840.00	6.51E–10	2.50E–06
Shred/Crush	RemedW		NA	
Waste Staging	RemedW		NA	
Load Rail Cars	RemedW *	7700.00	NA	
On–Site Transp.	RemedW	4440.00	NA	
Total	RemedW			2.50E–06
Lime Sludge Ponds				
Excavation	All Receptors	2100.00	3.52E–10	7.39E–07
Shred/Crush	RemedW	2184.00	3.52E–10	7.69E–07
Waste Staging	RemedW	2100.00	3.52E–10	7.39E–07
Load Rail Cars	RemedW	2143.00	NA	
On–Site Transp.	RemedW	160.00	NA	
Total	RemedW			2.25E–06
Solid Waste Landfill				
Excavation	All Receptors	2190.00	7.10E–10	1.55E–06
Shred/Crush	RemedW	2184.00	7.10E–10	1.55E–06
Waste Staging	RemedW	1750.00	7.10E–10	1.24E–06
Load Rail Cars	RemedW	2660.00	NA	
On–Site Transp.	RemedW	490.00	NA	
Total	RemedW			4.35E–06

* Based on exposure over 51 months.

Table C.II–20 Immersion Doses
Alternative 6

		Total Exp hr/person	Immersion Dose mrem/hr	Immersion Total Dose mrem
Active Flyash Pile				
Excavation	All Receptors	1818.00	1.13E–09	2.05E–06
Shred/Crush	RemedW	1688.00	1.13E–09	1.91E–06
Waste Staging	RemedW	1818.00	1.13E–09	2.05E–06
Load Rail Cars	RemedW		NA	
On–Site Transp.	RemedW	589.00	NA	
Total	RemedW			6.02E–06
Inactive Flyash/South Field				
Excavation	All Receptors	3540.00	6.51E–10	2.30E–06
Shred/Crush	RemedW	1010.00	6.51E–10	6.58E–07
Waste Staging	RemedW	3540.00	6.51E–10	2.30E–06
Load Rail Cars	RemedW	47.89	NA	
On–Site Transp.	RemedW	3704.00	NA	
Total	RemedW			5.27E–06
Lime Sludge Ponds				
Excavation	All Receptors	2397.00	3.52E–10	8.44E–07
Shred/Crush	RemedW		NA	
Waste Staging	RemedW		NA	
Load Rail Cars	RemedW		NA	
On–Site Transp.	RemedW	960.00	NA	
Total	RemedW			8.44E–07
Solid Waste Landfill				
Excavation	All Receptors	2000.00	7.10E–10	1.42E–06
Shred/Crush	RemedW	1390.00	7.10E–10	9.87E–07
Waste Staging	RemedW		NA	
Load Rail Cars	RemedW		NA	
On–Site Transp.	RemedW	1523.00	NA	
Total	RemedW			2.41E–06

Table C.II–21 Industrial Hazards: Expected Accidents other than Onsite Trucking
Alternative 2, 3, and 6
Injury and Fatality Rates for Workers

Alternative 2	Total man–hr	Injury Rate per man–hr	Injury Risk	Fatality Rate per man–hr	Fatality Risk
Solid Waste Landfill	12000	3.4E–05	4.08E–01	5.0E–07	6.00E–03
Lime Sludge Pond	4000	3.4E–05	1.36E–01	5.0E–07	2.00E–03
Inactive Flyash Pile	37470	3.4E–05	1.27E+00	5.0E–07	1.87E–02
South Field	11020	3.4E–05	3.75E–01	5.0E–07	5.51E–03
Active Flyash Pile	52140	3.4E–05	1.77E+00	5.0E–07	2.61E–02
Alternative 3					
Solid Waste Landfill	43720	3.4E–05	1.49E+00	5.0E–07	2.19E–02
Lime Sludge Pond	42000	3.4E–05	1.43E+00	5.0E–07	2.10E–02
Inactive Flyash Pile	52840	3.4E–05	1.80E+00	5.0E–07	2.64E–02
South Field	143000	3.4E–05	4.86E+00	5.0E–07	7.15E–02
Active Flyash Pile	41270	3.4E–05	1.40E+00	5.0E–07	2.06E–02
Alternative 6					
Solid Waste Landfill	14000	3.4E–05	4.76E–01	5.0E–07	7.00E–03
Lime Sludge Pond	71920	3.4E–05	2.45E+00	5.0E–07	3.60E–02
Inactive Flyash Pile	59530	3.4E–05	2.02E+00	5.0E–07	2.98E–02
South Field	156170	3.4E–05	5.31E+00	5.0E–07	7.81E–02
Active Flyash Pile	36400	3.4E–05	1.24E+00	5.0E–07	1.82E–02

njury and fatality rates from the RAWPA

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Table C.II-22 Industrial Hazards: Expected Accidents from Onsite Trucking
Alternative 2, 3, and 6

	Roundtrip Truck Miles – Onsite		Remediation Workers Rates for PO volumes		Remediation Workers Rates for FO volumes	
	PO	FO	injuries	fatalities	injuries	fatalies
Alternative 2						
Solid Waste Landfill	0	142	0	0	5.84E-06	2.99E-07
Lime Sludge Pond	0	204	0	0	8.37E-06	4.29E-07
Inactive Flyash Pile	0	3669	0	0	1.50E-04	7.70E-06
South Field	0	42	0	0	1.72E-06	8.81E-08
Active Flyash Pile	0	3173	0	0	1.30E-04	6.66E-06
Total	0	7230	0	0	2.96E-04	1.52E-05
Alternative 3						
Solid Waste Landfill	4899	1153	2.01E-04	1.03E-05	4.73E-05	2.42E-06
Lime Sludge Pond	1600	366	6.56E-05	3.36E-06	1.50E-05	7.68E-07
Inactive Flyash Pile	11924	11129	4.89E-04	2.50E-05	4.56E-04	2.34E-05
South Field	32474	7629	1.33E-03	6.82E-05	3.13E-04	1.60E-05
Active Flyash Pile	8540	7460	3.50E-04	1.79E-05	3.06E-04	1.57E-05
Total	59438	27737	2.44E-03	1.25E-04	1.14E-03	5.82E-05
Alternative 6						
Solid Waste Landfill	15042	3539	6.17E-04	3.16E-05	1.45E-04	7.43E-06
Lime Sludge Pond	9707	2217	3.98E-04	2.04E-05	9.09E-05	4.66E-06
Inactive Flyash Pile	9178	8549	3.76E-04	1.93E-05	3.51E-04	1.80E-05
South Field	27689	6481	1.14E-03	5.81E-05	2.66E-04	1.36E-05
Active Flyash Pile	5988	5231	2.46E-04	1.26E-05	2.14E-04	1.10E-05
Total	67604	26017	2.77E-03	1.42E-04	1.07E-03	5.46E-05

PO – based on volumes used for Private Ownership calculations
FO – based on volumes used for Federal Ownership calcualations
Injury and fatality frequencies from RAWPA
Worker fatality rate = 2.1e-9/mile
Worker injury rate = 4.1e-8/mile

Table C.II–23 Industrial Hazards: Expected Accidents from Rail Transportation
Alternative 3
Private Ownership and Federal Ownership Volumes

	# cars	# trips	total miles	Workers injuries	Workers fatalities	Public injuries	Public fatalities
Private Ownership							
Solid Waste Landfill	1623	10.2	39025	1.80E–01	1.80E–03	2.65E–01	7.02E–02
Lime Sludge Pond	1307	8.2	31450	1.45E–01	1.45E–03	2.14E–01	5.66E–02
Inactive Flyash Pile	1606	10.1	38643	1.78E–01	1.78E–03	2.63E–01	6.96E–02
South Field	5306	33.4	127674	5.87E–01	5.87E–03	8.68E–01	2.30E–01
Active Flyash Pile	1203	7.6	28925	1.33E–01	1.33E–03	1.97E–01	5.21E–02
Total	11044	69.5	265830	1.22E+00	1.22E–02	1.81E+00	4.78E–01
Federal Ownership							
Solid Waste Landfill	382	2.4	9182	4.22E–02	4.22E–04	6.24E–02	1.65E–02
Lime Sludge Pond	299	1.9	7193	3.31E–02	3.31E–04	4.89E–02	1.29E–02
Inactive Flyash Pile	1499	9.4	36079	1.66E–01	1.66E–03	2.45E–01	6.49E–02
South Field	1248	7.8	29996	1.38E–01	1.38E–03	2.04E–01	5.40E–02
Active Flyash Pile	1051	6.6	25290	1.16E–01	1.16E–03	1.72E–01	4.55E–02
Total	4476	28.2	107702	4.95E–01	4.95E–03	7.32E–01	1.94E–01

Accident Rates (RAWPA):	Fatality risk/mile	Injury risk/mile
Rail Workers	4.6E–08	4.6E–06
Public	1.8E–06	6.8E–06

Rail miles per trip is based on 1913 miles one–way and is calculated for a roundtrip at 3826 miles

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Table C.II–24 Industrial Hazards: Expected Accidents from Rail Transportation
Alternative 6
Private Ownership Volumes

	PO Volumes						
				Workers		Public	
	# cars	# trips	total miles	injuries	fatalities	injuries	fatalities
Alternative 6							
Solid Waste Landfill	0	0.0	0	0	0	0	0
Lime Sludge Pond	0	0.0	0	0	0	0	0
Inactive Flyash Pile	44	0.3	3826	1.76E–02	1.76E–04	2.60E–02	6.89E–03
South Field	4	0.0	3826	1.76E–02	1.76E–04	2.60E–02	6.89E–03
Active Flyash Pile	0	0.0	0	0	0	0	0
Total	48	0.3	3826	1.76E–02	1.76E–04	2.60E–02	6.89E–03

Accident Rates (RAWPA):	Fatality risk/mile	Injury risk/mile
Rail Workers	4.6E–08	4.6E–06
Public	1.8E–06	6.8E–06

Rail miles per trip is based on 1913 miles one–way and is calculated for a roundtrip at 3826 miles

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Table C.II–25 Rail Transportation: Doses from Incident–Free Impacts

Alternative 3 and 6

	Alternative 3						Alternative 6					
	Sol. Wst Landfill	Lime Sldg Pond	Inactive Flyash	South Field	Active Flyash	Total	Sol. Wst Landfill	Lime Sldg Pond	Inactive Flyash	South Field	Active Flyash	Totals
# cars	1622.54	1307.04	1605.63	5305.63	1202.82	11043.66	0	0	43.66	4.23	0	47.89
# trips	10.2	8.2	10.1	33.4	7.6	69.5	0.0	0.0	0.3	0.0	0.0	0.3
Doses, Workers (person rem)												
Rail Crew	4.29E–05	3.45E–05	4.24E–05	1.40E–04	3.18E–05	2.92E–04	0.00E+00	0.00E+00	1.15E–06	1.12E–07	0.00E+00	1.27E–06
Handlers	2.25E–01	1.81E–01	2.22E–01	7.34E–01	1.66E–01	1.53E+00	0.00E+00	0.00E+00	6.04E–03	5.85E–04	0.00E+00	6.63E–03
Doses, Public (person–rems)												
along route	5.04E–02	4.06E–02	4.99E–02	1.65E–01	3.74E–02	3.43E–01	0.00E+00	0.00E+00	1.36E–03	1.31E–04	0.00E+00	1.49E–03
on passing trains	5.70E–03	4.60E–03	5.64E–03	1.87E–02	4.23E–03	3.88E–02	0.00E+00	0.00E+00	1.53E–04	1.49E–05	0.00E+00	1.68E–04
on stops	8.33E–02	6.71E–02	8.24E–02	2.72E–01	6.17E–02	5.67E–01	0.00E+00	0.00E+00	2.24E–03	2.17E–04	0.00E+00	2.46E–03
storage depots	9.49E–03	7.64E–03	9.39E–03	3.10E–02	7.04E–03	6.46E–02	0.00E+00	0.00E+00	2.55E–04	2.47E–05	0.00E+00	2.80E–04
Total rems for all non–site populations	1.49E–01	1.20E–01	1.47E–01	4.87E–01	1.10E–01	1.01E+00	0.00E+00	0.00E+00	4.01E–03	3.88E–04	0.00E+00	4.39E–03

trips assumes 159 cars/trip

Table C.II-26 Rail Transport: Accident Impacts – Doses
Alternative 3
Private Ownership and Federal Ownership Volumes

		Private Ownership Volume: Expected Doses							Federal Ownership Volume: Expected Doses						
		Sol. Wst Landfill	Lime Sldg Pond	Inactive Flyash	South Field	Active Flyash	Totals person rem	Total Dose per person	Sol. Wst Landfill	Lime Sldg Pond	Inactive Flyash	South Field	Active Flyash	Totals person rem	Total Dose per person
	# cars	1622.54	1307.04	1605.63	5305.63	1202.82	11043.66		381.69	298.59	1498.59	1246.48	1050.7	4476.05	
	# trips	10.2	8.2	10.1	33.4	7.6	69.5		2.4	1.9	9.4	7.8	6.6	28.2	
Population															
Urban	# persons exposed		4.81E+05												
	Severity Group														
	1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	2	2.90E+02	2.33E+02	2.87E+02	9.48E+02	2.15E+02	1.97E+03	4.10E-03	6.82E+01	5.34E+01	2.68E+02	2.23E+02	1.88E+02	8.00E+02	1.66E-03
	3	5.80E+02	4.67E+02	5.74E+02	1.90E+03	4.30E+02	3.95E+03	8.20E-03	1.36E+02	1.07E+02	5.36E+02	4.45E+02	3.75E+02	1.60E+03	3.33E-03
	4	8.68E+02	7.00E+02	8.59E+02	2.84E+03	6.44E+02	5.91E+03	1.23E-02	2.04E+02	1.60E+02	8.02E+02	6.67E+02	5.63E+02	2.40E+03	4.98E-03
	5	1.15E+03	9.29E+02	1.14E+03	3.77E+03	8.55E+02	7.85E+03	1.63E-02	2.71E+02	2.12E+02	1.07E+03	8.86E+02	7.47E+02	3.18E+03	6.62E-03
	6	1.45E+03	1.17E+03	1.43E+03	4.74E+03	1.07E+03	9.86E+03	2.05E-02	3.41E+02	2.67E+02	1.34E+03	1.11E+03	9.39E+02	4.00E+03	8.31E-03
	7	1.73E+03	1.40E+03	1.72E+03	5.67E+03	1.29E+03	1.18E+04	2.45E-02	4.08E+02	3.20E+02	1.60E+03	1.33E+03	1.12E+03	4.79E+03	9.95E-03
	8	2.90E+03	2.33E+03	2.87E+03	9.48E+03	2.15E+03	1.97E+04	4.10E-02	6.82E+02	5.34E+02	2.68E+03	2.23E+03	1.88E+03	8.00E+03	1.66E-02
	Total by Sub Unit	8.97E+03	7.23E+03	8.88E+03	2.93E+04	6.65E+03			2.11E+03	1.65E+03	8.29E+03	6.89E+03	5.81E+03		
Suburban	# persons exposed		6.75E+04												
	Severity Group														
	1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	2	6.74E+01	5.43E+01	6.66E+01	2.20E+02	4.99E+01	4.58E+02	6.79E-03	1.58E+01	1.24E+01	6.22E+01	5.17E+01	4.36E+01	1.86E+02	2.75E-03
	3	1.35E+02	1.09E+02	1.33E+02	4.40E+02	9.99E+01	9.17E+02	1.36E-02	3.17E+01	2.48E+01	1.24E+02	1.03E+02	8.73E+01	3.72E+02	5.51E-03
	4	2.02E+02	1.63E+02	2.00E+02	6.61E+02	1.50E+02	1.38E+03	2.04E-02	4.75E+01	3.72E+01	1.87E+02	1.55E+02	1.31E+02	5.58E+02	8.26E-03
	5	2.66E+02	2.15E+02	2.64E+02	8.71E+02	1.97E+02	1.81E+03	2.69E-02	6.26E+01	4.91E+01	2.46E+02	2.05E+02	1.73E+02	7.35E+02	1.09E-02
	6	3.36E+02	2.70E+02	3.32E+02	1.10E+03	2.49E+02	2.29E+03	3.39E-02	7.90E+01	6.19E+01	3.10E+02	2.58E+02	2.17E+02	9.26E+02	1.37E-02
	7	4.03E+02	3.25E+02	3.99E+02	1.32E+03	2.99E+02	2.74E+03	4.06E-02	9.48E+01	7.43E+01	3.72E+02	3.10E+02	2.61E+02	1.11E+03	1.65E-02
	8	6.72E+02	5.42E+02	6.65E+02	2.20E+03	4.99E+02	4.58E+03	6.78E-02	1.58E+02	1.24E+02	6.21E+02	5.17E+02	4.36E+02	1.86E+03	2.75E-02
	Total by Sub Unit	2.08E+03	1.68E+03	2.06E+03	6.81E+03	1.54E+03			4.90E+02	3.84E+02	1.92E+03	1.60E+03	1.35E+03		
Rural	# persons exposed		1.26E+03												
	Severity Group														
	1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	2	1.26E+00	1.01E+00	1.24E+00	4.10E+00	9.30E-01	8.54E+00	6.78E-03	2.95E-01	2.31E-01	1.16E+00	9.64E-01	8.13E-01	3.46E+00	2.75E-03
	3	2.51E+00	2.02E+00	2.48E+00	8.21E+00	1.86E+00	1.71E+01	1.36E-02	5.90E-01	4.62E-01	2.32E+00	1.93E+00	1.63E+00	6.93E+00	5.50E-03
	4	3.77E+00	3.03E+00	3.73E+00	1.23E+01	2.79E+00	2.56E+01	2.03E-02	8.86E-01	6.94E-01	3.48E+00	2.89E+00	2.44E+00	1.04E+01	8.25E-03
	5	5.02E+00	4.04E+00	4.97E+00	1.64E+01	3.72E+00	3.42E+01	2.71E-02	1.18E+00	9.25E-01	4.64E+00	3.86E+00	3.25E+00	1.39E+01	1.10E-02
	6	6.28E+00	5.06E+00	6.21E+00	2.05E+01	4.65E+00	4.27E+01	3.39E-02	1.48E+00	1.16E+00	5.80E+00	4.82E+00	4.07E+00	1.73E+01	1.37E-02
	7	7.53E+00	6.07E+00	7.45E+00	2.46E+01	5.58E+00	5.13E+01	4.07E-02	1.77E+00	1.39E+00	6.96E+00	5.79E+00	4.88E+00	2.08E+01	1.65E-02
	8	1.26E+01	1.01E+01	1.24E+01	4.10E+01	9.30E+00	8.54E+01	6.78E-02	2.95E+00	2.31E+00	1.16E+01	9.64E+00	8.13E+00	3.46E+01	2.75E-02
	Total by Sub Unit	3.89E+01	3.13E+01	3.85E+01	1.27E+02	2.88E+01			9.15E+00	7.17E+00	3.60E+01	2.99E+01	2.52E+01		

Accident Consequences per Shipment are from Table C.5.TBD

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Table C.II–27 Rail Transport: Accident Impacts
Alternative 6
Private Ownership Volumes

		Expected Doses						
		Sol. Wst Landfill	Lime Sldg Pond	Inactive Flyash	South Field	Active Flyash	Totals person rem	Total Dose per person
	# cars	0	0	43.66	4.23	0	47.89	
	# trips	0.0	0.0	0.3	0.0	0.0	0.3	
Population								
Urban	# persons exposed		4.81E+05					
	Severity Group							
	1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	2	0.00E+00	0.00E+00	7.80E+00	7.56E−01	0.00E+00	8.55E+00	1.78E−05
	3	0.00E+00	0.00E+00	1.56E+01	1.51E+00	0.00E+00	1.71E+01	3.56E−05
	4	0.00E+00	0.00E+00	2.34E+01	2.26E+00	0.00E+00	2.56E+01	5.33E−05
	5	0.00E+00	0.00E+00	3.10E+01	3.01E+00	0.00E+00	3.40E+01	7.08E−05
	6	0.00E+00	0.00E+00	3.90E+01	3.78E+00	0.00E+00	4.28E+01	8.89E−05
	7	0.00E+00	0.00E+00	4.67E+01	4.52E+00	0.00E+00	5.12E+01	1.06E−04
	8	0.00E+00	0.00E+00	7.80E+01	7.56E+00	0.00E+00	8.55E+01	1.78E−04
	Total by Sub Unit	0.00E+00	0.00E+00	2.41E+02	2.34E+01	0.00E+00		
Suburban	# persons exposed		6.75E+04					
	Severity Group							
	1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	2	0.00E+00	0.00E+00	1.81E+00	1.76E−01	0.00E+00	1.99E+00	2.95E−05
	3	0.00E+00	0.00E+00	3.62E+00	3.51E−01	0.00E+00	3.98E+00	5.89E−05
	4	0.00E+00	0.00E+00	5.44E+00	5.27E−01	0.00E+00	5.96E+00	8.84E−05
	5	0.00E+00	0.00E+00	7.17E+00	6.94E−01	0.00E+00	7.86E+00	1.16E−04
	6	0.00E+00	0.00E+00	9.03E+00	8.75E−01	0.00E+00	9.91E+00	1.47E−04
	7	0.00E+00	0.00E+00	1.08E+01	1.05E+00	0.00E+00	1.19E+01	1.76E−04
	8	0.00E+00	0.00E+00	1.81E+01	1.75E+00	0.00E+00	1.98E+01	2.94E−04
	Total by Sub Unit	0.00E+00	0.00E+00	5.60E+01	5.43E+00	0.00E+00		
Rural	# persons exposed		1.26E+03					
	Severity Group							
	1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	2	0.00E+00	0.00E+00	3.38E−02	3.27E−03	0.00E+00	3.70E−02	2.94E−05
	3	0.00E+00	0.00E+00	6.75E−02	6.54E−03	0.00E+00	7.41E−02	5.88E−05
	4	0.00E+00	0.00E+00	1.01E−01	9.82E−03	0.00E+00	1.11E−01	8.82E−05
	5	0.00E+00	0.00E+00	1.35E−01	1.31E−02	0.00E+00	1.48E−01	1.18E−04
	6	0.00E+00	0.00E+00	1.69E−01	1.64E−02	0.00E+00	1.85E−01	1.47E−04
	7	0.00E+00	0.00E+00	2.03E−01	1.96E−02	0.00E+00	2.22E−01	1.76E−04
	8	0.00E+00	0.00E+00	3.38E−01	3.27E−02	0.00E+00	3.70E−01	2.94E−04
	Total by Sub Unit	0.00E+00	0.00E+00	1.05E+00	1.01E−01	0.00E+00		

Table C.II-28 Direct Radiation Risks using HEAST External Exposure CSFs
Alternative 2
Excavation Soil Concentrations

		CSF		Solid Waste Landfill		Lime Sludge Pond		S. Field/Inact. Flyash		Active Flyash	
		Risk/yr per pCi/g		soil conc	CS x CSF	soil conc	CS x CSF	soil conc	CS x CSF	soil conc	CS x CSF
Sr-90		0		1.58E+00	0	0.84	0	1.36	0	0.96	0
Tc-99		6.0E-13		7.54E-01	4.52E-13	1.05	6.30E-13	0.90	5.40E-13	NA	0
Cs-137		2.0E-06		2.50E-01	5.00E-07	0.17	3.36E-07	0.24	4.74E-07	NA	0
Rn-222		5.9E-06		1.55E+00	9.15E-06	1.56	9.22E-06	2.92	1.72E-05	5.24	3.09E-05
Ra-226		1.2E-08		1.55E+00	1.86E-08	1.56	1.87E-08	2.92	3.50E-08	5.24	6.29E-08
Ra-228		2.9E-06		2.56E+00	7.42E-06	1.80	5.22E-06	1.66	4.80E-06	4.34	1.26E-05
Th-228		5.6E-06		3.39E+00	1.90E-05	1.54	8.62E-06	1.70	9.54E-06	5.79	3.24E-05
Th-230		5.4E-11		1.23E+01	6.64E-10	8.38	4.53E-10	4.26	2.30E-10	5.72	3.09E-10
Th-232		2.6E-11		3.59E+00	9.33E-11	1.07	2.78E-11	1.53	3.98E-11	3.87	1.01E-10
U-234		3.0E-11		9.70E+01	2.91E-09	6.18	1.85E-10	30.19	9.06E-10	8.90	2.67E-10
U-235		2.4E-07		9.93E+00	2.38E-06	0.44	1.04E-07	18.46	4.43E-06	4.72	1.13E-06
U-238		5.1E-08		1.70E+02	8.67E-06	7.47	3.81E-07	32.30	1.65E-06	6.91	3.52E-07
Np-237		4.3E-07		3.51E-01	1.51E-07	0.32	1.39E-07	0.30	1.29E-07	0.45	1.94E-07
Pu-238		2.8E-11		3.28E-01	9.18E-12	0.20	5.57E-12	0.04	1.12E-12	0.12	3.44E-12
Formula: CS x CSFx FY			CS x CSF		4.73E-05		2.40E-05		3.83E-05		7.77E-05
CS = soil conc			*CS x CSF - Rn	**	3.81E-05	**	1.48E-05	**	2.11E-05	**	4.67E-05
FY = fraction of yr exposed											
Remediation Worker			Hr for Excav		1095		987		2694		2607
FY = hr for excav / 24 x 365											
Assumes exposure at 1 m			FY		0.13		0.11		0.31		0.30
			Risk Total		5.91E-06		2.71E-06		1.18E-05		2.31E-05
Pubic Exposure											
Exposure at 1000 ft (304.8 m)											
Public exposure will be 24 hr/d for											
total of days excavation occcurs											
FY = hr for excav/2080			FY		0.53		0.47		1.30		1.25
Dose Reduction Factor =	0.0000108		Risk Total		2.68E-10		1.23E-10		5.34E-10		1.05E-09

***for comparison of Rn contribution only

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Table C.II-29 Direct Radiation Risks using HEAST External Exposure CSFs
Alternative 3
Excavation Soil Concentrations

		CSF		Solid Waste Landfill		Lime Sludge Pond		S. Field/Inact. Flyash		Active Flyash	
		Risk/yr per pCi/g		soil conc	CS x CSF	soil conc	CS x CSF	soil conc	CS x CSF	soil conc	CS x CSF
Sr-90		0		1.58E+00	0	0.84	0	1.36	0	0.96	0
Tc-99		6.0E-13		7.54E-01	4.52E-13	1.05	6.30E-13	0.90	5.40E-13	NA	0
Cs-137		2.0E-06		2.50E-01	5.00E-07	0.17	3.36E-07	0.24	4.74E-07	NA	0
Rn-222		5.9E-06		1.55E+00	9.15E-06	1.56	9.22E-06	2.92	1.72E-05	5.24	3.09E-05
Ra-226		1.2E-08		1.55E+00	1.86E-08	1.56	1.87E-08	2.92	3.50E-08	5.24	6.29E-08
Ra-228		2.9E-06		2.56E+00	7.42E-06	1.80	5.22E-06	1.66	4.80E-06	4.34	1.26E-05
Th-228		5.6E-06		3.39E+00	1.90E-05	1.54	8.62E-06	1.70	9.54E-06	5.79	3.24E-05
Th-230		5.4E-11		1.23E+01	6.64E-10	8.38	4.53E-10	4.26	2.30E-10	5.72	3.09E-10
Th-232		2.6E-11		3.59E+00	9.33E-11	1.07	2.78E-11	1.53	3.98E-11	3.87	1.01E-10
U-234		3.0E-11		9.70E+01	2.91E-09	6.18	1.85E-10	30.19	9.06E-10	8.90	2.67E-10
U-235		2.4E-07		9.93E+00	2.38E-06	0.44	1.04E-07	18.46	4.43E-06	4.72	1.13E-06
U-238		5.1E-08		1.70E+02	8.67E-06	7.47	3.81E-07	32.30	1.65E-06	6.91	3.52E-07
Np-237		4.3E-07		3.51E-01	1.51E-07	0.32	1.39E-07	0.30	1.29E-07	0.45	1.94E-07
Pu-238		2.8E-11		3.28E-01	9.18E-12	0.20	5.57E-12	0.04	1.12E-12	0.12	3.44E-12
Formula: CS x CSFx FY											
CS = soil conc			CS x CSF		4.73E-05		2.40E-05		3.83E-05		7.77E-05
FY = fraction of yr exposed			*CS x CSF - Rn	**	3.81E-05	**	1.48E-05	**	2.11E-05	**	4.67E-05
Remediation Worker			Hr for Excav		2186		2100		3838		3439
FY = hr for excav / 24 x 365											
Assumes exposure at 1 m			FY		0.25		0.24		0.44		0.39
			Risk Total		1.18E-05		5.76E-06		1.68E-05		3.05E-05
Pubic Exposure											
Exposure at 1000 ft (304.8 m)											
Public exposure will be 24 hr/d for total of days excavation occcurs											
FY = hr for excav/2080			FY		1.05		1.01		1.85		1.65
Dose Reduction Factor =	0.0000108		Risk Total		5.35E-10		2.61E-10		7.60E-10		1.38E-09

***for comparison of Rn contribution only

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Table C.II-30 Direct Radiation Risks using HEAST External Exposure CSFs
Alternative 6
Excavation Soil Concentrations

		CSF		Solid Waste Landfill		Lime Sludge Pond		S. Field/Inact. Flyash		Active Flyash	
		Risk/yr per pCi/g		soil conc	CS x CSF	soil conc	CS x CSF	soil conc	CS x CSF	soil conc	CS x CSF
Sr-90		0		1.58E+00	0	0.84	0	1.36	0	0.96	0
Tc-99		6.0E-13		7.54E-01	4.52E-13	1.05	6.30E-13	0.90	5.40E-13	NA	0
Cs-137		2.0E-06		2.50E-01	5.00E-07	0.17	3.36E-07	0.24	4.74E-07	NA	0
Rn-222		5.9E-06		1.55E+00	9.15E-06	1.56	9.22E-06	2.92	1.72E-05	5.24	3.09E-05
Ra-226		1.2E-08		1.55E+00	1.86E-08	1.56	1.87E-08	2.92	3.50E-08	5.24	6.29E-08
Ra-228		2.9E-06		2.56E+00	7.42E-06	1.80	5.22E-06	1.66	4.80E-06	4.34	1.26E-05
Th-228		5.6E-06		3.39E+00	1.90E-05	1.54	8.62E-06	1.70	9.54E-06	5.79	3.24E-05
Th-230		5.4E-11		1.23E+01	6.64E-10	8.38	4.53E-10	4.26	2.30E-10	5.72	3.09E-10
Th-232		2.6E-11		3.59E+00	9.33E-11	1.07	2.78E-11	1.53	3.98E-11	3.87	1.01E-10
U-234		3.0E-11		9.70E+01	2.91E-09	6.18	1.85E-10	30.19	9.06E-10	8.90	2.67E-10
U-235		2.4E-07		9.93E+00	2.38E-06	0.44	1.04E-07	18.46	4.43E-06	4.72	1.13E-06
U-238		5.1E-08		1.70E+02	8.67E-06	7.47	3.81E-07	32.30	1.65E-06	6.91	3.52E-07
Np-237		4.3E-07		3.51E-01	1.51E-07	0.32	1.39E-07	0.30	1.29E-07	0.45	1.94E-07
Pu-238		2.8E-11		3.28E-01	9.18E-12	0.20	5.57E-12	0.04	1.12E-12	0.12	3.44E-12
Formula: CS x CSFx FY											
CS = soil conc			CS x CSF		4.73E-05		2.40E-05		3.83E-05		7.77E-05
FY = fraction of yr exposed			*CS x CSF - Rn	**	3.81E-05	**	1.48E-05	**	2.11E-05	**	4.67E-05
Remediation Worker			Hr for Excav		2000		2397		3536		1818
FY = hr for excav / 24 x 365											
Assumes exposure at 1 m			FY		0.23		0.27		0.40		0.21
			Risk Total		1.08E-05		6.58E-06		1.55E-05		1.61E-05
Pubic Exposure											
Exposure at 1000 ft (304.8 m)											
Public exposure will be 24 hr/d for total of days excavation occcurs											
FY = hr for excav/2080			FY		0.96		1.15		1.70		0.87
Dose Reduction Factor =		0.0000108	Risk Total		4.89E-10		2.98E-10		7.01E-10		7.31E-10

***for comparison of Rn contribution only

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PREFACE

The following attachment contains the detailed residual risk calculations for the remedial alternatives evaluated in this feasibility study risk Assessment. This attachment contains all the equations and parameters used for the quantification of exposure and subsequent risk per exposure pathway. The exposure equations and the parameters used in the exposure models are summarized in Section C.3.0 of this report. The RAWPA (DOE 1992) is the primary sources for these values; other values were used in accordance with EPA and/or DOE guidance.

The primary exposure media considered for residual risk evaluation are groundwater, air, and soil. Exposure to sediments are included in the group detailing soil exposure pathways. Exposure to surface water is not a viable pathway to potential Operable Unit 2 receptors (see Section C.2.0) and is therefore not included in the following attachments. The development of concentration terms for air, groundwater, and soil is provided in Section C.5.2. These concentrations were used to quantify intake. Food pathway source terms were quantified using the equations presented in Section C.5.2 of this report. The following attachment contains the detailed residual risk calculations for the remedial alternatives evaluated in this feasibility study risk assessment. This attachment contains all the equations and parameters used for the quantification of exposure and subsequent risk per exposure pathway. The exposure equations and parameters used in the exposure models are summarized in Section C.3.0 of this report. The RAWPA (DOE 1992) is the primary sources for these values; other values were used in accordance with EPA and/or DOE guidance.

The primary exposure media considered for residual risk evaluation are groundwater, air, and soil. Exposers to sediments are included in the group detailing soil exposure pathways. Exposure to surface water is not viable pathway to potential Operable Unit 2 receptors (see Section C.2.0) and is therefore not included in the following attachments. The development of concentration terms for air, groundwater, and soil is provided in Section C.5.2. These concentrations were used to quantify intake. Food pathway sources terms were quantified using the equations presented in Section C.5.2 of this report.

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Table C.III-1
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
Lime Sludge Pond with Federal Ownership: Expanded Trespasser
Via Inhalation of Gases and Particulates

Intake Equation = CA X EFa X EDa X IR X ETa + CA X EFc EDc X IR X ETc

IR	Inhalation rate of gases	0.83 m^3/hour
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure duration	32 Year
EDc	Exposure duration	12 Year
ETa	Exposure time (adult)	1 hour/day
ETc	Exposure time (child)	2 hour/day
CA	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	NA	pCi/m^3	U_{234}	NA	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	2.4E−07	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	NA	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E−11	NA
Np_{237+1d}	NA	2.9E−08	NA
Pu_{238}	NA	3.9E−08	NA
Ra_{226+8d}	NA	7.0E−09	NA
Ra_{228+1d}	NA	6.9E−10	NA
Rn_{222+4d}	7.7E−04	7.7E−12	5.9E−15
Sr_{90+1d}	NA	6.2E−11	NA
Tc_{99}	NA	8.3E−12	NA
Th_{228+7d}	NA	7.8E−08	NA
Th_{230}	NA	2.9E−08	NA
$Th_{232+10d}$	NA	1.1E−07	NA
U_{234}	NA	2.6E−08	NA
U_{235+1d}	NA	2.5E−08	NA
U_{238+2d}	NA	2.4E−08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 5.9E−15

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Table C.III–2
Summary of Intake Quantitation (chemicals) Alternative 2
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Adult)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	2	l/day
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in groundwater		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium–total	1.00E–08	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
arodor–1254	NA	mg/l	NA	NA	mg/l
arodor–1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

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Table C.III–2 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Adult)
Via Drinking Water Ingestion

Compound	HQ Calculation		
	CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	4.00E–04	NA
arsenic	NA	3.00E–04	NA
beryllium	NA	5.00E–03	NA
uranium–total	2.74E–10	3.00E–03	9.13E–08
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	5.00E–05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		9.13E–08

Compound	ILCR Calculation		
	CDI (mg/kg–day)	CSF (mg/kg–day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium–total	2.74E–10	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E–02	NA
aroclor–1254	NA	7.70E+00	NA
aroclor–1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

0243

Table C.III–3
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	1.0E–05	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	1.0E–05	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	1.0E–05	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	4.9E–01	1.6E–11	7.8E–12
U_{235+1d}	4.9E–01	1.6E–11	7.8E–12
U_{238+2d}	4.9E–01	2.0E–11	9.8E–12
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	2.5E–11

000493

Table C.III-4
Summary of Intake Quantitation (chemicals) Alternative 2
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Adult)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv	mg/cm^2-day
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non-carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non-carcinogens (EDn x365)	25550	days
SA	Skin surface area available for contact	23000	cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arsenic	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
beryllium	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
uranium-total	2.50E-15	mg/cm^2-day	NA	NA	mg/cm^2-day
benzo(a)pyrene	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
carbazole	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arodor-1254	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arodor-1260	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
dieldrin	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day			

References

Table C.III–4 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Adult)
Via Dermal Contact while Showering

	HQ Calculation		
Compound	CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	6.00E–05	NA
arsenic	NA	2.85E–04	NA
beryllium	NA	5.00E–03	NA
uranium–total	7.88E–13	1.50E–04	5.25E–09
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	4.50E–05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		5.25E–09

	ILCR Calculation		
Compound	CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium–total	7.88E–13	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E–02	NA
aroclor–1254	NA	1.03E+01	NA
aroclor–1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

Table C.III–5
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Adult)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	NA	pCi/m^3	U_{234}	NA	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	3.4E–09	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	NA	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	NA	2.9E–08	NA
Pu_{238}	NA	3.9E–08	NA
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	1.7E–03	7.7E–12	1.3E–14
Sr_{90+1d}	NA	6.2E–11	NA
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	NA	2.9E–08	NA
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	NA	2.6E–08	NA
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	NA	2.4E–08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
		ILCR Summation =	1.3E–14

000496

Table C.III–6
Summary of Intake Quantitation (chemicals) Alternative 2
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.101	kg/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in meat		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	1.0E–10	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor–1254	NA	mg/kg	NA	NA	mg/kg
arodor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

5860

Table C.III-6 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Meat Products

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.0E-13	3.0E-03	3.5E-11
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		3.5E-11

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.0E-13	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000498

Table C.III–7
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	NA	pCi/kg	U_{234}	1.0E–07	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.0E–07	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	1.0E–07	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	NA	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.9E–04	1.6E–11	3.0E–15
U_{235+1d}	1.9E–04	1.6E–11	3.0E–15
U_{238+2d}	1.9E–04	2.0E–11	3.7E–15
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	9.7E–15

000499

Table C.III–8
Summary of Intake Quantitation (chemicals) Alternative 2
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.4	l/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in animal products		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	3.6E–10	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor–1254	NA	mg/kg	NA	NA	mg/kg
arodor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-8 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Dairy Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.5E-12	3.0E-03	4.9E-10
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		4.9E-10

Compound	ILCR Calculation CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.5E-12	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000501

5860

Table C.III–9
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	NA	pCi/kg	U_{234}	3.6E–07	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	3.6E–07	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	3.6E–07	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	NA	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	2.6E–03	1.6E–11	4.2E–14
U_{235+1d}	2.6E–03	1.6E–11	4.2E–14
U_{238+2d}	2.6E–03	2.0E–11	5.3E–14
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
		ILCR Summation =	1.4E–13

000502

Table C.III–10
Summary of Intake and Risk Quantitation (chemicals) Alternative 2
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.122	kg/day
FI	Fraction ingested from contaminated source	1	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in vegetables		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	4.9E–08	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor–1254	NA	mg/kg	NA	NA	mg/kg
arodor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III–10 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Compound	HQ Calculation CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	4.0E–04	NA
arsenic	NA	3.0E–04	NA
beryllium	NA	5.0E–03	NA
uranium–total	8.2E–11	3.0E–03	2.7E–08
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	5.0E–05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.7E–08

Compound	ILCR Calculation CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium–total	8.2E–11	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E–02	NA
aroclor–1254	NA	7.7E+00	NA
aroclor–1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

Table C.III–11
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	NA	pCi/kg	U_{234}	4.9E–05	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	4.9E–05	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	4.9E–05	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	NA	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.5E–01	1.6E–11	2.3E–12
U_{235+1d}	1.5E–01	1.6E–11	2.3E–12
U_{238+2d}	1.5E–01	2.0E–11	2.9E–12
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	7.6E–12

000505

Table C.III-12
Summary of Intake Quantitation (chemicals) Alternative 2
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Child)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	1	l/day
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non-carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non-carcinogens (EDn x365)	2190	days
CS	Concentration of chemicals in groundwater		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium-total	1.00E-08	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
arodor-1254	NA	mg/l	NA	NA	mg/l
arodor-1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

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Table C.III-12 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Child)
Via Drinking Water Ingestion

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	6.39E-10	3.00E-03	2.13E-07
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.13E-07

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	5.48E-11	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000507

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Table C.III–13
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	1.0E–05	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	1.0E–05	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	1.0E–05	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	2.1E–02	1.6E–11	3.4E–13
U_{235+1d}	2.1E–02	1.6E–11	3.4E–13
U_{238+2d}	2.1E–02	2.0E–11	4.2E–13
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	1.1E–12

000508

Table C.III-14
Summary of Intake Quantitation (chemicals) Alternative 2
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Child)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv	mg/cm^2-day
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non-carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non-carcinogens (EDn x365)	2190	days
SA	Skin surface area available for contact	8000	cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arsenic	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
beryllium	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
uranium-total	2.50E-15	mg/cm^2-day	NA	NA	mg/cm^2-day
benzo(a)pyrene	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
carbazole	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arodor-1254	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arodor-1260	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
dieldrin	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day			

References

Table C.III–14 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Child)
Via Dermal Contact while Bathing

Compound	HQ Calculation CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	6.00E–05	NA
arsenic	NA	2.85E–04	NA
beryllium	NA	5.00E–03	NA
uranium–total	1.28E–12	1.50E–04	8.52E–09
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	4.50E–05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		8.52E–09

Compound	ILCR Calculation CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium–total	1.10E–13	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E–02	NA
aroclor–1254	NA	1.03E+01	NA
aroclor–1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

Table C.III–15
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Child)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	NA	pCi/m^3	U_{234}	NA	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	3.4E–09	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	NA	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	NA	2.9E–08	NA
Pu_{238}	NA	3.9E–08	NA
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	8.6E–05	7.7E–12	6.6E–16
Sr_{90+1d}	NA	6.2E–11	NA
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	NA	2.9E–08	NA
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	NA	2.6E–08	NA
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	NA	2.4E–08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 6.6E–16

000511

Table C.III – 16
Summary of Intake Quantitation (chemicals) Alternative 2
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.039	kg/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x365)	2190	days
CS	Concentration of chemicals in meat		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	1.0E–10	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor–1254	NA	mg/kg	NA	NA	mg/kg
arodor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III-16 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Meat Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.9E-13	3.0E-03	6.2E-11
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		6.2E-11

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.6E-14	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

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Table C.III–17
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	NA	pCi/kg	U_{234}	1.0E−07	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.0E−07	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	1.0E−07	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	NA	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	NA	2.2E−10	NA
Pu_{238}	NA	2.2E−10	NA
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	NA	3.6E−11	NA
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	NA	1.3E−11	NA
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	6.1E−06	1.6E−11	9.8E−17
U_{235+1d}	6.1E−06	1.6E−11	9.8E−17
U_{238+2d}	6.1E−06	2.0E−11	1.2E−16
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 3.2E−16

000514

Table C.III – 18
Summary of Intake Quantitation (chemicals) Alternative 2
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.9	l/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x365)	2190	days
CS	Concentration of chemicals in animal products		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	3.6E–10	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor–1254	NA	mg/kg	NA	NA	mg/kg
arodor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

000515

Table C.III-18 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Dairy Products

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.6E-11	3.0E-03	5.2E-09
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		5.2E-09

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.3E-12	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

0088

Table C.III–19
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	NA	pCi/kg	U_{234}	3.6E−07	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	3.6E−07	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	3.6E−07	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	NA	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	NA	2.2E−10	NA
Pu_{238}	NA	2.2E−10	NA
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	NA	3.6E−11	NA
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	NA	1.3E−11	NA
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	5.1E−04	1.6E−11	8.2E−15
U_{235+1d}	5.1E−04	1.6E−11	8.2E−15
U_{238+2d}	5.1E−04	2.0E−11	1.0E−14
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	2.7E−14

000517

Table C.III–20
Summary of Intake Quantitation (chemicals) Alternative 2
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.1	kg/day
FI	Fraction ingested from contaminated source	1	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x365)	2190	days
CS	Concentration of chemicals in vegetables		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	4.9E–08	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor–1254	NA	mg/kg	NA	NA	mg/kg
arodor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-20 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	3.1E-10	3.0E-03	1.0E-07
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.0E-07

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	2.7E-11	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

5860

Table C.III–21
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	NA	pCi/kg	U_{234}	4.9E–05	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	4.9E–05	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	4.9E–05	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	NA	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.0E–02	1.6E–11	1.6E–13
U_{235+1d}	1.0E–02	1.6E–11	1.6E–13
U_{238+2d}	1.0E–02	2.0E–11	2.1E–13
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	5.3E–13

000520

Table C.III-22
Summary of Intake Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Federal Ownership: Expanded Trespasser
Via Incidental Ingestion of Soil/Sediment

Intake Equation

$$= \frac{CS \times EFa \times EDa \times CF \times IRa}{BWa \times ATa} + \frac{CS \times EFc \times EDc \times CF \times IRc}{BWc \times ATc}$$

IRa	Ingestion rate of soil (adult)	12.5 mg/day
IRc	Ingestion rate of soil (child)	12.5 mg/day
CF	Conversion factor	1.00E-06 kg/mg
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure duration (adult)	32 Year
EDc	Exposure duration (child)	12 Year
BWa	Body weight (adult)	70 kg
BWc	Body weight (child)	43 kg
AT	Average time for carcinogens	25550 days
ATa	Average time for non-carcinogens (adult)	11680 days
ATc	Average time for non-carcinogens (child)	4380 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium-total	1.1E+01	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor-1254	NA	mg/kg	NA	NA	mg/kg
arodor-1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

5860

Table C.III-22 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Expanded Trespasser
Via Incidental Ingestion of Soil/Sediment

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.2E-06	3.0E-03	3.9E-04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		3.9E-04

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	2.6E-07	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000522

0086

Table C.III–23
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Federal Ownership: Expanded Trespasser
Via Incidental Ingestion of Soil/Sediment

Intake Equation = CS X EFa X EDa X FI X IRa + CS X EFc X EDc X FI X IRc

IRa	Ingestion rate of soil (adult)	12.5 mg/day
IRc	Ingestion rate of soil (child)	12.5 mg/day
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure Duration	32 Year
EDc	Exposure Duration	12 Year
FI	Fractional Intake	1 (unitless)
CS	Concentration of radionuclides in soil	(see table below)

Cs_{137+1d}	NA	pCi/mg	$Th_{232+10d}$	NA	pCi/mg
Np_{237+1d}	1.3E−04	pCi/mg	U_{234}	NA	pCi/mg
Pu_{238}	NA	pCi/mg	U_{235+1d}	NA	pCi/mg
Ra_{226+8d}	NA	pCi/mg	U_{238+2d}	NA	pCi/mg
Ra_{228+1d}	NA	pCi/mg	NA	NA	pCi/mg
Rn_{222+4d}	NA	pCi/mg	NA	NA	pCi/mg
Sr_{90+1d}	5.4E−04	pCi/mg	NA	NA	pCi/mg
Tc_{99}	NA	pCi/mg	NA	NA	pCi/mg
Th_{228+7d}	NA	pCi/mg	NA	NA	pCi/mg
Th_{230}	5.2E−04	pCi/mg	NA	NA	pCi/mg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	4.2E+00	2.2E−10	9.3E−10
Pu_{238}	NA	2.2E−10	NA
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	1.8E+01	3.6E−11	6.3E−10
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	1.7E+01	1.3E−11	2.2E−10
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	NA	1.6E−11	NA
U_{235+1d}	NA	1.6E−11	NA
U_{238+2d}	NA	2.0E−11	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.8E−09

000523

Table C.III–24
Summary of Intake Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Federal Ownership: Expanded Trespasser
Via Dermal Contact with Soil/Sediment

Intake Equation = $\frac{CS \times EFa \times EDa \times CF \times ABS \times AF \times SAa}{BWa \times ATa}$ + $\frac{CS \times EFc \times EDc \times CF \times ABS \times AF \times SAc}{BWc \times ATc}$

SA	Surface area of exposed skin (adult)	5750	cm^2/day
SA	Surface area of exposed skin (child)	4200	cm^2/day
AF	Soil to skin adherence factor	1	mg/cm^2
ABS	chemicals specific absorbtion factor (see table below)	csv	
CF	Conversion factor	1E–06	kg/mg
EFa	Exposure frequency (adult)	40	days/year
EFc	Exposure frequency (child)	110	days/year
EDa	Exposure duration (adult)	32	Year
EDc	Exposure duration (child)	12	Year
BWa	Body weight (adult)	70	kg
BWc	Body weight (child)	43	kg
AT	Average time for carcinogens	25550	days
ATa	Average time for non–carcinogens (adult)	11680	days
ATc	Average time for non–carcinogens (child)	4380	days
CS	Concentration of chemicals in soil	(see table below)	

Chemical Concentrations

Compound	ABS	Concentrati	Units	Compound	ABS	Concentrati	Units
antimony	1.0E–02	NA	mg/kg	NA	NA	NA	mg/kg
arsenic	1.0E–03	NA	mg/kg	NA	NA	NA	mg/kg
beryllium	1.0E–02	NA	mg/kg	NA	NA	NA	mg/kg
uranium–total	1.0E–02	1.1E+01	mg/kg	NA	NA	NA	mg/kg
benzo(a)pyrene	3.0E–01	NA	mg/kg	NA	NA	NA	mg/kg
carbazole	3.0E–01	NA	mg/kg	NA	NA	NA	mg/kg
arodor–1254	6.0E–02	NA	mg/kg	NA	NA	NA	mg/kg
arodor–1260	6.0E–02	NA	mg/kg	NA	NA	NA	mg/kg
dieldrin	3.0E–01	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg				

References

000524

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Table C.III-24 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Expanded Trespasser
Via Dermal Contact with Soil/Sediment

Compound	HQ Calculation CDI (mg/kg-day)	HQ Calculation RfD (mg/kg-day)	HQ Calculation HQ (unitless)
antimony	NA	6.0E-05	NA
arsenic	NA	2.9E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	4.2E-06	1.5E-04	2.8E-02
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.5E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.8E-02

Compound	ILCR Calculation CDI (mg/kg-day)	ILCR Calculation CSF $(mg/kg-day)^{-1}$	ILCR Calculation ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.9E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.0E-06	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.2E-02	NA
aroclor-1254	NA	1.0E+01	NA
aroclor-1260	NA	1.0E+01	NA
dieldrin	NA	1.8E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

5860

Table C.III-25
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Federal Ownership: Expanded Trespasser
Via Inhalation of Gases and Particulates

Intake Equation = CA X EFa X EDa X IR X ETa + CA X EFc EDc X IR X ETc

IR	Inhalation rate of gases	0.83 m^3/hour
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure duration	32 Year
EDc	Exposure duration	12 Year
ETa	Exposure time (adult)	1 hour/day
ETc	Exposure time (child)	2 hour/day
CA	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	4.3E-07	pCi/m^3	U_{234}	NA	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	1.8E-06	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	1.7E-06	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E-11	NA
Np_{237+1d}	1.4E-03	2.9E-08	4.1E-11
Pu_{238}	NA	3.9E-08	NA
Ra_{226+8d}	NA	7.0E-09	NA
Ra_{228+1d}	NA	6.9E-10	NA
Rn_{222+4d}	NA	7.7E-12	NA
Sr_{90+1d}	5.9E-03	6.2E-11	3.6E-13
Tc_{99}	NA	8.3E-12	NA
Th_{228+7d}	NA	7.8E-08	NA
Th_{230}	5.6E-03	2.9E-08	1.6E-10
$Th_{232+10d}$	NA	1.1E-07	NA
U_{234}	NA	2.6E-08	NA
U_{235+1d}	NA	2.5E-08	NA
U_{238+2d}	NA	2.4E-08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.0E-10

000526

0086

Table C.III–26
Summary of Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Federal Ownership: Expanded Trespasser
Via External Radiation

Exposure Equation = $[CR \times EFa \times EDa \times ET_{oa} \times (1-SH_o)] + [CR \times EFc \times EDc \times ET_{oc} \times (1-SH_o)]$

EFa	Fraction of year spent exposured (adult)	0.11 (unitless)
EFc	Fraction of year spent exposured (child)	0.3 (unitless)
EDa	Exposure duration (adult)	32 Year
EDc	Exposure duration (child)	12 Year
ET_{oa}	Fraction of day spent outdoors (adult)	0.04 (unitless)
ET_{oc}	Fraction of day spent outdoors (child)	0.08 (unitless)
SH_o	Shield factor outdoors	NA (unitless)
CR	Radionuclide specific concentrations	(see table below)

Cs_{137+1d}	NA	pCi/g	$Th_{232+10d}$	NA	pCi/g
Np_{237+1d}	1.3E−01	pCi/g	U_{234}	NA	pCi/g
Pu_{238}	NA	pCi/g	U_{235+1d}	NA	pCi/g
Ra_{226+8d}	NA	pCi/g	U_{238+2d}	NA	pCi/g
Ra_{228+1d}	NA	pCi/g	NA	NA	pCi/g
Rn_{222+4d}	NA	pCi/g	NA	NA	pCi/g
Sr_{90+1d}	5.4E−01	pCi/g	NA	NA	pCi/g
Tc_{99}	NA	pCi/g	NA	NA	pCi/g
Th_{228+7d}	NA	pCi/g	NA	NA	pCi/g
Th_{230}	5.2E−01	pCi/g	NA	NA	pCi/g

Radionuclides	CDI (year pCi/g)	CSF $(g/pCi-year)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.0E−06	NA
Np_{237+1d}	5.6E−02	4.3E−07	2.4E−08
Pu_{238}	NA	2.8E−11	NA
Ra_{226+8d}	NA	6.0E−06	NA
Ra_{228+1d}	NA	2.9E−06	NA
Rn_{222+4d}	NA	5.9E−06	NA
Sr_{90+1d}	2.3E−01	NA	NA
Tc_{99}	NA	6.0E−13	NA
Th_{228+7d}	NA	5.6E−06	NA
Th_{230}	2.2E−01	5.4E−11	1.2E−11
$Th_{232+10d}$	NA	8.5E−06	NA
U_{234}	NA	3.0E−11	NA
U_{235+1d}	NA	2.4E−07	NA
U_{238+2d}	NA	5.1E−08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.4E−08

000527

Table C.III–27
Summary of Intake Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Adult)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	2	l/day
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in groundwater		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium–total	1.23E–04	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
arodor–1254	NA	mg/l	NA	NA	mg/l
arodor–1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

Table C.III–27 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Adult)
Via Drinking Water Ingestion

Compound	HQ Calculation CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	4.00E–04	NA
arsenic	NA	3.00E–04	NA
beryllium	NA	5.00E–03	NA
uranium–total	3.37E–06	3.00E–03	1.12E–03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	5.00E–05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
HQ Summation =			1.12E–03

Compound	ILCR Calculation CDI (mg/kg–day)	CSF (mg/kg–day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium–total	3.37E–06	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E–02	NA
aroclor–1254	NA	7.70E+00	NA
aroclor–1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
ILCR Summation =			NA

5860

Table C.III–28
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	3.7E−02	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	2.0E−03	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	4.1E−02	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	NA	2.2E−10	NA
Pu_{238}	NA	2.2E−10	NA
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	NA	3.6E−11	NA
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	NA	1.3E−11	NA
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	1.8E+03	1.6E−11	2.9E−08
U_{235+1d}	9.8E+01	1.6E−11	1.6E−09
U_{238+2d}	2.0E+03	2.0E−11	4.0E−08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 7.1E−08

000530

Table C.III-29
Summary of Intake Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Adult)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv	mg/cm^2-day
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non-carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non-carcinogens (EDn x365)	25550	days
SA	Skin surface area available for contact	23000	cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arsenic	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
beryllium	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
uranium-total	3.08E-11	mg/cm^2-day	NA	NA	mg/cm^2-day
benzo(a)pyrene	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
carbazole	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arodor-1254	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arodor-1260	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
dieldrin	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day			

References

000531

Table C.III–29 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Adult)
Via Dermal Contact while Showering

	HQ Calculation		
Compound	CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	6.00E–05	NA
arsenic	NA	2.85E–04	NA
beryllium	NA	5.00E–03	NA
uranium–total	9.69E–09	1.50E–04	6.46E–05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	4.50E–05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
HQ Summation =			6.46E–05

	ILCR Calculation		
Compound	CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium–total	9.69E–09	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E–02	NA
aroclor–1254	NA	1.03E+01	NA
aroclor–1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
ILCR Summation =			NA

.0087

Table C.III–30
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Adult)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	6.2E–09	pCi/m^3	U_{234}	NA	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	2.6E–08	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	2.5E–08	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	3.0E–03	2.9E–08	8.8E–11
Pu_{238}	NA	3.9E–08	NA
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	NA	7.7E–12	NA
Sr_{90+1d}	1.3E–02	6.2E–11	7.8E–13
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	1.2E–02	2.9E–08	3.5E–10
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	NA	2.6E–08	NA
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	NA	2.4E–08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 4.4E–10

000533

Table C.III–31
Summary of Intake Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.101	kg/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in meat		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	1.2E–06	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor–1254	NA	mg/kg	NA	NA	mg/kg
arodor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-31 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Meat Products

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.3E-09	3.0E-03	4.3E-07
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		4.3E-07

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.3E-09	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000535

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Table C.III–32
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	2.6E–08	pCi/kg	U_{234}	3.7E–04	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	2.0E–05	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	4.1E–04	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	2.3E–06	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.3E–08	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	4.9E–05	2.2E–10	1.1E–14
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	4.2E–03	3.6E–11	1.5E–13
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	2.5E–05	1.3E–11	3.2E–16
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	6.9E–01	1.6E–11	1.1E–11
U_{235+1d}	3.7E–02	1.6E–11	5.9E–13
U_{238+2d}	7.6E–01	2.0E–11	1.5E–11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.7E–11

000536

Table C.III–33
Summary of Intake Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.4	l/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in animal products		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	4.5E–06	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor–1254	NA	mg/kg	NA	NA	mg/kg
arodor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

5860

Table C.III–33 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

	HQ Calculation		
Compound	CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	4.0E–04	NA
arsenic	NA	3.0E–04	NA
beryllium	NA	5.0E–03	NA
uranium–total	1.8E–08	3.0E–03	6.1E–06
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	5.0E–05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		6.1E–06

	ILCR Calculation		
Compound	CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium–total	1.8E–08	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E–02	NA
aroclor–1254	NA	7.7E+00	NA
aroclor–1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000538

Table C.III–34
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	2.4E–09	pCi/kg	U_{234}	1.3E–03	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	7.2E–05	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	1.5E–03	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	1.1E–05	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.1E–08	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	1.8E–05	2.2E–10	3.9E–15
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	8.4E–02	3.6E–11	3.0E–12
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	8.2E–05	1.3E–11	1.1E–15
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	9.8E+00	1.6E–11	1.6E–10
U_{235+1d}	5.3E–01	1.6E–11	8.5E–12
U_{238+2d}	1.1E+01	2.0E–11	2.2E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	3.9E–10

000539

Table C.III–35
Summary of Intake and Risk Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.122	kg/day
FI	Fraction ingested from contaminated source	1	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in vegetables		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	6.0E–04	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor–1254	NA	mg/kg	NA	NA	mg/kg
arodor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-35 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.0E-06	3.0E-03	3.4E-04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		3.4E-04

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.0E-06	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000541

5860

Table C.III–36
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	6.2E–06	pCi/kg	U_{234}	1.8E–01	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	9.8E–03	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.0E–01	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	7.4E–05	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	2.7E–05	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	1.8E–02	2.2E–10	4.1E–12
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	2.2E–01	3.6E–11	7.9E–12
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	8.2E–02	1.3E–11	1.1E–12
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	5.4E+02	1.6E–11	8.7E–09
U_{235+1d}	2.9E+01	1.6E–11	4.7E–10
U_{238+2d}	6.0E+02	2.0E–11	1.2E–08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
		ILCR Summation =	2.1E–08

000542

Table C.III-37
Summary of Intake Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Child)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	1	l/day
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non-carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non-carcinogens (EDn x365)	2190	days
CS	Concentration of chemicals in groundwater		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium-total	1.23E-04	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
arodor-1254	NA	mg/l	NA	NA	mg/l
arodor-1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

Table C.III–37 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Child)
Via Drinking Water Ingestion

Compound	HQ Calculation CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	4.00E–04	NA
arsenic	NA	3.00E–04	NA
beryllium	NA	5.00E–03	NA
uranium–total	7.86E–06	3.00E–03	2.62E–03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	5.00E–05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.62E–03

Compound	ILCR Calculation CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium–total	6.74E–07	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E–02	NA
aroclor–1254	NA	7.70E+00	NA
aroclor–1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

0.0R 2

Table C.III–38
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	3.7E–02	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	2.0E–03	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	4.1E–02	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	7.8E+01	1.6E–11	1.2E–09
U_{235+1d}	4.2E+00	1.6E–11	6.7E–11
U_{238+2d}	8.6E+01	2.0E–11	1.7E–09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 3.0E–09

000545

Table C.III–39
Summary of Intake Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Child)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv	mg/cm^2–day
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x365)	2190	days
SA	Skin surface area available for contact	8000	cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
arsenic	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
beryllium	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
uranium–total	3.08E–11	mg/cm^2–day	NA	NA	mg/cm^2–day
benzo(a)pyrene	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
carbazole	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
arodor–1254	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
arodor–1260	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
dieldrin	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day			

References

Table C.III-39
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Child)
Via Dermal Contact while Bathing

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	1.57E-08	1.50E-04	1.05E-04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.05E-04

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg\text{-}day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	1.35E-09	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000547

Table C.III–40
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Child)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	6.2E–09	pCi/m^3	U_{234}	NA	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	2.6E–08	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	2.5E–08	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	1.6E–04	2.9E–08	4.5E–12
Pu_{238}	NA	3.9E–08	NA
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	NA	7.7E–12	NA
Sr_{90+1d}	6.5E–04	6.2E–11	4.0E–14
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	6.2E–04	2.9E–08	1.8E–11
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	NA	2.6E–08	NA
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	NA	2.4E–08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	2.3E–11

000548

Table C.III–41
Summary of Intake Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.039	kg/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x365)	2190	days
CS	Concentration of chemicals in meat		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	1.2E–06	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor–1254	NA	mg/kg	NA	NA	mg/kg
arodor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III-41 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Meat Products

Compound	HQ Calculation		
	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	2.3E-09	3.0E-03	7.7E-07
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		7.7E-07

Compound	ILCR Calculation		
	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	2.0E-10	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

0282.

Table C.III-42
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	2.6E-08	pCi/kg	U_{234}	3.7E-04	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	2.0E-05	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	4.1E-04	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	2.3E-06	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.3E-08	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	1.6E-06	2.2E-10	3.5E-16
Pu_{238}	NA	2.2E-10	NA
Ra_{226+8d}	NA	7.8E-10	NA
Ra_{228+1d}	NA	1.0E-10	NA
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	1.4E-04	3.6E-11	5.0E-15
Tc_{99}	NA	1.3E-12	NA
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	8.2E-07	1.3E-11	1.1E-17
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	2.3E-02	1.6E-11	3.6E-13
U_{235+1d}	1.2E-03	1.6E-11	2.0E-14
U_{238+2d}	2.5E-02	2.0E-11	5.0E-13
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 8.9E-13

Table C.III-43
Summary of Intake Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.9	l/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non-carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non-carcinogens (EDn x365)	2190	days
CS	Concentration of chemicals in animal products		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium-total	4.5E-06	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor-1254	NA	mg/kg	NA	NA	mg/kg
arodor-1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III-43 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Dairy Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.9E-07	3.0E-03	6.4E-05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		6.4E-05

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.6E-08	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000553

Table C.III–44
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	2.4E–09	pCi/kg	U_{234}	1.3E–03	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	7.2E–05	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	1.5E–03	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	1.1E–05	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.1E–08	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	3.4E–06	2.2E–10	7.4E–16
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	1.6E–02	3.6E–11	5.8E–13
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	1.6E–05	1.3E–11	2.1E–16
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.9E+00	1.6E–11	3.0E–11
U_{235+1d}	1.0E–01	1.6E–11	1.6E–12
U_{238+2d}	2.1E+00	2.0E–11	4.2E–11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 7.4E–11

000554

Table C.III–45
Summary of Intake and Risk Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x365)	2190 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	6.0E–04	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor–1254	NA	mg/kg	NA	NA	mg/kg
arodor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III-45 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	3.9E-06	3.0E-03	1.3E-03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.3E-03

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg\text{-}day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	3.3E-07	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

Table C.III–46
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	6.2E–06	pCi/kg	U_{234}	1.8E–01	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	9.8E–03	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.0E–01	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	7.4E–05	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	2.7E–05	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	1.3E–03	2.2E–10	2.8E–13
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	1.5E–02	3.6E–11	5.6E–13
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	5.8E–03	1.3E–11	7.5E–14
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	3.8E+01	1.6E–11	6.1E–10
U_{235+1d}	2.1E+00	1.6E–11	3.3E–11
U_{238+2d}	4.2E+01	2.0E–11	8.4E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.5E–09

000557

5860

Table C.III–47
Summary of Intake Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Private Ownership: Off–Property Farmer (Adult)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	2	l/day
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in groundwater		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium–total	2.30E–07	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
arodor–1254	NA	mg/l	NA	NA	mg/l
arodor–1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

Table C.III–47 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: Off–Property Farmer (Adult)
Via Drinking Water Ingestion

Compound	HQ Calculation CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	4.00E–04	NA
arsenic	NA	3.00E–04	NA
beryllium	NA	5.00E–03	NA
uranium–total	6.30E–09	3.00E–03	2.10E–06
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	5.00E–05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.10E–06

Compound	ILCR Calculation CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium–total	6.30E–09	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E–02	NA
aroclor–1254	NA	7.70E+00	NA
aroclor–1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000559

Table C.III–49
Summary of Intake Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Private Ownership: Off–Property Farmer (Adult)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv	mg/cm²–day
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x365)	25550	days
SA	Skin surface area available for contact	23000	cm²

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm²–day	NA	NA	mg/cm²–day
arsenic	NA	mg/cm²–day	NA	NA	mg/cm²–day
beryllium	NA	mg/cm²–day	NA	NA	mg/cm²–day
uranium–total	5.75E–14	mg/cm²–day	NA	NA	mg/cm²–day
benzo(a)pyrene	NA	mg/cm²–day	NA	NA	mg/cm²–day
carbazole	NA	mg/cm²–day	NA	NA	mg/cm²–day
arodor–1254	NA	mg/cm²–day	NA	NA	mg/cm²–day
arodor–1260	NA	mg/cm²–day	NA	NA	mg/cm²–day
dieldrin	NA	mg/cm²–day	NA	NA	mg/cm²–day
NA	NA	mg/cm²–day	NA	NA	mg/cm²–day
NA	NA	mg/cm²–day	NA	NA	mg/cm²–day
NA	NA	mg/cm²–day	NA	NA	mg/cm²–day
NA	NA	mg/cm²–day	NA	NA	mg/cm²–day
NA	NA	mg/cm²–day	NA	NA	mg/cm²–day
NA	NA	mg/cm²–day	NA	NA	mg/cm²–day
NA	NA	mg/cm²–day	NA	NA	mg/cm²–day

References

195000

Table C.III–48
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	7.1E–05	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	3.7E–06	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	7.8E–05	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	3.5E+00	1.6E–11	5.6E–11
U_{235+1d}	1.8E–01	1.6E–11	2.9E–12
U_{238+2d}	3.8E+00	2.0E–11	7.6E–11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.4E–10

080

5860

Table C.III-49 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: Off-Property Farmer (Adult)
Via Dermal Contact while Bathing

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	1.81E-11	1.50E-04	1.21E-07
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.21E-07

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	1.81E-11	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000562

Table C.III–50
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Private Ownership: Off–Property Farmer (Adult)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	3.2E–09	pCi/m^3	U_{234}	NA	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	3.5E–09	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	3.3E–07	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	1.6E–03	2.9E–08	4.5E–11
Pu_{238}	NA	3.9E–08	NA
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	NA	7.7E–12	NA
Sr_{90+1d}	1.7E–03	6.2E–11	1.1E–13
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	1.6E–01	2.9E–08	4.6E–09
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	NA	2.6E–08	NA
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	NA	2.4E–08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 4.7E–09

000563

Table C.III–51
Summary of Intake Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.101	kg/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in meat		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	2.3E–09	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor–1254	NA	mg/kg	NA	NA	mg/kg
arodor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-51 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: Off-Property Farmer (Adult)
Via Ingestion of Meat Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	2.4E-12	3.0E-03	8.0E-10
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		8.0E-10

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg\text{-}day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	2.4E-12	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000565

5860

Table C.III–52
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	1.4E–08	pCi/kg	U_{234}	7.1E–07	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	3.7E–08	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	7.8E–07	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	3.1E–07	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.8E–07	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	2.5E–05	2.2E–10	5.5E–15
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	5.7E–04	3.6E–11	2.1E–14
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	3.3E–04	1.3E–11	4.2E–15
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.3E–03	1.6E–11	2.1E–14
U_{235+1d}	6.9E–05	1.6E–11	1.1E–15
U_{238+2d}	1.4E–03	2.0E–11	2.9E–14
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 8.2E–14

000566

Table C.III – 53
Summary of Intake Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.4	l/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in animal products		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	8.3E–09	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor–1254	NA	mg/kg	NA	NA	mg/kg
arodor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

000567

5860

Table C.III–53 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

Compound	HQ Calculation CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	4.0E–04	NA
arsenic	NA	3.0E–04	NA
beryllium	NA	5.0E–03	NA
uranium–total	3.4E–11	3.0E–03	1.1E–08
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	5.0E–05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.1E–08

Compound	ILCR Calculation CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium–total	3.4E–11	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E–02	NA
aroclor–1254	NA	7.7E+00	NA
aroclor–1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000568

Table C.III–54
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	1.2E–09	pCi/kg	U_{234}	2.6E–06	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.3E–07	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.8E–06	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	1.5E–06	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.5E–07	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	9.0E–06	2.2E–10	2.0E–15
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	1.1E–02	3.6E–11	4.1E–13
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	1.1E–03	1.3E–11	1.4E–14
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.9E–02	1.6E–11	3.0E–13
U_{235+1d}	9.8E–04	1.6E–11	1.6E–14
U_{238+2d}	2.1E–02	2.0E–11	4.1E–13
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
		ILCR Summation =	1.2E–12

000569

Table C.III-55
Summary of Intake and Risk Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Private Ownership: Off-Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.122	kg/day
FI	Fraction ingested from contaminated source	1	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non-carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non-carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in vegetables		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium-total	1.1E-06	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor-1254	NA	mg/kg	NA	NA	mg/kg
arodor-1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

0086

Table C.III-55 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: Off-Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.9E-09	3.0E-03	6.3E-07
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		6.3E-07

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.9E-09	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000571

5860

Table C.III-56
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Private Ownership: Off-Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	3.2E-06	pCi/kg	U_{234}	3.5E-04	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.8E-05	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	3.8E-04	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	1.0E-05	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	3.6E-04	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	9.5E-03	2.2E-10	2.1E-12
Pu_{238}	NA	2.2E-10	NA
Ra_{226+8d}	NA	7.8E-10	NA
Ra_{228+1d}	NA	1.0E-10	NA
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	3.0E-02	3.6E-11	1.1E-12
Tc_{99}	NA	1.3E-12	NA
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	1.1E+00	1.3E-11	1.4E-11
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	1.0E+00	1.6E-11	1.7E-11
U_{235+1d}	5.4E-02	1.6E-11	8.7E-13
U_{238+2d}	1.1E+00	2.0E-11	2.3E-11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	5.7E-11

000572

Table C.III–57
Summary of Intake Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Private Ownership: Off–Property Farmer (Child)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	1	l/day
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x365)	2190	days
CS	Concentration of chemicals in groundwater		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium–total	2.30E–07	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
arodor–1254	NA	mg/l	NA	NA	mg/l
arodor–1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

Table C.III–57 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: Off–Property Farmer (Child)
Via Drinking Water Ingestion

Compound	HQ Calculation CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	4.00E–04	NA
arsenic	NA	3.00E–04	NA
beryllium	NA	5.00E–03	NA
uranium–total	1.47E–08	3.00E–03	4.90E–06
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	5.00E–05	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
HQ Summation =			4.90E–06

Compound	ILCR Calculation CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium–total	1.26E–09	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E–02	NA
aroclor–1254	NA	7.70E+00	NA
aroclor–1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
ILCR Summation =			NA

Table C.III-58
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	7.1E-05	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	3.7E-06	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	7.8E-05	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	NA	2.2E-10	NA
Pu_{238}	NA	2.2E-10	NA
Ra_{226+8d}	NA	7.8E-10	NA
Ra_{228+1d}	NA	1.0E-10	NA
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	NA	3.6E-11	NA
Tc_{99}	NA	1.3E-12	NA
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	NA	1.3E-11	NA
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	1.5E-01	1.6E-11	2.4E-12
U_{235+1d}	7.8E-03	1.6E-11	1.2E-13
U_{238+2d}	1.6E-01	2.0E-11	3.3E-12
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 5.8E-12

000575

Table C.III-59
Summary of Intake Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Private Ownership: Off-Property Farmer (Child)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv	mg/cm^2-day
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non-carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non-carcinogens (EDn x365)	2190	days
SA	Skin surface area available for contact	8000	cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arsenic	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
beryllium	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
uranium-total	5.75E-14	mg/cm^2-day	NA	NA	mg/cm^2-day
benzo(a)pyrene	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
carbazole	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arodor-1254	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arodor-1260	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
dieldrin	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day			

References

Table C.III-59 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: Off-Property Farmer (Child)
Via Dermal Contact while Bathing

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	2.94E-11	1.50E-04	1.96E-07
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.96E-07

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	2.52E-12	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000577

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Table C.III–60
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Private Ownership: Off–Property Farmer (Child)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	3.2E–09	pCi/m^3	U_{234}	NA	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	3.5E–09	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	3.3E–07	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	8.0E–05	2.9E–08	2.3E–12
Pu_{238}	NA	3.9E–08	NA
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	NA	7.7E–12	NA
Sr_{90+1d}	8.8E–05	6.2E–11	5.5E–15
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	8.2E–03	2.9E–08	2.4E–10
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	NA	2.6E–08	NA
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	NA	2.4E–08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	2.4E–10

000578

Table C.III–61
Summary of Intake Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.039	kg/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x365)	2190	days
CS	Concentration of chemicals in meat		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	2.3E–09	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor–1254	NA	mg/kg	NA	NA	mg/kg
arodor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

000579

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Table C.III-61 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Meat Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	4.3E-12	3.0E-03	1.4E-09
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.4E-09

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	3.7E-13	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000580

Table C.III–62
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	1.4E–08	pCi/kg	U_{234}	7.1E–07	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	3.7E–08	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	7.8E–07	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	3.1E–07	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.8E–07	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	8.3E–07	2.2E–10	1.8E–16
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	1.9E–05	3.6E–11	6.8E–16
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	1.1E–05	1.3E–11	1.4E–16
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	4.4E–05	1.6E–11	7.0E–16
U_{235+1d}	2.3E–06	1.6E–11	3.6E–17
U_{238+2d}	4.8E–05	2.0E–11	9.6E–16
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.7E–15

000581

Table C.III-63
Summary of Intake Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.9	l/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non-carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non-carcinogens (EDn x365)	2190	days
CS	Concentration of chemicals in animal products		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium-total	8.3E-09	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor-1254	NA	mg/kg	NA	NA	mg/kg
arodor-1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III-63 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Dairy Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	3.6E-10	3.0E-03	1.2E-07
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.2E-07

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	3.1E-11	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000583

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Table C.III–64
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	1.2E–09	pCi/kg	U_{234}	2.6E–06	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.3E–07	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.8E–06	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	1.5E–06	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.5E–07	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	1.7E–06	2.2E–10	3.8E–16
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	2.2E–03	3.6E–11	7.9E–14
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	2.1E–04	1.3E–11	2.7E–15
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	3.6E–03	1.6E–11	5.8E–14
U_{235+1d}	1.9E–04	1.6E–11	3.0E–15
U_{238+2d}	4.0E–03	2.0E–11	8.0E–14
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.2E–13

000584

Table C.III–65
Summary of Intake and Risk Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x365)	2190 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	1.1E–06	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor–1254	NA	mg/kg	NA	NA	mg/kg
arodor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III-65 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	7.2E-09	3.0E-03	2.4E-06
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.4E-06

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg\text{-}day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	6.2E-10	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000586

Table C.III–66
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	3.2E–06	pCi/kg	U_{234}	3.5E–04	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.8E–05	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	3.8E–04	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	1.0E–05	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	3.6E–04	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	6.7E–04	2.2E–10	1.5E–13
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	2.1E–03	3.6E–11	7.6E–14
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	7.5E–02	1.3E–11	9.8E–13
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	7.3E–02	1.6E–11	1.2E–12
U_{235+1d}	3.8E–03	1.6E–11	6.1E–14
U_{238+2d}	8.0E–02	2.0E–11	1.6E–12
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	4.0E–12

000587

Table C.III-67
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Private Ownership: On-Property Perched Groundwater User
Via Incidental Ingestion of Soil

Intake Equation = CS X EF X EDn X FI X IR

IRs	Ingestion rate of soil (RAGS, 1989)	180 mg/day
EF	Exposure frequency	350 days/year
EDn	Exposure Duration	70 Year
FI	Fractional Intake	1 (unitless)
CS	Concentration of radionuclides in soil	

Cs_{137+1d}	NA	pCi/mg	$Th_{232+10d}$	NA	pCi/mg
Np_{237+1d}	5.10E-06	pCi/mg	U_{234}	2.20E-04	pCi/mg
Pu_{238}	NA	pCi/mg	U_{235+1d}	9.00E-05	pCi/mg
Ra_{226+8d}	NA	pCi/mg	U_{238+2d}	NA	pCi/mg
Ra_{228+1d}	NA	pCi/mg	NA	NA	pCi/mg
Rn_{222+4d}	NA	pCi/mg	NA	NA	pCi/mg
Sr_{90+1d}	5.60E-06	pCi/mg	NA	NA	pCi/mg
Tc_{99}	NA	pCi/mg	NA	NA	pCi/mg
Th_{228+7d}	NA	pCi/mg	NA	NA	pCi/mg
Th_{230}	5.20E-04	pCi/mg	NA	NA	pCi/mg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.80E-11	NA
Np_{237+1d}	2.25E+01	2.20E-10	4.95E-09
Pu_{238}	NA	2.20E-10	NA
Ra_{226+8d}	NA	7.80E-10	NA
Ra_{228+1d}	NA	1.00E-10	NA
Rn_{222+4d}	NA	1.70E-12	NA
Sr_{90+1d}	2.47E+01	3.60E-11	8.89E-10
Tc_{99}	NA	1.30E-12	NA
Th_{228+7d}	NA	5.50E-11	NA
Th_{230}	2.29E+03	1.30E-11	2.98E-08
$Th_{232+10d}$	NA	1.70E-10	NA
U_{234}	9.70E+02	1.60E-11	1.55E-08
U_{235+1d}	3.97E+02	1.60E-11	6.35E-09
U_{238+2d}	NA	2.00E-11	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 5.75E-08

0086

Table C.III–68
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Private Ownership: On–Property Perched Groundwater User
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	9.3E−05	pCi/l	U_{234}	6.4E−01	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	3.4E−02	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	7.0E−01	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	5.6E−04	pCi/l	NA	NA	pCi/l
Tc_{99}	1.6E−02	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	4.6E+00	2.2E−10	1.0E−09
Pu_{238}	NA	2.2E−10	NA
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	2.7E+01	3.6E−11	9.9E−10
Tc_{99}	7.8E+02	1.3E−12	1.0E−09
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	NA	1.3E−11	NA
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	3.1E+04	1.6E−11	5.0E−07
U_{235+1d}	1.7E+03	1.6E−11	2.7E−08
U_{238+2d}	3.4E+04	2.0E−11	6.9E−07
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.2E−06

000589

Table C.III–69
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Private Ownership: On–Property Perched Groundwater User
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	2.2E–07	pCi/m^3	U_{234}	NA	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	2.5E–07	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	2.3E–05	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	1.1E–01	2.9E–08	3.2E–09
Pu_{238}	NA	3.9E–08	NA
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	NA	7.7E–12	NA
Sr_{90+1d}	1.2E–01	6.2E–11	7.4E–12
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	1.1E+01	2.9E–08	3.2E–07
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	NA	2.6E–08	NA
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	NA	2.4E–08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	3.3E–07

000590

Table C.III – 70
Summary of Intake Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Private Ownership: On – Property Perched Groundwater User
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.101	kg/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non – carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non – carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in meat		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium – total	6.0E – 08	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor – 1254	NA	mg/kg	NA	NA	mg/kg
arodor – 1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

000591

Table C.III–70 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: On–Property Perched Groundwater User
Via Ingestion of Meat Products

Compound	HQ Calculation CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	4.0E–04	NA
arsenic	NA	3.0E–04	NA
beryllium	NA	5.0E–03	NA
uranium–total	6.2E–11	3.0E–03	2.1E–08
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	5.0E–05	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
HQ Summation =			2.1E–08

Compound	ILCR Calculation CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium–total	6.2E–11	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E–02	NA
aroclor–1254	NA	7.7E+00	NA
aroclor–1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
ILCR Summation =			NA

0286

Table C.III–71
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Private Ownership: On–Property Perched Groundwater User
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	2.8E–04	pCi/kg	U_{234}	4.1E–02	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.7E–02	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.0E–05	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	2.1E–01	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.7E–03	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	5.2E–01	2.2E–10	1.1E–10
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	3.9E+02	3.6E–11	1.4E–08
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	3.2E+00	1.3E–11	4.1E–11
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	7.6E+01	1.6E–11	1.2E–09
U_{235+1d}	3.1E+01	1.6E–11	4.9E–10
U_{238+2d}	3.7E–02	2.0E–11	7.4E–13
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.6E–08

000593

Table C.III – 72
Summary of Intake Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Private Ownership: On – Property Perched Groundwater User
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.4	l/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non – carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non – carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in animal products		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium – total	2.2E –07	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor – 1254	NA	mg/kg	NA	NA	mg/kg
arodor – 1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-72 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: On-Property Perched Groundwater User
Via Ingestion of Dairy Products

Compound	HQ Calculation: CDI (mg/kg-day)	HQ Calculation: RfD (mg/kg-day)	HQ Calculation: HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	8.9E-10	3.0E-03	3.0E-07
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		3.0E-07

Compound	ILCR Calculation: CDI (mg/kg-day)	ILCR Calculation: CSF $(mg/kg-day)^{-1}$	ILCR Calculation: ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	8.9E-10	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

5860

Table C.III–73
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Private Ownership: On–Property Perched Groundwater User
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	2.6E–05	pCi/kg	U_{234}	1.2E–01	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	5.0E–02	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	7.2E–05	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	1.1E+00	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.4E–03	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	1.9E–01	2.2E–10	4.1E–11
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	7.7E+03	3.6E–11	2.8E–07
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	1.0E+01	1.3E–11	1.4E–10
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	9.0E+02	1.6E–11	1.4E–08
U_{235+1d}	3.7E+02	1.6E–11	5.9E–09
U_{238+2d}	5.3E–01	2.0E–11	1.1E–11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		3.0E–07

000596

Table C.III – 74
Summary of Intake and Risk Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Private Ownership: On – Property Perched Groundwater User
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.122	kg/day
FI	Fraction ingested from contaminated source	1	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non – carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non – carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in vegetables		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium – total	2.9E – 05	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor – 1254	NA	mg/kg	NA	NA	mg/kg
arodor – 1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

000597

5860

Table C.III-74 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: On-Property Perched Groundwater User
Via Ingestion of Vegetables and Fruits

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	4.9E-08	3.0E-03	1.6E-05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.6E-05

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	4.9E-08	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000598

048 3

Table C.III–75
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Private Ownership: On–Property Perched Groundwater User
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	5.1E–02	pCi/kg	U_{234}	1.9E+00	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	7.7E–01	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	9.8E–03	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	1.4E+01	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	4.7E–01	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	1.5E+02	2.2E–10	3.4E–08
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	4.2E+04	3.6E–11	1.5E–06
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	1.4E+03	1.3E–11	1.8E–08
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	5.6E+03	1.6E–11	9.0E–08
U_{235+1d}	2.3E+03	1.6E–11	3.7E–08
U_{238+2d}	2.9E+01	2.0E–11	5.9E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	1.7E–06

000599

5860

Table C.III-76
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Private Ownership: On-Property Perched Groundwater User
Via External Radiation

Dose Equivalency Equat: = $[DR \times EF \times EDn \times ET_i \times (1-SH_i)] + [DR \times EF \times EDn \times ET_o \times (1-SH_o)]$

EF	Fraction of year spent exposured	0.96 (unitless)
ED	Exposure duration	70 Year
ET_i	Fraction of day spent indoors	0.76 (unitless)
ET_o	Fraction of day spent outdoors	0.24 (unitless)
SH_i	Shield factor indoors	0.5 (unitless)
SH_o	Shield factor outdoors	NA (unitless)
DR	Radionuclide specific dose concentrations	(see table below)

Cs_{137+1d}	NA	pCi/g	$Th_{232+10d}$	NA	pCi/g
Np_{237+1d}	5.10E-03	pCi/g	U_{234}	2.20E-01	pCi/g
Pu_{238}	NA	pCi/g	U_{235+1d}	9.00E-02	pCi/g
Ra_{226+8d}	NA	pCi/g	U_{238+2d}	NA	pCi/g
Ra_{228+1d}	NA	pCi/g	NA	NA	pCi/g
Rn_{222+4d}	NA	pCi/g	NA	NA	pCi/g
Sr_{90+1d}	5.60E-03	pCi/g	NA	NA	pCi/g
Tc_{99}	NA	pCi/g	NA	NA	pCi/g
Th_{228+7d}	NA	pCi/g	NA	NA	pCi/g
Th_{230}	5.20E-01	pCi/g	NA	NA	pCi/g

Radionuclides	CDI (year pCi/g)	CSF $(g/pCi-year)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.0E-06	NA
Np_{237+1d}	2.1E-01	4.3E-07	9.1E-08
Pu_{238}	NA	2.8E-11	NA
Ra_{226+8d}	NA	6.0E-06	NA
Ra_{228+1d}	NA	2.9E-06	NA
Rn_{222+4d}	NA	5.9E-06	NA
Sr_{90+1d}	2.3E-01	NA	NA
Tc_{99}	NA	6.0E-13	NA
Th_{228+7d}	NA	5.6E-06	NA
Th_{230}	2.2E+01	5.4E-11	1.2E-09
$Th_{232+10d}$	NA	8.5E-06	NA
U_{234}	9.2E+00	3.0E-11	2.7E-10
U_{235+1d}	3.7E+00	2.4E-07	9.0E-07
U_{238+2d}	NA	5.1E-08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	9.9E-07

000600

Table C.III–77
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Incidental Ingestion of Soil

Intake Equation = CS X EF X EDn X FI X IR

IRs	Ingestion rate of soil (RAGS, 1989)	180 mg/day
EF	Exposure frequency	350 days/year
EDn	Exposure Duration	70 Year
FI	Fractional Intake	1 (unitless)
CS	Concentration of radionuclides in soil	

Cs_{137+1d}	NA	pCi/mg	$Th_{232+10d}$	NA	pCi/mg
Np_{237+1d}	5.10E–06	pCi/mg	U_{234}	2.20E–04	pCi/mg
Pu_{238}	NA	pCi/mg	U_{235+1d}	9.00E–05	pCi/mg
Ra_{226+8d}	NA	pCi/mg	U_{238+2d}	NA	pCi/mg
Ra_{228+1d}	NA	pCi/mg	NA	NA	pCi/mg
Rn_{222+4d}	NA	pCi/mg	NA	NA	pCi/mg
Sr_{90+1d}	5.60E–06	pCi/mg	NA	NA	pCi/mg
Tc_{99}	NA	pCi/mg	NA	NA	pCi/mg
Th_{228+7d}	NA	pCi/mg	NA	NA	pCi/mg
Th_{230}	5.20E–04	pCi/mg	NA	NA	pCi/mg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.80E–11	NA
Np_{237+1d}	2.25E+01	2.20E–10	4.95E–09
Pu_{238}	NA	2.20E–10	NA
Ra_{226+8d}	NA	7.80E–10	NA
Ra_{228+1d}	NA	1.00E–10	NA
Rn_{222+4d}	NA	1.70E–12	NA
Sr_{90+1d}	2.47E+01	3.60E–11	8.89E–10
Tc_{99}	NA	1.30E–12	NA
Th_{228+7d}	NA	5.50E–11	NA
Th_{230}	2.29E+03	1.30E–11	2.98E–08
$Th_{232+10d}$	NA	1.70E–10	NA
U_{234}	9.70E+02	1.60E–11	1.55E–08
U_{235+1d}	3.97E+02	1.60E–11	6.35E–09
U_{238+2d}	NA	2.00E–11	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 5.75E–08

000601

Table C.III-78
Summary of Intake Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	2	l/day
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non-carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non-carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in groundwater		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium-total	6.00E-06	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
arodor-1254	NA	mg/l	NA	NA	mg/l
arodor-1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l

References

006602

5860

0386

Table C.III-78 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Drinking Water Ingestion

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	1.64E-07	3.00E-03	5.48E-05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		5.48E-05

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	1.64E-07	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000603

Table C.III–79
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	1.9E–03	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	1.0E–04	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	2.0E–03	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	9.3E+01	1.6E–11	1.5E–09
U_{235+1d}	4.9E+00	1.6E–11	7.8E–11
U_{238+2d}	9.8E+01	2.0E–11	2.0E–09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 3.5E–09

000604

Table C.III-80
Summary of Intake Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv	mg/cm^2-day
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non-carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non-carcinogens (EDn x365)	25550	days
SA	Skin surface area available for contact	23000	cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arsenic	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
beryllium	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
uranium-total	1.50E-12	mg/cm^2-day	NA	NA	mg/cm^2-day
benzo(a)pyrene	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
carbazole	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arodor-1254	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arodor-1260	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
dieldrin	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day			

References

000605

Table C.III-80 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Dermal Contact while Bathing

Compound	HQ Calculation		
	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	4.73E-10	1.50E-04	3.15E-06
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	HQ Summation =		3.15E-06

Compound	ILCR Calculation		
	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	4.73E-10	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	ILCR Summation =		NA

Table C.III–81
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	2.2E–07	pCi/m^3	U_{234}	NA	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	2.5E–07	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	2.3E–05	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	1.1E–01	2.9E–08	3.2E–09
Pu_{238}	NA	3.9E–08	NA
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	NA	7.7E–12	NA
Sr_{90+1d}	1.2E–01	6.2E–11	7.4E–12
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	1.1E+01	2.9E–08	3.2E–07
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	NA	2.6E–08	NA
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	NA	2.4E–08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 3.3E–07

000607

Table C.III-82
Summary of Intake Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.101	kg/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non-carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non-carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in meat		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium-total	6.0E-08	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor-1254	NA	mg/kg	NA	NA	mg/kg
arodor-1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-82 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Ingestion of Meat Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	6.2E-11	3.0E-03	2.1E-08
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.1E-08

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	6.2E-11	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000609

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Table C.III-83
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	2.8E-04	pCi/kg	U_{234}	4.1E-02	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.7E-02	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.0E-05	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	2.1E-01	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.7E-03	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	5.2E-01	2.2E-10	1.1E-10
Pu_{238}	NA	2.2E-10	NA
Ra_{226+8d}	NA	7.8E-10	NA
Ra_{228+1d}	NA	1.0E-10	NA
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	3.9E+02	3.6E-11	1.4E-08
Tc_{99}	NA	1.3E-12	NA
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	3.2E+00	1.3E-11	4.1E-11
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	7.6E+01	1.6E-11	1.2E-09
U_{235+1d}	3.1E+01	1.6E-11	4.9E-10
U_{238+2d}	3.7E-02	2.0E-11	7.4E-13
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		1.6E-08

000610

Table C.III–84
Summary of Intake Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.4	l/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in animal products		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	2.2E–07	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor–1254	NA	mg/kg	NA	NA	mg/kg
arodor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III-84 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Ingestion of Dairy Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	8.9E-10	3.0E-03	3.0E-07
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		3.0E-07

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	8.9E-10	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000612

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Table C.III-85
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	2.6E-05	pCi/kg	U_{234}	1.2E-01	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	5.0E-02	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	7.2E-05	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	1.1E+00	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.4E-03	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	1.9E-01	2.2E-10	4.1E-11
Pu_{238}	NA	2.2E-10	NA
Ra_{226+8d}	NA	7.8E-10	NA
Ra_{228+1d}	NA	1.0E-10	NA
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	7.7E+03	3.6E-11	2.8E-07
Tc_{99}	NA	1.3E-12	NA
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	1.0E+01	1.3E-11	1.4E-10
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	9.0E+02	1.6E-11	1.4E-08
U_{235+1d}	3.7E+02	1.6E-11	5.9E-09
U_{238+2d}	5.3E-01	2.0E-11	1.1E-11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 3.0E-07

000613

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Table C.III-86
Summary of Intake and Risk Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x365)	25550 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium-total	2.9E-05	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor-1254	NA	mg/kg	NA	NA	mg/kg
arodor-1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

FEMP-OU02-5 DRAFT
August 24, 1994

000614

Table C.III-86 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Ingestion of Vegetables and Fruits

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	4.9E-08	3.0E-03	1.6E-05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.6E-05

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	4.9E-08	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

5860

Table C.III-87
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	5.1E-02	pCi/kg	U_{234}	1.9E+00	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	7.7E-01	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	9.8E-03	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	1.4E+01	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	4.7E-01	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	1.5E+02	2.2E-10	3.4E-08
Pu_{238}	NA	2.2E-10	NA
Ra_{226+8d}	NA	7.8E-10	NA
Ra_{228+1d}	NA	1.0E-10	NA
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	4.2E+04	3.6E-11	1.5E-06
Tc_{99}	NA	1.3E-12	NA
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	1.4E+03	1.3E-11	1.8E-08
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	5.6E+03	1.6E-11	9.0E-08
U_{235+1d}	2.3E+03	1.6E-11	3.7E-08
U_{238+2d}	2.9E+01	2.0E-11	5.9E-10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.7E-06

Table C.III–88
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via External Radiation

Dose Equivalency Equat: = $[DR \times EF \times EDn \times ET_i \times (1-SH_i)] + [DR \times EF \times EDn \times ET_o \times (1-SH_o)]$

EF	Fraction of year spent exposured	0.96 (unitless)
ED	Exposure duration	70 Year
ET_i	Fraction of day spent indoors	0.76 (unitless)
ET_o	Fraction of day spent outdoors	0.24 (unitless)
SH_i	Shield factor indoors	0.5 (unitless)
SH_o	Shield factor outdoors	NA (unitless)
DR	Radionuclide specific dose concentrations	(see table below)

Cs_{137+1d}	NA	pCi/g	$Th_{232+10d}$	NA	pCi/g
Np_{237+1d}	5.10E–03	pCi/g	U_{234}	2.20E–01	pCi/g
Pu_{238}	NA	pCi/g	U_{235+1d}	9.00E–02	pCi/g
Ra_{226+8d}	NA	pCi/g	U_{238+2d}	NA	pCi/g
Ra_{228+1d}	NA	pCi/g	NA	NA	pCi/g
Rn_{222+4d}	NA	pCi/g	NA	NA	pCi/g
Sr_{90+1d}	5.60E–03	pCi/g	NA	NA	pCi/g
Tc_{99}	NA	pCi/g	NA	NA	pCi/g
Th_{228+7d}	NA	pCi/g	NA	NA	pCi/g
Th_{230}	5.20E–01	pCi/g	NA	NA	pCi/g

Radionuclides	CDI (year pCi/g)	CSF $(g/pCi-year)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.0E–06	NA
Np_{237+1d}	2.1E–01	4.3E–07	9.1E–08
Pu_{238}	NA	2.8E–11	NA
Ra_{226+8d}	NA	6.0E–06	NA
Ra_{228+1d}	NA	2.9E–06	NA
Rn_{222+4d}	NA	5.9E–06	NA
Sr_{90+1d}	2.3E–01	NA	NA
Tc_{99}	NA	6.0E–13	NA
Th_{228+7d}	NA	5.6E–06	NA
Th_{230}	2.2E+01	5.4E–11	1.2E–09
$Th_{232+10d}$	NA	8.5E–06	NA
U_{234}	9.2E+00	3.0E–11	2.7E–10
U_{235+1d}	3.7E+00	2.4E–07	9.0E–07
U_{238+2d}	NA	5.1E–08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 9.9E–07

000617

Table C.III–89
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Private Ownership: On–Property Farmer (Child)
Via Incidental Ingestion of Soil

Intake Equation = CS X EF X EDn X FI X IR

IRs	Ingestion rate of soil (RAGS, 1989)	200 mg/day
EF	Exposure frequency	350 days/year
EDn	Exposure Duration	6 Year
FI	Fractional Intake	1 (unitless)
CS	Concentration of radionuclides in soil	

Cs_{137+1d}	0.00E+00	pCi/mg	$Th_{232+10d}$	0.00E+00	pCi/mg
Np_{237+1d}	5.10E−06	pCi/mg	U_{234}	2.20E−04	pCi/mg
Pu_{238}	0.00E+00	pCi/mg	U_{235+1d}	9.00E−05	pCi/mg
Ra_{226+8d}	0.00E+00	pCi/mg	U_{238+2d}	0.00E+00	pCi/mg
Ra_{228+1d}	0.00E+00	pCi/mg	0	0.00E+00	pCi/mg
Rn_{222+4d}	0.00E+00	pCi/mg	0	0.00E+00	pCi/mg
Sr_{90+1d}	5.60E−06	pCi/mg	0	0.00E+00	pCi/mg
Tc_{99}	0.00E+00	pCi/mg	0	0.00E+00	pCi/mg
Th_{228+7d}	0.00E+00	pCi/mg	0	0.00E+00	pCi/mg
Th_{230}	5.20E−04	pCi/mg	0	0.00E+00	pCi/mg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.80E−11	NA
Np_{237+1d}	2.14E+00	2.20E−10	4.71E−10
Pu_{238}	NA	2.20E−10	NA
Ra_{226+8d}	NA	7.80E−10	NA
Ra_{228+1d}	NA	1.00E−10	NA
Rn_{222+4d}	NA	1.70E−12	NA
Sr_{90+1d}	2.35E+00	3.60E−11	8.47E−11
Tc_{99}	NA	1.30E−12	NA
Th_{228+7d}	NA	5.50E−11	NA
Th_{230}	2.18E+02	1.30E−11	2.84E−09
$Th_{232+10d}$	NA	1.70E−10	NA
U_{234}	9.24E+01	1.60E−11	1.48E−09
U_{235+1d}	3.78E+01	1.60E−11	6.05E−10
U_{238+2d}	NA	2.00E−11	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA

ILCR Summation = 5.48E−09

Table C.III-90
Summary of Intake Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Private Ownership: On-Property Farmer (Child)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	1	l/day
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non-carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non-carcinogens (EDn x365)	2190	days
CS	Concentration of chemicals in groundwater		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	0.00E+00	mg/l	0	0.00E+00	mg/l
arsenic	0.00E+00	mg/l	0	0.00E+00	mg/l
beryllium	0.00E+00	mg/l	0	0.00E+00	mg/l
uranium-total	6.00E-06	mg/l	0	0.00E+00	mg/l
benzo(a)pyrene	0.00E+00	mg/l	0	0.00E+00	mg/l
carbazole	0.00E+00	mg/l	0	0.00E+00	mg/l
arodor-1254	0.00E+00	mg/l	0	0.00E+00	mg/l
arodor-1260	0.00E+00	mg/l	0	0.00E+00	mg/l
dieldrin	0.00E+00	mg/l	0	0.00E+00	mg/l
0	0.00E+00	mg/l	0	0.00E+00	mg/l
0	0.00E+00	mg/l	0	0.00E+00	mg/l
0	0.00E+00	mg/l	0	0.00E+00	mg/l
0	0.00E+00	mg/l	0	0.00E+00	mg/l
0	0.00E+00	mg/l	0	0.00E+00	mg/l
0	0.00E+00	mg/l	0	0.00E+00	mg/l
0	0.00E+00	mg/l	0	0.00E+00	mg/l
0	0.00E+00	mg/l			

References

Table C.III-90 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: On-Property Farmer (Child)
Via Drinking Water Ingestion

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	3.84E-07	3.00E-03	1.28E-04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
	HQ Summation =		1.28E-04

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	3.29E-08	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
	ILCR Summation =		0.00E+00

Table C.III–91
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Private Ownership: On–Property Farmer (Child)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	0.0E+00	pCi/l	$Th_{232+10d}$	0.0E+00	pCi/l
Np_{237+1d}	0.0E+00	pCi/l	U_{234}	1.9E−03	pCi/l
Pu_{238}	0.0E+00	pCi/l	U_{235+1d}	1.0E−04	pCi/l
Ra_{226+8d}	0.0E+00	pCi/l	U_{238+2d}	2.0E−03	pCi/l.
Ra_{228+1d}	0.0E+00	pCi/l	0.0E+00	0.0E+00	pCi/l
Rn_{222+4d}	0.0E+00	pCi/l	0.0E+00	0.0E+00	pCi/l
Sr_{90+1d}	0.0E+00	pCi/l	0.0E+00	0.0E+00	pCi/l
Tc_{99}	0.0E+00	pCi/l	0.0E+00	0.0E+00	pCi/l
Th_{228+7d}	0.0E+00	pCi/l	0.0E+00	0.0E+00	pCi/l
Th_{230}	0.0E+00	pCi/l	0.0E+00	0.0E+00	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	NA	2.2E−10	NA
Pu_{238}	NA	2.2E−10	NA
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	NA	3.6E−11	NA
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	NA	1.3E−11	NA
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	4.0E+00	1.6E−11	6.4E−11
U_{235+1d}	2.1E−01	1.6E−11	3.4E−12
U_{238+2d}	4.2E+00	2.0E−11	8.4E−11
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
		ILCR Summation =	1.5E−10

Table C.III-92
Summary of Intake Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Private Ownership: On-Property Farmer (Child)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv	mg/cm^2-day
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non-carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non-carcinogens (EDn x365)	2190	days
SA	Skin surface area available for contact	8000	cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2-day	0	NA	mg/cm^2-day
arsenic	NA	mg/cm^2-day	0	NA	mg/cm^2-day
beryllium	NA	mg/cm^2-day	0	NA	mg/cm^2-day
uranium-total	1.50E-12	mg/cm^2-day	0	NA	mg/cm^2-day
benzo(a)pyrene	NA	mg/cm^2-day	0	NA	mg/cm^2-day
carbazole	NA	mg/cm^2-day	0	NA	mg/cm^2-day
arodor-1254	NA	mg/cm^2-day	0	NA	mg/cm^2-day
arodor-1260	NA	mg/cm^2-day	0	NA	mg/cm^2-day
dieldrin	NA	mg/cm^2-day	0	NA	mg/cm^2-day
0	NA	mg/cm^2-day	0	NA	mg/cm^2-day
0	NA	mg/cm^2-day	0	NA	mg/cm^2-day
0	NA	mg/cm^2-day	0	NA	mg/cm^2-day
0	NA	mg/cm^2-day	0	NA	mg/cm^2-day
0	NA	mg/cm^2-day	0	NA	mg/cm^2-day
0	NA	mg/cm^2-day	0	NA	mg/cm^2-day
0	NA	mg/cm^2-day			

References

Table C.III-92
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: On-Property Farmer (Child)
Via Dermal Contact while Bathing

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	7.67E-10	1.50E-04	5.11E-06
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
HQ Summation =			5.11E-06

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	6.58E-11	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
ILCR Summation =			0.00E+00

5860

Table C.III–93
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Private Ownership: On–Property Farmer (Child)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	0.0E+00	pCi/m^3	$Th_{232+10d}$	0.0E+00	pCi/m^3
Np_{237+1d}	2.2E–07	pCi/m^3	U_{234}	0.0E+00	pCi/m^3
Pu_{238}	0.0E+00	pCi/m^3	U_{235+1d}	0.0E+00	pCi/m^3
Ra_{226+8d}	0.0E+00	pCi/m^3	U_{238+2d}	0.0E+00	pCi/m^3
Ra_{228+1d}	0.0E+00	pCi/m^3	0.0E+00	0.0E+00	pCi/m^3
Rn_{222+4d}	0.0E+00	pCi/m^3	0.0E+00	0.0E+00	pCi/m^3
Sr_{90+1d}	2.5E–07	pCi/m^3	0.0E+00	0.0E+00	pCi/m^3
Tc_{99}	0.0E+00	pCi/m^3	0.0E+00	0.0E+00	pCi/m^3
Th_{228+7d}	0.0E+00	pCi/m^3	0.0E+00	0.0E+00	pCi/m^3
Th_{230}	2.3E–05	pCi/m^3	0.0E+00	0.0E+00	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	5.6E–03	2.9E–08	1.6E–10
Pu_{238}	NA	3.9E–08	NA
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	NA	7.7E–12	NA
Sr_{90+1d}	6.2E–03	6.2E–11	3.8E–13
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	5.7E–01	2.9E–08	1.7E–08
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	NA	2.6E–08	NA
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	NA	2.4E–08	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA

ILCR Summation = 1.7E–08

000624

Table C.III-94
Summary of Intake Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Private Ownership: On-Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.039	kg/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non-carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non-carcinogens (EDn x365)	2190	days
CS	Concentration of chemicals in meat		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	0.0E+00	mg/kg	***	0.0E+00	mg/kg
arsenic	0.0E+00	mg/kg	***	0.0E+00	mg/kg
beryllium	0.0E+00	mg/kg	***	0.0E+00	mg/kg
uranium-total	6.0E-08	mg/kg	***	0.0E+00	mg/kg
benzo(a)pyrene	0.0E+00	mg/kg	***	0.0E+00	mg/kg
carbazole	0.0E+00	mg/kg	***	0.0E+00	mg/kg
arodor-1254	0.0E+00	mg/kg	***	0.0E+00	mg/kg
arodor-1260	0.0E+00	mg/kg	***	0.0E+00	mg/kg
dieldrin	0.0E+00	mg/kg	***	0.0E+00	mg/kg
0	0.0E+00	mg/kg	***	0.0E+00	mg/kg
0	0.0E+00	mg/kg	***	0.0E+00	mg/kg
0	0.0E+00	mg/kg	***	0.0E+00	mg/kg
0	0.0E+00	mg/kg	***	0.0E+00	mg/kg
0	0.0E+00	mg/kg	***	0.0E+00	mg/kg
0	0.0E+00	mg/kg	***	0.0E+00	mg/kg
0	0.0E+00	mg/kg			

References

5860

Table C.III−94 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: On−Property Farmer (Child)
Via Ingestion of Meat Products

Compound	HQ Calculation		
	CDI (mg/kg−day)	RfD (mg/kg−day)	HQ (unitless)
antimony	NA	4.0E−04	NA
arsenic	NA	3.0E−04	NA
beryllium	NA	5.0E−03	NA
uranium−total	1.1E−10	3.0E−03	3.7E−08
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor−1254	NA	NA	NA
aroclor−1260	NA	NA	NA
dieldrin	NA	5.0E−05	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
	HQ Summation =		3.7E−08

Compound	ILCR Calculation		
	CDI (mg/kg−day)	CSF (mg/kg−day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium−total	9.6E−12	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E−02	NA
aroclor−1254	NA	7.7E+00	NA
aroclor−1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
	ILCR Summation =		0.0E+00

000626

Table C.III–95
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Private Ownership: On–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	0.0E+00	pCi/kg	$Th_{232+10d}$	0.0E+00	pCi/kg
Np_{237+1d}	2.8E–04	pCi/kg	U_{234}	4.1E–02	pCi/kg
Pu_{238}	0.0E+00	pCi/kg	U_{235+1d}	1.7E–02	pCi/kg
Ra_{226+8d}	0.0E+00	pCi/kg	U_{238+2d}	2.0E–05	pCi/kg
Ra_{228+1d}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Sr_{90+1d}	2.1E–01	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Tc_{99}	0.0E+00	pCi/kg..	0.0E+00	0.0E+00	pCi/kg
Th_{228+7d}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Th_{230}	1.7E–03	pCi/kg	0.0E+00	0.0E+00	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	1.7E–02	2.2E–10	3.8E–12
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	1.3E+01	3.6E–11	4.7E–10
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	1.0E–01	1.3E–11	1.4E–12
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	2.5E+00	1.6E–11	4.0E–11
U_{235+1d}	1.0E+00	1.6E–11	1.6E–11
U_{238+2d}	1.2E–03	2.0E–11	2.5E–14
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA

ILCR Summation = 5.3E–10

Table C.III–96
Summary of Intake Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Private Ownership: On–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.9	l/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x365)	2190	days
CS	Concentration of chemicals in animal products		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	0.0E+00	mg/kg	***	0.0E+00	mg/kg
arsenic	0.0E+00	mg/kg	***	0.0E+00	mg/kg
beryllium	0.0E+00	mg/kg	***	0.0E+00	mg/kg
uranium–total	2.2E–07	mg/kg	***	0.0E+00	mg/kg
benzo(a)pyrene	0.0E+00	mg/kg	***	0.0E+00	mg/kg
carbazole	0.0E+00	mg/kg	***	0.0E+00	mg/kg
arodor–1254	0.0E+00	mg/kg	***	0.0E+00	mg/kg
arodor–1260	0.0E+00	mg/kg	***	0.0E+00	mg/kg
dieldrin	0.0E+00	mg/kg	***	0.0E+00	mg/kg
********	0.0E+00	mg/kg	***	0.0E+00	mg/kg
********	0.0E+00	mg/kg	***	0.0E+00	mg/kg
********	0.0E+00	mg/kg	***	0.0E+00	mg/kg
********	0.0E+00	mg/kg	***	0.0E+00	mg/kg
********	0.0E+00	mg/kg	***	0.0E+00	mg/kg
********	0.0E+00	mg/kg	***	0.0E+00	mg/kg
********	0.0E+00	mg/kg			

References

Table C.III-96 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: On-Property Farmer (Child)
Via Ingestion of Dairy Products

Compound	HQ Calculation		
	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	9.3E-09	3.0E-03	3.1E-06
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
	HQ Summation =		3.1E-06

Compound	ILCR Calculation		
	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	8.0E-10	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
	ILCR Summation =		0.0E+00

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Table C.III–97
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Private Ownership: On–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	0.0E+00	pCi/kg	$Th_{232+10d}$	0.0E+00	pCi/kg
Np_{237+1d}	2.6E–05	pCi/kg	U_{234}	1.2E–01	pCi/kg
Pu_{238}	0.0E+00	pCi/kg	U_{235+1d}	5.0E–02	pCi/kg
Ra_{226+8d}	0.0E+00	pCi/kg	U_{238+2d}	7.2E–05	pCi/kg
Ra_{228+1d}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Sr_{90+1d}	1.1E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Tc_{99}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Th_{228+7d}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Th_{230}	1.4E–03	pCi/kg	0.0E+00	0.0E+00	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	3.6E–02	2.2E–10	8.0E–12
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	1.5E+03	3.6E–11	5.4E–08
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	2.0E+00	1.3E–11	2.6E–11
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.7E+02	1.6E–11	2.8E–09
U_{235+1d}	7.1E+01	1.6E–11	1.1E–09
U_{238+2d}	1.0E–01	2.0E–11	2.0E–12
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA

ILCR Summation = 5.8E–08

Table C.III–98
Summary of Intake and Risk Quantitation (chemicals) Alternative 3
Lime Sludge Pond with Private Ownership: On–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.1	kg/day
FI	Fraction ingested from contaminated source	1	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x365)	2190	days
CS	Concentration of chemicals in vegetables		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
arsenic	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
beryllium	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
uranium–total	2.9E–05	mg/kg	•••	0.0E+00	mg/kg
benzo(a)pyrene	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
carbazole	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
arodor–1254	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
arodor–1260	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
dieldrin	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
••••••••	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
••••••••	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
••••••••	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
••••••••	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
••••••••	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
••••••••	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
••••••••	0.0E+00	mg/kg			

References

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Table C.III–98 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: On–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Compound	HQ Calculation CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	4.0E–04	NA
arsenic	NA	3.0E–04	NA
beryllium	NA	5.0E–03	NA
uranium–total	1.9E–07	3.0E–03	6.3E–05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	5.0E–05	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
	HQ Summation =		6.3E–05

Compound	ILCR Calculation CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium–total	1.6E–08	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E–02	NA
aroclor–1254	NA	7.7E+00	NA
aroclor–1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
	ILCR Summation =		0.0E+00

Table C.III–99
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Private Ownership: On–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	0.0E+00	pCi/kg	$Th_{232+10d}$	0.0E+00	pCi/kg
Np_{237+1d}	5.1E−02	pCi/kg	U_{234}	1.9E+00	pCi/kg
Pu_{238}	0.0E+00	pCi/kg	U_{235+1d}	7.7E−01	pCi/kg
Ra_{226+8d}	0.0E+00	pCi/kg	U_{238+2d}	9.8E−03	pCi/kg
Ra_{228+1d}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Sr_{90+1d}	1.4E+01	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Tc_{99}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Th_{228+7d}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Th_{230}	4.7E−01	pCi/kg	0.0E+00	0.0E+00	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	1.1E+01	2.2E−10	2.4E−09
Pu_{238}	NA	2.2E−10	NA
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	2.9E+03	3.6E−11	1.1E−07
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	9.9E+01	1.3E−11	1.3E−09
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	3.9E+02	1.6E−11	6.3E−09
U_{235+1d}	1.6E+02	1.6E−11	2.6E−09
U_{238+2d}	2.1E+00	2.0E−11	4.1E−11
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA

ILCR Summation = 1.2E−07

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Table C.III-100
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Lime Sludge Pond with Private Ownership: On-Property Farmer (Child)
Via External Radiation

Dose Equivalency Equat: = $[DR \times EF \times EDn \times ET_i \times (1-SH_i)] + [DR \times EF \times EDn \times ET_o \times (1-SH_o)]$

EF	Fraction of year spent exposured	0.96 (unitless)
ED	Exposure duration	6 Year
ET_i	Fraction of day spent indoors	0.92 (unitless)
ET_o	Fraction of day spent outdoors	0.08 (unitless)
SH_i	Shield factor indoors	0.5 (unitless)
SH_o	Shield factor outdoors	0 (unitless)
DR	Radionuclide specific dose concentrations	(see table below)

Cs_{137+1d}	NA	pCi/g	$Th_{232+10d}$	NA	pCi/g
Np_{237+1d}	5.10E-03	pCi/g	U_{234}	2.20E-01	pCi/g
Pu_{238}	NA	pCi/g	U_{235+1d}	9.00E-02	pCi/g
Ra_{226+8d}	NA	pCi/g	U_{238+2d}	NA	pCi/g
Ra_{228+1d}	NA	pCi/g	0	NA	pCi/g
Rn_{222+4d}	NA	pCi/g	0	NA	pCi/g
Sr_{90+1d}	5.60E-03	pCi/g	0	NA	pCi/g
Tc_{99}	NA	pCi/g	0	NA	pCi/g
Th_{228+7d}	NA	pCi/g	0	NA	pCi/g
Th_{230}	5.20E-01	pCi/g	0	NA	pCi/g

Radionuclides	CDI (year pCi/g)	CSF $(g/pCi-year)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.0E-06	NA
Np_{237+1d}	1.6E-02	4.3E-07	6.8E-09
Pu_{238}	NA	2.8E-11	NA
Ra_{226+8d}	NA	6.0E-06	NA
Ra_{228+1d}	NA	2.9E-06	NA
Rn_{222+4d}	NA	5.9E-06	NA
Sr_{90+1d}	1.7E-02	NA	0.0E+00
Tc_{99}	NA	6.0E-13	NA
Th_{228+7d}	NA	5.6E-06	NA
Th_{230}	1.6E+00	5.4E-11	8.7E-11
$Th_{232+10d}$	NA	8.5E-06	NA
U_{234}	6.8E-01	3.0E-11	2.1E-11
U_{235+1d}	2.8E-01	2.4E-07	6.7E-08
U_{238+2d}	NA	5.1E-08	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
		ILCR Summation =	7.4E-08

Table C.III – 101
Summary of Intake Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Federal Ownership: Expanded Trespasser
Via Incidental Ingestion of Soil/Sediment

Intake Equation

$$= \frac{CS \times EFa \times EDa \times CF \times IRa}{BWa \times ATa} + \frac{CS \times EFc \times EDc \times CF \times IRc}{BWc \times ATc}$$

IRa	Ingestion rate of soil (adult)	12.5 mg/day
IRc	Ingestion rate of soil (child)	12.5 mg/day
CF	Conversion factor	1.00E – 06 kg/mg
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure duration (adult)	32 Year
EDc	Exposure duration (child)	12 Year
BWa	Body weight (adult)	70 kg
BWc	Body weight (child)	43 kg
AT	Average time for carcinogens	25550 days
ATa	Average time for non – carcinogens (adult)	11680 days
ATc	Average time for non – carcinogens (child)	4380 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium – total	1.1E+01	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor – 1254	NA	mg/kg	NA	NA	mg/kg
arodor – 1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III-101 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Expanded Trespasser
Via Incidental Ingestion of Soil/Sediment

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.2E-06	3.0E-03	3.9E-04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		3.9E-04

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	2.6E-07	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

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Table C.III-102
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Federal Ownership: Expanded Trespasser
Via Incidental Ingestion of Soil/Sediment

Intake Equation = CS X EFa X EDa X FI X IRa + CS X EFc X EDc X FI X IRc

IRa	Ingestion rate of soil (adult)	12.5	mg/day
IRc	Ingestion rate of soil (child)	12.5	mg/day
EFa	Exposure frequency (adult)	40	days/year
EFc	Exposure frequency (child)	110	days/year
EDa	Exposure Duration	32	Year
EDc	Exposure Duration	12	Year
FI	Fractional Intake	1	(unitless)
CS	Concentration of radionuclides in soil		(see table below)

Cs_{137+1d}	NA	pCi/mg	$Th_{232+10d}$	NA	pCi/mg
Np_{237+1d}	1.3E-04	pCi/mg	U_{234}	NA	pCi/mg
Pu_{238}	NA	pCi/mg	U_{235+1d}	NA	pCi/mg
Ra_{226+8d}	NA	pCi/mg	U_{238+2d}	NA	pCi/mg
Ra_{228+1d}	NA	pCi/mg	NA	NA	pCi/mg
Rn_{222+4d}	NA	pCi/mg	NA	NA	pCi/mg
Sr_{90+1d}	5.4E-04	pCi/mg	NA	NA	pCi/mg
Tc_{99}	NA	pCi/mg	NA	NA	pCi/mg
Th_{228+7d}	NA	pCi/mg	NA	NA	pCi/mg
Th_{230}	5.2E-04	pCi/mg	NA	NA	pCi/mg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	4.2E+00	2.2E-10	9.3E-10
Pu_{238}	NA	2.2E-10	NA
Ra_{226+8d}	NA	7.8E-10	NA
Ra_{228+1d}	NA	1.0E-10	NA
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	1.8E+01	3.6E-11	6.3E-10
Tc_{99}	NA	1.3E-12	NA
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	1.7E+01	1.3E-11	2.2E-10
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	NA	1.6E-11	NA
U_{235+1d}	NA	1.6E-11	NA
U_{238+2d}	NA	2.0E-11	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	1.8E-09

000637

Table C.III – 103
Summary of Intake Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Federal Ownership: Expanded Trespasser
Via Dermal Contact with Soil/Sediment

Intake Equation = $\frac{CS \times EFa \times EDa \times CF \times ABS \times AF \times SAa}{BWa \times ATa}$ + $\frac{CS \times EFc \times EDc \times CF \times ABS \times AF \times SAc}{BWc \times ATc}$

SA	Surface area of exposed skin (adult)	5750	cm^2/day
SA	Surface area of exposed skin (child)	4200	cm^2/day
AF	Soil to skin adherence factor	1	mg/cm^2
ABS	chemicals specific absorbtion factor (see table below)	csv	
CF	Conversion factor	1E–06	kg/mg
EFa	Exposure frequency (adult)	40	days/year
EFc	Exposure frequency (child)	110	days/year
EDa	Exposure duration (adult)	32	Year
EDc	Exposure duration (child)	12	Year
BWa	Body weight (adult)	70	kg
BWc	Body weight (child)	43	kg
AT	Average time for carcinogens	25550	days
ATa	Average time for non–carcinogens (adult)	11680	days
ATc	Average time for non–carcinogens (child)	4380	days
CS	Concentration of chemicals in soil	(see table below)	

Chemical Concentrations

Compound	ABS	Concentrati	Units	Compound	ABS	Concentrati	Units
antimony	1.0E–02	NA	mg/kg	NA	NA	NA	mg/kg
arsenic	1.0E–03	NA	mg/kg	NA	NA	NA	mg/kg
beryllium	1.0E–02	NA	mg/kg	NA	NA	NA	mg/kg
uranium–total	1.0E–02	1.1E+01	mg/kg	NA	NA	NA	mg/kg
benzo(a)pyrene	3.0E–01	NA	mg/kg	NA	NA	NA	mg/kg
carbazole	3.0E–01	NA	mg/kg	NA	NA	NA	mg/kg
arodor–1254	6.0E–02	NA	mg/kg	NA	NA	NA	mg/kg
arodor–1260	6.0E–02	NA	mg/kg	NA	NA	NA	mg/kg
dieldrin	3.0E–01	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg				

References

0386

Table C.III-103 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Expanded Trespasser
Via Dermal Contact with Soil/Sediment

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.0E-05	NA
arsenic	NA	2.9E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	4.2E-06	1.5E-04	2.8E-02
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.5E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.8E-02

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.9E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.0E-06	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.2E-02	NA
aroclor-1254	NA	1.0E+01	NA
aroclor-1260	NA	1.0E+01	NA
dieldrin	NA	1.8E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000639

5860

Table C.III–104
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Federal Ownership: Expanded Trespasser
Via Inhalation of Gases and Particulates

Intake Equation = CA X EFa X EDa X IR X ETa + CA X EFc EDc X IR X ETc

IR	Inhalation rate of gases	0.83 m^3/hour
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure duration	32 Year
EDc	Exposure duration	12 Year
ETa	Exposure time (adult)	1 hour/day
ETc	Exposure time (child)	2 hour/day
CA	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	4.3E−07	pCi/m^3	U_{234}	NA	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	1.8E−06	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	1.7E−06	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E−11	NA
Np_{237+1d}	1.4E−03	2.9E−08	4.1E−11
Pu_{238}	NA	3.9E−08	NA
Ra_{226+8d}	NA	7.0E−09	NA
Ra_{228+1d}	NA	6.9E−10	NA
Rn_{222+4d}	NA	7.7E−12	NA
Sr_{90+1d}	5.9E−03	6.2E−11	3.6E−13
Tc_{99}	NA	8.3E−12	NA
Th_{228+7d}	NA	7.8E−08	NA
Th_{230}	5.6E−03	2.9E−08	1.6E−10
$Th_{232+10d}$	NA	1.1E−07	NA
U_{234}	NA	2.6E−08	NA
U_{235+1d}	NA	2.5E−08	NA
U_{238+2d}	NA	2.4E−08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.0E−10

Table C.III-105
Summary of Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Federal Ownership: Expanded Trespasser
Via External Radiation

Exposure Equation = $[CR \times EFa \times EDa \times ET_{oo} \times (1-SH_o)] + [CR \times EFc \times EDc \times ET_{oc} \times (1-SH_o)]$

EFa	Fraction of year spent exposured (adult)	0.11 (unitless)
EFc	Fraction of year spent exposured (child)	0.3 (unitless)
EDa	Exposure duration (adult)	32 Year
EDc	Exposure duration (child)	12 Year
ET_{oo}	Fraction of day spent outdoors (adult)	0.04 (unitless)
ET_{oc}	Fraction of day spent outdoors (child)	0.08 (unitless)
SH_o	Shield factor outdoors	NA (unitless)
CR	Radionuclide specific concentrations	(see table below)

Cs_{137+1d}	NA	pCi/g	$Th_{232+10d}$	NA	pCi/g
Np_{237+1d}	1.3E-01	pCi/g	U_{234}	NA	pCi/g
Pu_{238}	NA	pCi/g	U_{235+1d}	NA	pCi/g
Ra_{226+8d}	NA	pCi/g	U_{238+2d}	NA	pCi/g
Ra_{228+1d}	NA	pCi/g	NA	NA	pCi/g
Rn_{222+4d}	NA	pCi/g	NA	NA	pCi/g
Sr_{90+1d}	5.4E-01	pCi/g	NA	NA	pCi/g
Tc_{99}	NA	pCi/g	NA	NA	pCi/g
Th_{228+7d}	NA	pCi/g	NA	NA	pCi/g
Th_{230}	5.2E-01	pCi/g	NA	NA	pCi/g

Radionuclides	CDI (year pCi/g)	CSF $(g/pCi-year)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.0E-06	NA
Np_{237+1d}	5.6E-02	4.3E-07	2.4E-08
Pu_{238}	NA	2.8E-11	NA
Ra_{226+8d}	NA	6.0E-06	NA
Ra_{228+1d}	NA	2.9E-06	NA
Rn_{222+4d}	NA	5.9E-06	NA
Sr_{90+1d}	2.3E-01	NA	NA
Tc_{99}	NA	6.0E-13	NA
Th_{228+7d}	NA	5.6E-06	NA
Th_{230}	2.2E-01	5.4E-11	1.2E-11
$Th_{232+10d}$	NA	8.5E-06	NA
U_{234}	NA	3.0E-11	NA
U_{235+1d}	NA	2.4E-07	NA
U_{238+2d}	NA	5.1E-08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.4E-08

Table C.III-106
Summary of Intake Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Adult)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	2	l/day
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non-carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non-carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in groundwater		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium-total	1.23E-04	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
arodor-1254	NA	mg/l	NA	NA	mg/l
arodor-1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

0 0 8 6

Table C.III-106 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Adult)
Via Drinking Water Ingestion

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	3.37E-06	3.00E-03	1.12E-03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.12E-03

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	3.37E-06	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

5860

Table C.III-107
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	3.7E-02	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	2.0E-03	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	4.1E-02	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	NA	2.2E-10	NA
Pu_{238}	NA	2.2E-10	NA
Ra_{226+8d}	NA	7.8E-10	NA
Ra_{228+1d}	NA	1.0E-10	NA
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	NA	3.6E-11	NA
Tc_{99}	NA	1.3E-12	NA
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	NA	1.3E-11	NA
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	1.8E+03	1.6E-11	2.9E-08
U_{235+1d}	9.8E+01	1.6E-11	1.6E-09
U_{238+2d}	2.0E+03	2.0E-11	4.0E-08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 7.1E-08

000644

Table C.III-108
Summary of Intake Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Adult)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv	mg/cm^2-day
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non-carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non-carcinogens (EDn x365)	25550	days
SA	Skin surface area available for contact	23000	cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arsenic	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
beryllium	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
uranium-total	3.08E-11	mg/cm^2-day	NA	NA	mg/cm^2-day
benzo(a)pyrene	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
carbazole	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arodor-1254	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arodor-1260	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
dieldrin	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day			

References

Table C.III−108 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Off−Property Farmer (Adult)
Via Dermal Contact while Showering

Compound	HQ Calculation CDI (mg/kg−day)	RfD (mg/kg−day)	HQ (unitless)
antimony	NA	6.00E−05	NA
arsenic	NA	2.85E−04	NA
beryllium	NA	5.00E−03	NA
uranium−total	9.69E−09	1.50E−04	6.46E−05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor−1254	NA	NA	NA
aroclor−1260	NA	NA	NA
dieldrin	NA	4.50E−05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		6.46E−05

Compound	ILCR Calculation CDI (mg/kg−day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium−total	9.69E−09	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E−02	NA
aroclor−1254	NA	1.03E+01	NA
aroclor−1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

Table C.III–109
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Adult)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	6.2E–09	pCi/m^3	U_{234}	NA	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	2.6E–08	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	2.5E–08	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	3.0E–03	2.9E–08	8.8E–11
Pu_{238}	NA	3.9E–08	NA
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	NA	7.7E–12	NA
Sr_{90+1d}	1.3E–02	6.2E–11	7.8E–13
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	1.2E–02	2.9E–08	3.5E–10
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	NA	2.6E–08	NA
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	NA	2.4E–08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	4.4E–10

Table C.III–110
Summary of Intake Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.101	kg/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in meat		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	1.2E–06	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor–1254	NA	mg/kg	NA	NA	mg/kg
arodor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

0086

Table C.III-110 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Meat Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.3E-09	3.0E-03	4.3E-07
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		4.3E-07

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.3E-09	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000649

5860

Table C.III–111
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	2.6E–08	pCi/kg	U_{234}	3.7E–04	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	2.0E–05	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	4.1E–04	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	2.3E–06	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.3E–08	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	4.9E–05	2.2E–10	1.1E–14
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	4.2E–03	3.6E–11	1.5E–13
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	2.5E–05	1.3E–11	3.2E–16
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	6.9E–01	1.6E–11	1.1E–11
U_{235+1d}	3.7E–02	1.6E–11	5.9E–13
U_{238+2d}	7.6E–01	2.0E–11	1.5E–11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.7E–11

Table C.III – 112
Summary of Intake Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Federal Ownership: Off – Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.4	l/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non – carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non – carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in animal products		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium – total	4.5E –06	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor – 1254	NA	mg/kg	NA	NA	mg/kg
arodor – 1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

000651

Table C.III–112 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

Compound	HQ Calculation CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	4.0E–04	NA
arsenic	NA	3.0E–04	NA
beryllium	NA	5.0E–03	NA
uranium–total	1.8E–08	3.0E–03	6.1E–06
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	5.0E–05	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
HQ Summation =			6.1E–06

Compound	ILCR Calculation CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium–total	1.8E–08	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E–02	NA
aroclor–1254	NA	7.7E+00	NA
aroclor–1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
ILCR Summation =			NA

0882

Table C.III–113
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	2.4E−09	pCi/kg	U_{234}	1.3E−03	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	7.2E−05	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	1.5E−03	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	1.1E−05	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.1E−08	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	1.8E−05	2.2E−10	3.9E−15
Pu_{238}	NA	2.2E−10	NA
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	8.4E−02	3.6E−11	3.0E−12
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	8.2E−05	1.3E−11	1.1E−15
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	9.8E+00	1.6E−11	1.6E−10
U_{235+1d}	5.3E−01	1.6E−11	8.5E−12
U_{238+2d}	1.1E+01	2.0E−11	2.2E−10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 3.9E−10

Table C.III – 114
Summary of Intake and Risk Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation

$$= \frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$$

IR	Ingestion rate of fruits or vegetables	0.122	kg/day
FI	Fraction ingested from contaminated source	1	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in vegetables		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	6.0E–04	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor–1254	NA	mg/kg	NA	NA	mg/kg
arodor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III–114 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Compound	HQ Calculation CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	4.0E–04	NA
arsenic	NA	3.0E–04	NA
beryllium	NA	5.0E–03	NA
uranium–total	1.0E–06	3.0E–03	3.4E–04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	5.0E–05	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
HQ Summation =			3.4E–04

Compound	ILCR Calculation CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium–total	1.0E–06	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E–02	NA
aroclor–1254	NA	7.7E+00	NA
aroclor–1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
ILCR Summation =			NA

5860

Table C.III-115
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	6.2E-06	pCi/kg	U_{234}	1.8E-01	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	9.8E-03	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.0E-01	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	7.4E-05	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	2.7E-05	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	1.8E-02	2.2E-10	4.1E-12
Pu_{238}	NA	2.2E-10	NA
Ra_{226+8d}	NA	7.8E-10	NA
Ra_{228+1d}	NA	1.0E-10	NA
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	2.2E-01	3.6E-11	7.9E-12
Tc_{99}	NA	1.3E-12	NA
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	8.2E-02	1.3E-11	1.1E-12
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	5.4E+02	1.6E-11	8.7E-09
U_{235+1d}	2.9E+01	1.6E-11	4.7E-10
U_{238+2d}	6.0E+02	2.0E-11	1.2E-08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.1E-08

000656

Table C.III-116
Summary of Intake Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Child)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	1	l/day
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non-carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non-carcinogens (EDn x365)	2190	days
CS	Concentration of chemicals in groundwater		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium-total	1.23E-04	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
arodor-1254	NA	mg/l	NA	NA	mg/l
arodor-1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

000657

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Table C.III-116 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Child)
Via Drinking Water Ingestion

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	7.86E-06	3.00E-03	2.62E-03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.62E-03

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	6.74E-07	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

0083

Table C.III–117
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	3.7E−02	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	2.0E−03	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	4.1E−02	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	NA	2.2E−10	NA
Pu_{238}	NA	2.2E−10	NA
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	NA	3.6E−11	NA
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	NA	1.3E−11	NA
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	7.8E+01	1.6E−11	1.2E−09
U_{235+1d}	4.2E+00	1.6E−11	6.7E−11
U_{238+2d}	8.6E+01	2.0E−11	1.7E−09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 3.0E−09

Table C.III-118
Summary of Intake Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Child)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv	mg/cm^2-day
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non-carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non-carcinogens (EDn x365)	2190	days
SA	Skin surface area available for contact	8000	cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arsenic	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
beryllium	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
uranium-total	3.08E-11	mg/cm^2-day	NA	NA	mg/cm^2-day
benzo(a)pyrene	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
carbazole	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arodor-1254	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arodor-1260	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
dieldrin	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day			

References

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Table C.III-118
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Child)
Via Dermal Contact while Bathing

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	1.57E-08	1.50E-04	1.05E-04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.05E-04

Compound	ILCR Calculation CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	1.35E-09	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

5860

Table C.III-119
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Child)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	6.2E-09	pCi/m^3	U_{234}	NA	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	2.6E-08	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	2.5E-08	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E-11	NA
Np_{237+1d}	1.6E-04	2.9E-08	4.5E-12
Pu_{238}	NA	3.9E-08	NA
Ra_{226+8d}	NA	7.0E-09	NA
Ra_{228+1d}	NA	6.9E-10	NA
Rn_{222+4d}	NA	7.7E-12	NA
Sr_{90+1d}	6.5E-04	6.2E-11	4.0E-14
Tc_{99}	NA	8.3E-12	NA
Th_{228+7d}	NA	7.8E-08	NA
Th_{230}	6.2E-04	2.9E-08	1.8E-11
$Th_{232+10d}$	NA	1.1E-07	NA
U_{234}	NA	2.6E-08	NA
U_{235+1d}	NA	2.5E-08	NA
U_{238+2d}	NA	2.4E-08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		2.3E-11

000662

Table C.III – 120
Summary of Intake Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.039	kg/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x365)	2190	days
CS	Concentration of chemicals in meat		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	1.2E–06	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor–1254	NA	mg/kg	NA	NA	mg/kg
arodor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

5860

Table C.III-120 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Meat Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	2.3E-09	3.0E-03	7.7E-07
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		7.7E-07

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	2.0E-10	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000664

0087

Table C.III–121
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	2.6E–08	pCi/kg	U_{234}	3.7E–04	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	2.0E–05	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	4.1E–04	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	2.3E–06	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.3E–08	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	1.6E–06	2.2E–10	3.5E–16
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	1.4E–04	3.6E–11	5.0E–15
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	8.2E–07	1.3E–11	1.1E–17
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	2.3E–02	1.6E–11	3.6E–13
U_{235+1d}	1.2E–03	1.6E–11	2.0E–14
U_{238+2d}	2.5E–02	2.0E–11	5.0E–13
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 8.9E–13

Table C.III-122
Summary of Intake Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.9	l/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non-carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non-carcinogens (EDn x365)	2190	days
CS	Concentration of chemicals in animal products		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium-total	4.5E-06	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor-1254	NA	mg/kg	NA	NA	mg/kg
arodor-1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-122 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Dairy Products

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.9E-07	3.0E-03	6.4E-05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		6.4E-05

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.6E-08	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000667

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Table C.III-123
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	2.4E-09	pCi/kg	U_{234}	1.3E-03	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	7.2E-05	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	1.5E-03	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	1.1E-05	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.1E-08	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	3.4E-06	2.2E-10	7.4E-16
Pu_{238}	NA	2.2E-10	NA
Ra_{226+8d}	NA	7.8E-10	NA
Ra_{228+1d}	NA	1.0E-10	NA
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	1.6E-02	3.6E-11	5.8E-13
Tc_{99}	NA	1.3E-12	NA
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	1.6E-05	1.3E-11	2.1E-16
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	1.9E+00	1.6E-11	3.0E-11
U_{235+1d}	1.0E-01	1.6E-11	1.6E-12
U_{238+2d}	2.1E+00	2.0E-11	4.2E-11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 7.4E-11

000668

Table C.III – 124
Summary of Intake and Risk Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x365)	2190 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium – total	6.0E–04	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor – 1254	NA	mg/kg	NA	NA	mg/kg
arodor – 1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg

References

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Table C.III-124 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Compound	HQ Calculation CDI (mg/kg-day)	HQ Calculation RfD (mg/kg-day)	HQ Calculation HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	3.9E-06	3.0E-03	1.3E-03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.3E-03

Compound	ILCR Calculation CDI (mg/kg-day)	ILCR Calculation CSF $(mg/kg-day)^{-1}$	ILCR Calculation ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	3.3E-07	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000670

Table C.III–125
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	6.2E–06	pCi/kg	U_{234}	1.8E–01	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	9.8E–03	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.0E–01	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	7.4E–05	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	2.7E–05	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	1.3E–03	2.2E–10	2.8E–13
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	1.5E–02	3.6E–11	5.6E–13
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	5.8E–03	1.3E–11	7.5E–14
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	3.8E+01	1.6E–11	6.1E–10
U_{235+1d}	2.1E+00	1.6E–11	3.3E–11
U_{238+2d}	4.2E+01	2.0E–11	8.4E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
		ILCR Summation =	1.5E–09

Table C.III-126
Summary of Intake Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Private Ownership: Off-Property Farmer (Adult)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	2	l/day
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non-carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non-carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in groundwater		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium-total	2.30E-07	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
arodor-1254	NA	mg/l	NA	NA	mg/l
arodor-1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l

References

**Table C.III-126 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: Off-Property Farmer (Adult)
Via Drinking Water Ingestion**

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	6.30E-09	3.00E-03	2.10E-06
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.10E-06

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	6.30E-09	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

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Table C.III–127
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	7.1E–05	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	3.7E–06	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	7.8E–05	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	3.5E+00	1.6E–11	5.6E–11
U_{235+1d}	1.8E–01	1.6E–11	2.9E–12
U_{238+2d}	3.8E+00	2.0E–11	7.6E–11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.4E–10

Table C.III-128
Summary of Intake Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Private Ownership: Off-Property Farmer (Adult)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv	mg/cm^2-day
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non-carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non-carcinogens (EDn x365)	25550	days
SA	Skin surface area available for contact	23000	cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arsenic	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
beryllium	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
uranium-total	5.75E-14	mg/cm^2-day	NA	NA	mg/cm^2-day
benzo(a)pyrene	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
carbazole	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arodor-1254	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arodor-1260	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
dieldrin	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day

References

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Table C.III-128 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: Off-Property Farmer (Adult)
Via Dermal Contact while Bathing

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	1.81E-11	1.50E-04	1.21E-07
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.21E-07

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	1.81E-11	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

Table C.III–129
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Private Ownership: Off–Property Farmer (Adult)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	3.2E–09	pCi/m^3	U_{234}	NA	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	3.5E–09	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	3.3E–07	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	1.6E–03	2.9E–08	4.5E–11
Pu_{238}	NA	3.9E–08	NA
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	NA	7.7E–12	NA
Sr_{90+1d}	1.7E–03	6.2E–11	1.1E–13
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	1.6E–01	2.9E–08	4.6E–09
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	NA	2.6E–08	NA
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	NA	2.4E–08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 4.7E–09

Table C.III – 130
Summary of Intake Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.101	kg/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in meat		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	2.3E–09	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor–1254	NA	mg/kg	NA	NA	mg/kg
arodor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III−130 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: Off−Property Farmer (Adult)
Via Ingestion of Meat Products

Compound	HQ Calculation CDI (mg/kg−day)	HQ Calculation RfD (mg/kg−day)	HQ Calculation HQ (unitless)
antimony	NA	4.0E−04	NA
arsenic	NA	3.0E−04	NA
beryllium	NA	5.0E−03	NA
uranium−total	2.4E−12	3.0E−03	8.0E−10
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor−1254	NA	NA	NA
aroclor−1260	NA	NA	NA
dieldrin	NA	5.0E−05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		8.0E−10

Compound	ILCR Calculation CDI (mg/kg−day)	ILCR Calculation CSF $(mg/kg-day)^{-1}$	ILCR Calculation ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium−total	2.4E−12	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E−02	NA
aroclor−1254	NA	7.7E+00	NA
aroclor−1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

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Table C.III-131
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Private Ownership: Off-Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	1.4E-08	pCi/kg	U_{234}	7.1E-07	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	3.7E-08	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	7.8E-07	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	3.1E-07	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.8E-07	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	2.5E-05	2.2E-10	5.5E-15
Pu_{238}	NA	2.2E-10	NA
Ra_{226+8d}	NA	7.8E-10	NA
Ra_{228+1d}	NA	1.0E-10	NA
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	5.7E-04	3.6E-11	2.1E-14
Tc_{99}	NA	1.3E-12	NA
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	3.3E-04	1.3E-11	4.2E-15
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	1.3E-03	1.6E-11	2.1E-14
U_{235+1d}	6.9E-05	1.6E-11	1.1E-15
U_{238+2d}	1.4E-03	2.0E-11	2.9E-14
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	8.2E-14

000680

Table C.III – 132
Summary of Intake Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.4	l/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in animal products		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	8.3E–09	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor–1254	NA	mg/kg	NA	NA	mg/kg
arodor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III-132 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: Off-Property Farmer (Adult)
Via Ingestion of Dairy Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	3.4E-11	3.0E-03	1.1E-08
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.1E-08

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	3.4E-11	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000682

Table C.III–133
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	1.2E–09	pCi/kg	U_{234}	2.6E–06	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.3E–07	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.8E–06	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	1.5E–06	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.5E–07	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	9.0E–06	2.2E–10	2.0E–15
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	1.1E–02	3.6E–11	4.1E–13
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	1.1E–03	1.3E–11	1.4E–14
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.9E–02	1.6E–11	3.0E–13
U_{235+1d}	9.8E–04	1.6E–11	1.6E–14
U_{238+2d}	2.1E–02	2.0E–11	4.1E–13
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.2E–12

000683

Table C.III–134
Summary of Intake and Risk Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.122	kg/day
FI	Fraction ingested from contaminated source	1	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in vegetables		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	1.1E–06	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor–1254	NA	mg/kg	NA	NA	mg/kg
arodor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III-134 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: Off-Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.9E-09	3.0E-03	6.3E-07
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		6.3E-07

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.9E-09	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000885

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Table C.III–135
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	3.2E–06	pCi/kg	U_{234}	3.5E–04	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.8E–05	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	3.8E–04	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	1.0E–05	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	3.6E–04	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	9.5E–03	2.2E–10	2.1E–12
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	3.0E–02	3.6E–11	1.1E–12
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	1.1E+00	1.3E–11	1.4E–11
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.0E+00	1.6E–11	1.7E–11
U_{235+1d}	5.4E–02	1.6E–11	8.7E–13
U_{238+2d}	1.1E+00	2.0E–11	2.3E–11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 5.7E–11

Table C.III-136
Summary of Intake Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Private Ownership: Off-Property Farmer (Child)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	1	l/day
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non-carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non-carcinogens (EDn x365)	2190	days
CS	Concentration of chemicals in groundwater		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium-total	2.30E-07	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
arodor-1254	NA	mg/l	NA	NA	mg/l
arodor-1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l

References

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Table C.III–136 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: Off–Property Farmer (Child)
Via Drinking Water Ingestion

Compound	HQ Calculation		
	CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	4.00E–04	NA
arsenic	NA	3.00E–04	NA
beryllium	NA	5.00E–03	NA
uranium–total	1.47E–08	3.00E–03	4.90E–06
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	5.00E–05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		4.90E–06

Compound	ILCR Calculation		
	CDI (mg/kg–day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium–total	1.26E–09	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E–02	NA
aroclor–1254	NA	7.70E+00	NA
aroclor–1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

0086

Table C.III-137
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	7.1E-05	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	3.7E-06	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	7.8E-05	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	NA	2.2E-10	NA
Pu_{238}	NA	2.2E-10	NA
Ra_{226+8d}	NA	7.8E-10	NA
Ra_{228+1d}	NA	1.0E-10	NA
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	NA	3.6E-11	NA
Tc_{99}	NA	1.3E-12	NA
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	NA	1.3E-11	NA
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	1.5E-01	1.6E-11	2.4E-12
U_{235+1d}	7.8E-03	1.6E-11	1.2E-13
U_{238+2d}	1.6E-01	2.0E-11	3.3E-12
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	5.8E-12

000689

Table C.III-138
Summary of Intake Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Private Ownership: Off-Property Farmer (Child)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv	mg/cm^2-day
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non-carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non-carcinogens (EDn x365)	2190	days
SA	Skin surface area available for contact	8000	cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arsenic	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
beryllium	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
uranium-total	5.75E-14	mg/cm^2-day	NA	NA	mg/cm^2-day
benzo(a)pyrene	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
carbazole	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arodor-1254	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arodor-1260	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
dieldrin	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day			

References

Table C.III-138 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: Off-Property Farmer (Child)
Via Dermal Contact while Bathing

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	2.94E-11	1.50E-04	1.96E-07
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.96E-07

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	2.52E-12	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

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Table C.III–139
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Private Ownership: Off–Property Farmer (Child)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	3.2E–09	pCi/m^3	U_{234}	NA	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	3.5E–09	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	3.3E–07	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	8.0E–05	2.9E–08	2.3E–12
Pu_{238}	NA	3.9E–08	NA
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	NA	7.7E–12	NA
Sr_{90+1d}	8.8E–05	6.2E–11	5.5E–15
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	8.2E–03	2.9E–08	2.4E–10
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	NA	2.6E–08	NA
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	NA	2.4E–08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.4E–10

Table C.III – 140
Summary of Intake Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Private Ownership: Off – Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.039	kg/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non – carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non – carcinogens (EDn x365)	2190	days
CS	Concentration of chemicals in meat		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium – total	2.3E –09	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor – 1254	NA	mg/kg	NA	NA	mg/kg
arodor – 1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III-140 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Meat Products

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	4.3E-12	3.0E-03	1.4E-09
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.4E-09

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	3.7E-13	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

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Table C.III–141
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	1.4E–08	pCi/kg	U_{234}	7.1E–07	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	3.7E–08	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	7.8E–07	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	3.1E–07	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.8E–07	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	8.3E–07	2.2E–10	1.8E–16
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	1.9E–05	3.6E–11	6.8E–16
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	1.1E–05	1.3E–11	1.4E–16
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	4.4E–05	1.6E–11	7.0E–16
U_{235+1d}	2.3E–06	1.6E–11	3.6E–17
U_{238+2d}	4.8E–05	2.0E–11	9.6E–16
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.7E–15

000695

Table C.III – 142
Summary of Intake Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.9	l/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x365)	2190	days
CS	Concentration of chemicals in animal products		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	8.3E–09	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor–1254	NA	mg/kg	NA	NA	mg/kg
arodor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III-142 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Dairy Products

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	3.6E-10	3.0E-03	1.2E-07
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.2E-07

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	3.1E-11	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000697

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Table C.III–143
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	1.2E–09	pCi/kg	U_{234}	2.6E–06	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.3E–07	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.8E–06	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	1.5E–06	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.5E–07	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	1.7E–06	2.2E–10	3.8E–16
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	2.2E–03	3.6E–11	7.9E–14
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	2.1E–04	1.3E–11	2.7E–15
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	3.6E–03	1.6E–11	5.8E–14
U_{235+1d}	1.9E–04	1.6E–11	3.0E–15
U_{238+2d}	4.0E–03	2.0E–11	8.0E–14
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.2E–13

000698

Table C.III-144
Summary of Intake and Risk Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.1	kg/day
FI	Fraction ingested from contaminated source	1	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non-carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non-carcinogens (EDn x365)	2190	days
CS	Concentration of chemicals in vegetables		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium-total	1.1E-06	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor-1254	NA	mg/kg	NA	NA	mg/kg
arodor-1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III-144 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	7.2E-09	3.0E-03	2.4E-06
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.4E-06

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	6.2E-10	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

5860

Table C.III–145
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	3.2E–06	pCi/kg	U_{234}	3.5E–04	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.8E–05	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	3.8E–04	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	1.0E–05	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	3.6E–04	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	6.7E–04	2.2E–10	1.5E–13
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	2.1E–03	3.6E–11	7.6E–14
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	7.5E–02	1.3E–11	9.8E–13
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	7.3E–02	1.6E–11	1.2E–12
U_{235+1d}	3.8E–03	1.6E–11	6.1E–14
U_{238+2d}	8.0E–02	2.0E–11	1.6E–12
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 4.0E–12

Table C.III–146
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Private Ownership: On–Property Perched Groundwater User
Via Incidental Ingestion of Soil

Intake Equation = CS X EF X EDn X FI X IR

IRs	Ingestion rate of soil (RAGS, 1989)	180 mg/day
EF	Exposure frequency	350 days/year
EDn	Exposure Duration	70 Year
FI	Fractional Intake	1 (unitless)
CS	Concentration of radionuclides in soil	

Cs_{137+1d}	NA	pCi/mg	$Th_{232+10d}$	NA	pCi/mg
Np_{237+1d}	5.10E–06	pCi/mg	U_{234}	2.20E–04	pCi/mg
Pu_{238}	NA	pCi/mg	U_{235+1d}	9.00E–05	pCi/mg
Ra_{226+8d}	NA	pCi/mg	U_{238+2d}	NA	pCi/mg
Ra_{228+1d}	NA	pCi/mg	NA	NA	pCi/mg
Rn_{222+4d}	NA	pCi/mg	NA	NA	pCi/mg
Sr_{90+1d}	5.60E–06	pCi/mg	NA	NA	pCi/mg
Tc_{99}	NA	pCi/mg	NA	NA	pCi/mg
Th_{228+7d}	NA	pCi/mg	NA	NA	pCi/mg
Th_{230}	5.20E–04	pCi/mg	NA	NA	pCi/mg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.80E–11	NA
Np_{237+1d}	2.25E+01	2.20E–10	4.95E–09
Pu_{238}	NA	2.20E–10	NA
Ra_{226+8d}	NA	7.80E–10	NA
Ra_{228+1d}	NA	1.00E–10	NA
Rn_{222+4d}	NA	1.70E–12	NA
Sr_{90+1d}	2.47E+01	3.60E–11	8.89E–10
Tc_{99}	NA	1.30E–12	NA
Th_{228+7d}	NA	5.50E–11	NA
Th_{230}	2.29E+03	1.30E–11	2.98E–08
$Th_{232+10d}$	NA	1.70E–10	NA
U_{234}	9.70E+02	1.60E–11	1.55E–08
U_{235+1d}	3.97E+02	1.60E–11	6.35E–09
U_{238+2d}	NA	2.00E–11	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 5.75E–08

5860

Table C.III–147
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Private Ownership: On–Property Perched Groundwater User
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	9.3E–05	pCi/l	U_{234}	6.4E–01	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	3.4E–02	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	7.0E–01	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	5.6E–04	pCi/l	NA	NA	pCi/l
Tc_{99}	1.6E–02	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	4.6E+00	2.2E–10	1.0E–09
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	2.7E+01	3.6E–11	9.9E–10
Tc_{99}	7.8E+02	1.3E–12	1.0E–09
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	3.1E+04	1.6E–11	5.0E–07
U_{235+1d}	1.7E+03	1.6E–11	2.7E–08
U_{238+2d}	3.4E+04	2.0E–11	6.9E–07
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.2E–06

Table C.III–148
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Private Ownership: On–Property Perched Groundwater User
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	2.2E–07	pCi/m^3	U_{234}	NA	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	2.5E–07	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	2.3E–05	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	1.1E–01	2.9E–08	3.2E–09
Pu_{238}	NA	3.9E–08	NA
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	NA	7.7E–12	NA
Sr_{90+1d}	1.2E–01	6.2E–11	7.4E–12
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	1.1E+01	2.9E–08	3.2E–07
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	NA	2.6E–08	NA
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	NA	2.4E–08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 3.3E–07

5860

Table C.III – 149
Summary of Intake Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Private Ownership: On – Property Perched Groundwater User
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.101	kg/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non – carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non – carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in meat		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium – total	6.0E – 08	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor – 1254	NA	mg/kg	NA	NA	mg/kg
arodor – 1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-149 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: On-Property Perched Groundwater User
Via Ingestion of Meat Products

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	6.2E-11	3.0E-03	2.1E-08
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.1E-08

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	6.2E-11	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000706

Table C.III-150
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Private Ownership: On-Property Perched Groundwater User
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	2.8E-04	pCi/kg	U_{234}	4.1E-02	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.7E-02	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.0E-05	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	2.1E-01	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.7E-03	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	5.2E-01	2.2E-10	1.1E-10
Pu_{238}	NA	2.2E-10	NA
Ra_{226+8d}	NA	7.8E-10	NA
Ra_{228+1d}	NA	1.0E-10	NA
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	3.9E+02	3.6E-11	1.4E-08
Tc_{99}	NA	1.3E-12	NA
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	3.2E+00	1.3E-11	4.1E-11
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	7.6E+01	1.6E-11	1.2E-09
U_{235+1d}	3.1E+01	1.6E-11	4.9E-10
U_{238+2d}	3.7E-02	2.0E-11	7.4E-13
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.6E-08

Table C.III – 151
Summary of Intake Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Private Ownership: On–Property Perched Groundwater User
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.4	l/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in animal products		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	2.2E–07	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor–1254	NA	mg/kg	NA	NA	mg/kg
arodor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

5860

Table C.III-151 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: On-Property Perched Groundwater User
Via Ingestion of Dairy Products

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	8.9E-10	3.0E-03	3.0E-07
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		3.0E-07

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	8.9E-10	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000709

0082

Table C.III–152
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Private Ownership: On–Property Perched Groundwater User
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	2.6E–05	pCi/kg	U_{234}	1.2E–01	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	5.0E–02	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	7.2E–05	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	1.1E+00	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.4E–03	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	1.9E–01	2.2E–10	4.1E–11
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	7.7E+03	3.6E–11	2.8E–07
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	1.0E+01	1.3E–11	1.4E–10
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	9.0E+02	1.6E–11	1.4E–08
U_{235+1d}	3.7E+02	1.6E–11	5.9E–09
U_{238+2d}	5.3E–01	2.0E–11	1.1E–11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		3.0E–07

5860

Table C.III – 153
Summary of Intake and Risk Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Private Ownership: On – Property Perched Groundwater User
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.122	kg/day
FI	Fraction ingested from contaminated source	1	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non – carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non – carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in vegetables		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium – total	2.9E – 05	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor – 1254	NA	mg/kg	NA	NA	mg/kg
arodor – 1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg

References

Table C.III-153 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: On-Property Perched Groundwater User
Via Ingestion of Vegetables and Fruits

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	4.9E-08	3.0E-03	1.6E-05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.6E-05

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	4.9E-08	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

5860

Table C.III–154
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Private Ownership: On–Property Perched Groundwater User
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	5.1E–02	pCi/kg	U_{234}	1.9E+00	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	7.7E–01	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	9.8E–03	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	1.4E+01	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	4.7E–01	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	1.5E+02	2.2E–10	3.4E–08
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	4.2E+04	3.6E–11	1.5E–06
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	1.4E+03	1.3E–11	1.8E–08
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	5.6E+03	1.6E–11	9.0E–08
U_{235+1d}	2.3E+03	1.6E–11	3.7E–08
U_{238+2d}	2.9E+01	2.0E–11	5.9E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.7E–06

000713

Table C.III–155
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Private Ownership: On–Property Perched Groundwater User
Via External Radiation

Dose Equivalency Equat: = $[DR \times EF \times EDn \times ET_i \times (1-SH_i)] + [DR \times EF \times EDn \times ET_o \times (1-SH_o)]$

EF	Fraction of year spent exposured	0.96 (unitless)
ED	Exposure duration	70 Year
ET_i	Fraction of day spent indoors	0.76 (unitless)
ET_o	Fraction of day spent outdoors	0.24 (unitless)
SH_i	Shield factor indoors	0.5 (unitless)
SH_o	Shield factor outdoors	NA (unitless)
DR	Radionuclide specific dose concentrations	(see table below)

Cs_{137+1d}	NA	pCi/g	$Th_{232+10d}$	NA	pCi/g
Np_{237+1d}	5.10E–03	pCi/g	U_{234}	2.20E–01	pCi/g
Pu_{238}	NA	pCi/g	U_{235+1d}	9.00E–02	pCi/g
Ra_{226+8d}	NA	pCi/g	U_{238+2d}	NA	pCi/g
Ra_{228+1d}	NA	pCi/g	NA	NA	pCi/g
Rn_{222+4d}	NA	pCi/g	NA	NA	pCi/g
Sr_{90+1d}	5.60E–03	pCi/g	NA	NA	pCi/g
Tc_{99}	NA	pCi/g	NA	NA	pCi/g
Th_{228+7d}	NA	pCi/g	NA	NA	pCi/g
Th_{230}	5.20E–01	pCi/g	NA	NA	pCi/g

Radionuclides	CDI (year pCi/g)	CSF $(g/pCi-year)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.0E–06	NA
Np_{237+1d}	2.1E–01	4.3E–07	9.1E–08
Pu_{238}	NA	2.8E–11	NA
Ra_{226+8d}	NA	6.0E–06	NA
Ra_{228+1d}	NA	2.9E–06	NA
Rn_{222+4d}	NA	5.9E–06	NA
Sr_{90+1d}	2.3E–01	NA	NA
Tc_{99}	NA	6.0E–13	NA
Th_{228+7d}	NA	5.6E–06	NA
Th_{230}	2.2E+01	5.4E–11	1.2E–09
$Th_{232+10d}$	NA	8.5E–06	NA
U_{234}	9.2E+00	3.0E–11	2.7E–10
U_{235+1d}	3.7E+00	2.4E–07	9.0E–07
U_{238+2d}	NA	5.1E–08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
		ILCR Summation =	9.9E–07

Table C.III-156
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Incidental Ingestion of Soil

Intake Equation = CS X EF X EDn X FI X IR

IRs	Ingestion rate of soil (RAGS, 1989)	180 mg/day
EF	Exposure frequency	350 days/year
EDn	Exposure Duration	70 Year
FI	Fractional Intake	1 (unitless)
CS	Concentration of radionuclides in soil	

Cs_{137+1d}	NA	pCi/mg	$Th_{232+10d}$	NA	pCi/mg
Np_{237+1d}	5.10E-06	pCi/mg	U_{234}	2.20E-04	pCi/mg
Pu_{238}	NA	pCi/mg	U_{235+1d}	9.00E-05	pCi/mg
Ra_{226+8d}	NA	pCi/mg	U_{238+2d}	NA	pCi/mg
Ra_{228+1d}	NA	pCi/mg	NA	NA	pCi/mg
Rn_{222+4d}	NA	pCi/mg	NA	NA	pCi/mg
Sr_{90+1d}	5.60E-06	pCi/mg	NA	NA	pCi/mg
Tc_{99}	NA	pCi/mg	NA	NA	pCi/mg
Th_{228+7d}	NA	pCi/mg	NA	NA	pCi/mg
Th_{230}	5.20E-04	pCi/mg	NA	NA	pCi/mg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.80E-11	NA
Np_{237+1d}	2.25E+01	2.20E-10	4.95E-09
Pu_{238}	NA	2.20E-10	NA
Ra_{226+8d}	NA	7.80E-10	NA
Ra_{228+1d}	NA	1.00E-10	NA
Rn_{222+4d}	NA	1.70E-12	NA
Sr_{90+1d}	2.47E+01	3.60E-11	8.89E-10
Tc_{99}	NA	1.30E-12	NA
Th_{228+7d}	NA	5.50E-11	NA
Th_{230}	2.29E+03	1.30E-11	2.98E-08
$Th_{232+10d}$	NA	1.70E-10	NA
U_{234}	9.70E+02	1.60E-11	1.55E-08
U_{235+1d}	3.97E+02	1.60E-11	6.35E-09
U_{238+2d}	NA	2.00E-11	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 5.75E-08

Table C.III-157
Summary of Intake Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	2	l/day
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non-carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non-carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in groundwater		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium-total	6.00E-06	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
arodor-1254	NA	mg/l	NA	NA	mg/l
arodor-1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

000716

Table C.III-157 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Drinking Water Ingestion

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	1.64E-07	3.00E-03	5.48E-05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		5.48E-05

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	1.64E-07	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

0986

Table C.III–158
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	1.9E–03	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	1.0E–04	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	2.0E–03	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	9.3E+01	1.6E–11	1.5E–09
U_{235+1d}	4.9E+00	1.6E–11	7.8E–11
U_{238+2d}	9.8E+01	2.0E–11	2.0E–09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 3.5E–09

000718

Table C.III-159
Summary of Intake Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv	mg/cm^2-day
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non-carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non-carcinogens (EDn x365)	25550	days
SA	Skin surface area available for contact	23000	cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arsenic	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
beryllium	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
uranium-total	1.50E-12	mg/cm^2-day	NA	NA	mg/cm^2-day
benzo(a)pyrene	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
carbazole	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arodor-1254	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arodor-1260	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
dieldrin	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day

References

0086

Table C.III-159 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Dermal Contact while Bathing

Compound	HQ Calculation		
	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	4.73E-10	1.50E-04	3.15E-06
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		3.15E-06

Compound	ILCR Calculation		
	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	4.73E-10	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000720

5860

Table C.III–160
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	2.2E–07	pCi/m^3	U_{234}	NA	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	2.5E–07	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	2.3E–05	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	1.1E–01	2.9E–08	3.2E–09
Pu_{238}	NA	3.9E–08	NA
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	NA	7.7E–12	NA
Sr_{90+1d}	1.2E–01	6.2E–11	7.4E–12
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	1.1E+01	2.9E–08	3.2E–07
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	NA	2.6E–08	NA
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	NA	2.4E–08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 3.3E–07

Table C.III – 161
Summary of Intake Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Federal Ownership: On – Property RME Resident Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.101	kg/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non – carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non – carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in meat		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium – total	6.0E–08	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor – 1254	NA	mg/kg	NA	NA	mg/kg
arodor – 1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III-161 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Ingestion of Meat Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	6.2E-11	3.0E-03	2.1E-08
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.1E-08

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	6.2E-11	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000723

Table C.III–162
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	2.8E–04	pCi/kg	U_{234}	4.1E–02	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.7E–02	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.0E–05	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	2.1E–01	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.7E–03	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	5.2E–01	2.2E–10	1.1E–10
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	3.9E+02	3.6E–11	1.4E–08
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	3.2E+00	1.3E–11	4.1E–11
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	7.6E+01	1.6E–11	1.2E–09
U_{235+1d}	3.1E+01	1.6E–11	4.9E–10
U_{238+2d}	3.7E–02	2.0E–11	7.4E–13
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.6E–08

Table C.III – 163
Summary of Intake Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Federal Ownership: On – Property RME Resident Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.4	l/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non – carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non – carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in animal products		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium – total	2.2E – 07	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor – 1254	NA	mg/kg	NA	NA	mg/kg
arodor – 1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III-163 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Ingestion of Dairy Products

Compound	HQ Calculation		
	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	8.9E-10	3.0E-03	3.0E-07
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		3.0E-07

Compound	ILCR Calculation		
	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	8.9E-10	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000726

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Table C.III–164
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	2.6E−05	pCi/kg	U_{234}	1.2E−01	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	5.0E−02	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	7.2E−05	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	1.1E+00	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.4E−03	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	1.9E−01	2.2E−10	4.1E−11
Pu_{238}	NA	2.2E−10	NA
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	7.7E+03	3.6E−11	2.8E−07
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	1.0E+01	1.3E−11	1.4E−10
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	9.0E+02	1.6E−11	1.4E−08
U_{235+1d}	3.7E+02	1.6E−11	5.9E−09
U_{238+2d}	5.3E−01	2.0E−11	1.1E−11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	3.0E−07

000727

Table C.III – 165
Summary of Intake and Risk Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.122	kg/day
FI	Fraction ingested from contaminated source	1	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x365)	25550	days
CS	Concentration of chemicals in vegetables		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	2.9E–05	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
arodor–1254	NA	mg/kg	NA	NA	mg/kg
arodor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III-165 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Ingestion of Vegetables and Fruits

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	4.9E-08	3.0E-03	1.6E-05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.6E-05

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	4.9E-08	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

0080

Table C.III–166
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	5.1E–02	pCi/kg	U_{234}	1.9E+00	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	7.7E–01	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	9.8E–03	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	1.4E+01	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	4.7E–01	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	1.5E+02	2.2E–10	3.4E–08
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	4.2E+04	3.6E–11	1.5E–06
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	1.4E+03	1.3E–11	1.8E–08
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	5.6E+03	1.6E–11	9.0E–08
U_{235+1d}	2.3E+03	1.6E–11	3.7E–08
U_{238+2d}	2.9E+01	2.0E–11	5.9E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	1.7E–06

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Table C.III-167
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via External Radiation

Dose Equivalency Equat: = $[DR \times EF \times EDn \times ET_i \times (1-SH_i)] + [DR \times EF \times EDn \times ET_o \times (1-SH_o)]$

EF	Fraction of year spent exposured	0.96 (unitless)
ED	Exposure duration	70 Year
ET_i	Fraction of day spent indoors	0.76 (unitless)
ET_o	Fraction of day spent outdoors	0.24 (unitless)
SH_i	Shield factor indoors	0.5 (unitless)
SH_o	Shield factor outdoors	NA (unitless)
DR	Radionuclide specific dose concentrations	(see table below)

Cs_{137+1d}	NA	pCi/g	$Th_{232+10d}$	NA	pCi/g
Np_{237+1d}	5.10E-03	pCi/g	U_{234}	2.20E-01	pCi/g
Pu_{238}	NA	pCi/g	U_{235+1d}	9.00E-02	pCi/g
Ra_{226+8d}	NA	pCi/g	U_{238+2d}	NA	pCi/g
Ra_{228+1d}	NA	pCi/g	NA	NA	pCi/g
Rn_{222+4d}	NA	pCi/g	NA	NA	pCi/g
Sr_{90+1d}	5.60E-03	pCi/g	NA	NA	pCi/g
Tc_{99}	NA	pCi/g	NA	NA	pCi/g
Th_{228+7d}	NA	pCi/g	NA	NA	pCi/g
Th_{230}	5.20E-01	pCi/g	NA	NA	pCi/g

Radionuclides	CDI (year pCi/g)	CSF $(g/pCi-year)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.0E-06	NA
Np_{237+1d}	2.1E-01	4.3E-07	9.1E-08
Pu_{238}	NA	2.8E-11	NA
Ra_{226+8d}	NA	6.0E-06	NA
Ra_{228+1d}	NA	2.9E-06	NA
Rn_{222+4d}	NA	5.9E-06	NA
Sr_{90+1d}	2.3E-01	NA	NA
Tc_{99}	NA	6.0E-13	NA
Th_{228+7d}	NA	5.6E-06	NA
Th_{230}	2.2E+01	5.4E-11	1.2E-09
$Th_{232+10d}$	NA	8.5E-06	NA
U_{234}	9.2E+00	3.0E-11	2.7E-10
U_{235+1d}	3.7E+00	2.4E-07	9.0E-07
U_{238+2d}	NA	5.1E-08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 9.9E-07

Table C.III–168
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Private Ownership: On–Property Farmer (Child)
Via Incidental Ingestion of Soil

Intake Equation = CS X EF X EDn X FI X IR

IRs	Ingestion rate of soil (RAGS, 1989)	200 mg/day
EF	Exposure frequency	350 days/year
EDn	Exposure Duration	6 Year
FI	Fractional Intake	1 (unitless)
CS	Concentration of radionuclides in soil	

Cs_{137+1d}	0.00E+00	pCi/mg	$Th_{232+10d}$	0.00E+00	pCi/mg
Np_{237+1d}	5.10E−06	pCi/mg	U_{234}	2.20E−04	pCi/mg
Pu_{238}	0.00E+00	pCi/mg	U_{235+1d}	9.00E−05	pCi/mg
Ra_{226+8d}	0.00E+00	pCi/mg	U_{238+2d}	0.00E+00	pCi/mg
Ra_{228+1d}	0.00E+00	pCi/mg	0	0.00E+00	pCi/mg
Rn_{222+4d}	0.00E+00	pCi/mg	0	0.00E+00	pCi/mg
Sr_{90+1d}	5.60E−06	pCi/mg	0	0.00E+00	pCi/mg
Tc_{99}	0.00E+00	pCi/mg	0	0.00E+00	pCi/mg
Th_{228+7d}	0.00E+00	pCi/mg	0	0.00E+00	pCi/mg
Th_{230}	5.20E−04	pCi/mg	0	0.00E+00	pCi/mg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.80E−11	NA
Np_{237+1d}	2.14E+00	2.20E−10	4.71E−10
Pu_{238}	NA	2.20E−10	NA
Ra_{226+8d}	NA	7.80E−10	NA
Ra_{228+1d}	NA	1.00E−10	NA
Rn_{222+4d}	NA	1.70E−12	NA
Sr_{90+1d}	2.35E+00	3.60E−11	8.47E−11
Tc_{99}	NA	1.30E−12	NA
Th_{228+7d}	NA	5.50E−11	NA
Th_{230}	2.18E+02	1.30E−11	2.84E−09
$Th_{232+10d}$	NA	1.70E−10	NA
U_{234}	9.24E+01	1.60E−11	1.48E−09
U_{235+1d}	3.78E+01	1.60E−11	6.05E−10
U_{238+2d}	NA	2.00E−11	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA

ILCR Summation = 5.48E−09

Table C.III-169
Summary of Intake Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Private Ownership: On-Property Farmer (Child)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	1	l/day
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non-carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non-carcinogens (EDn x365)	2190	days
CS	Concentration of chemicals in groundwater		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	0.00E+00	mg/l	0	0.00E+00	mg/l
arsenic	0.00E+00	mg/l	0	0.00E+00	mg/l
beryllium	0.00E+00	mg/l	0	0.00E+00	mg/l
uranium-total	6.00E-06	mg/l	0	0.00E+00	mg/l
benzo(a)pyrene	0.00E+00	mg/l	0	0.00E+00	mg/l
carbazole	0.00E+00	mg/l	0	0.00E+00	mg/l
arodor-1254	0.00E+00	mg/l	0	0.00E+00	mg/l
arodor-1260	0.00E+00	mg/l	0	0.00E+00	mg/l
dieldrin	0.00E+00	mg/l	0	0.00E+00	mg/l
0	0.00E+00	mg/l	0	0.00E+00	mg/l
0	0.00E+00	mg/l	0	0.00E+00	mg/l
0	0.00E+00	mg/l	0	0.00E+00	mg/l
0	0.00E+00	mg/l	0	0.00E+00	mg/l
0	0.00E+00	mg/l	0	0.00E+00	mg/l
0	0.00E+00	mg/l	0	0.00E+00	mg/l
0	0.00E+00	mg/l			

References

Table C.III-169 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: On-Property Farmer (Child)
Via Drinking Water Ingestion

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	3.84E-07	3.00E-03	1.28E-04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
HQ Summation =			1.28E-04

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	3.29E-08	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
ILCR Summation =			0.00E+00

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Table C.III-170
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Private Ownership: On-Property Farmer (Child)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	0.0E+00	pCi/l	$Th_{232+10d}$	0.0E+00	pCi/l
Np_{237+1d}	0.0E+00	pCi/l	U_{234}	1.9E-03	pCi/l
Pu_{238}	0.0E+00	pCi/l	U_{235+1d}	1.0E-04	pCi/l
Ra_{226+8d}	0.0E+00	pCi/l	U_{238+2d}	2.0E-03	pCi/l
Ra_{228+1d}	0.0E+00	pCi/l	0.0E+00	0.0E+00	pCi/l
Rn_{222+4d}	0.0E+00	pCi/l	0.0E+00	0.0E+00	pCi/l
Sr_{90+1d}	0.0E+00	pCi/l	0.0E+00	0.0E+00	pCi/l
Tc_{99}	0.0E+00	pCi/l	0.0E+00	0.0E+00	pCi/l
Th_{228+7d}	0.0E+00	pCi/l	0.0E+00	0.0E+00	pCi/l
Th_{230}	0.0E+00	pCi/l	0.0E+00	0.0E+00	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	NA	2.2E-10	NA
Pu_{238}	NA	2.2E-10	NA
Ra_{226+8d}	NA	7.8E-10	NA
Ra_{228+1d}	NA	1.0E-10	NA
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	NA	3.6E-11	NA
Tc_{99}	NA	1.3E-12	NA
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	NA	1.3E-11	NA
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	4.0E+00	1.6E-11	6.4E-11
U_{235+1d}	2.1E-01	1.6E-11	3.4E-12
U_{238+2d}	4.2E+00	2.0E-11	8.4E-11
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA

ILCR Summation = 1.5E-10

Table C.III-171
Summary of Intake Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Private Ownership: On-Property Farmer (Child)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv	mg/cm^2-day
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non-carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non-carcinogens (EDn x365)	2190	days
SA	Skin surface area available for contact	8000	cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2-day	0	NA	mg/cm^2-day
arsenic	NA	mg/cm^2-day	0	NA	mg/cm^2-day
beryllium	NA	mg/cm^2-day	0	NA	mg/cm^2-day
uranium-total	1.50E-12	mg/cm^2-day	0	NA	mg/cm^2-day
benzo(a)pyrene	NA	mg/cm^2-day	0	NA	mg/cm^2-day
carbazole	NA	mg/cm^2-day	0	NA	mg/cm^2-day
arodor-1254	NA	mg/cm^2-day	0	NA	mg/cm^2-day
arodor-1260	NA	mg/cm^2-day	0	NA	mg/cm^2-day
dieldrin	NA	mg/cm^2-day	0	NA	mg/cm^2-day
0	NA	mg/cm^2-day	0	NA	mg/cm^2-day
0	NA	mg/cm^2-day	0	NA	mg/cm^2-day
0	NA	mg/cm^2-day	0	NA	mg/cm^2-day
0	NA	mg/cm^2-day	0	NA	mg/cm^2-day
0	NA	mg/cm^2-day	0	NA	mg/cm^2-day
0	NA	mg/cm^2-day	0	NA	mg/cm^2-day
0	NA	mg/cm^2-day			

References

Table C.III-171
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: On-Property Farmer (Child)
Via Dermal Contact while Bathing

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	7.67E-10	1.50E-04	5.11E-06
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
	HQ Summation =		5.11E-06

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	6.58E-11	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
	ILCR Summation =		0.00E+00

Table C.III–172
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Private Ownership: On–Property Farmer (Child)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	0.0E+00	pCi/m^3	$Th_{232+10d}$	0.0E+00	pCi/m^3
Np_{237+1d}	2.2E–07	pCi/m^3	U_{234}	0.0E+00	pCi/m^3
Pu_{238}	0.0E+00	pCi/m^3	U_{235+1d}	0.0E+00	pCi/m^3
Ra_{226+8d}	0.0E+00	pCi/m^3	U_{238+2d}	0.0E+00	pCi/m^3
Ra_{228+1d}	0.0E+00	pCi/m^3	0.0E+00	0.0E+00	pCi/m^3
Rn_{222+4d}	0.0E+00	pCi/m^3	0.0E+00	0.0E+00	pCi/m^3
Sr_{90+1d}	2.5E–07	pCi/m^3	0.0E+00	0.0E+00	pCi/m^3
Tc_{99}	0.0E+00	pCi/m^3	0.0E+00	0.0E+00	pCi/m^3
Th_{228+7d}	0.0E+00	pCi/m^3	0.0E+00	0.0E+00	pCi/m^3
Th_{230}	2.3E–05	pCi/m^3	0.0E+00	0.0E+00	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	5.6E–03	2.9E–08	1.6E–10
Pu_{238}	NA	3.9E–08	NA
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	NA	7.7E–12	NA
Sr_{90+1d}	6.2E–03	6.2E–11	3.8E–13
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	5.7E–01	2.9E–08	1.7E–08
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	NA	2.6E–08	NA
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	NA	2.4E–08	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
		ILCR Summation =	1.7E–08

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Table C.III-173
Summary of Intake Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Private Ownership: On-Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.039	kg/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non-carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non-carcinogens (EDn x365)	2190	days
CS	Concentration of chemicals in meat		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	0.0E+00	mg/kg	***	0.0E+00	mg/kg
arsenic	0.0E+00	mg/kg	***	0.0E+00	mg/kg
beryllium	0.0E+00	mg/kg	***	0.0E+00	mg/kg
uranium-total	6.0E-08	mg/kg	***	0.0E+00	mg/kg
benzo(a)pyrene	0.0E+00	mg/kg	***	0.0E+00	mg/kg
carbazole	0.0E+00	mg/kg	***	0.0E+00	mg/kg
arodor-1254	0.0E+00	mg/kg	***	0.0E+00	mg/kg
arodor-1260	0.0E+00	mg/kg	***	0.0E+00	mg/kg
dieldrin	0.0E+00	mg/kg	***	0.0E+00	mg/kg
0	0.0E+00	mg/kg	***	0.0E+00	mg/kg
0	0.0E+00	mg/kg	***	0.0E+00	mg/kg
0	0.0E+00	mg/kg	***	0.0E+00	mg/kg
0	0.0E+00	mg/kg	***	0.0E+00	mg/kg
0	0.0E+00	mg/kg	***	0.0E+00	mg/kg
0	0.0E+00	mg/kg	***	0.0E+00	mg/kg
0	0.0E+00	mg/kg			

References

Table C.III–173 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: On–Property Farmer (Child)
Via Ingestion of Meat Products

Compound	HQ Calculation CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	4.0E–04	NA
arsenic	NA	3.0E–04	NA
beryllium	NA	5.0E–03	NA
uranium–total	1.1E–10	3.0E–03	3.7E–08
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	5.0E–05	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
HQ Summation =			3.7E–08

Compound	ILCR Calculation CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium–total	9.6E–12	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E–02	NA
aroclor–1254	NA	7.7E+00	NA
aroclor–1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
ILCR Summation =			0.0E+00

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Table C.III–174
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Private Ownership: On–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	0.0E+00	pCi/kg	$Th_{232+10d}$	0.0E+00	pCi/kg
Np_{237+1d}	2.8E–04	pCi/kg	U_{234}	4.1E–02	pCi/kg
Pu_{238}	0.0E+00	pCi/kg	U_{235+1d}	1.7E–02	pCi/kg
Ra_{226+8d}	0.0E+00	pCi/kg	U_{238+2d}	2.0E–05	pCi/kg
Ra_{228+1d}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Sr_{90+1d}	2.1E–01	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Tc_{99}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Th_{228+7d}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Th_{230}	1.7E–03	pCi/kg	0.0E+00	0.0E+00	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	1.7E–02	2.2E–10	3.8E–12
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	1.3E+01	3.6E–11	4.7E–10
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	1.0E–01	1.3E–11	1.4E–12
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	2.5E+00	1.6E–11	4.0E–11
U_{235+1d}	1.0E+00	1.6E–11	1.6E–11
U_{238+2d}	1.2E–03	2.0E–11	2.5E–14
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA

ILCR Summation = 5.3E–10

000741

Table C.III – 175
Summary of Intake Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Private Ownership: On – Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.9	l/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non – carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non – carcinogens (EDn x365)	2190	days
CS	Concentration of chemicals in animal products		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	0.0E+00	mg/kg	***	0.0E+00	mg/kg
arsenic	0.0E+00	mg/kg	***	0.0E+00	mg/kg
beryllium	0.0E+00	mg/kg	***	0.0E+00	mg/kg
uranium – total	2.2E – 07	mg/kg	***	0.0E+00	mg/kg
benzo(a)pyrene	0.0E+00	mg/kg	***	0.0E+00	mg/kg
carbazole	0.0E+00	mg/kg	***	0.0E+00	mg/kg
arodor – 1254	0.0E+00	mg/kg	***	0.0E+00	mg/kg
arodor – 1260	0.0E+00	mg/kg	***	0.0E+00	mg/kg
dieldrin	0.0E+00	mg/kg	***	0.0E+00	mg/kg
********	0.0E+00	mg/kg	***	0.0E+00	mg/kg
********	0.0E+00	mg/kg	***	0.0E+00	mg/kg
********	0.0E+00	mg/kg	***	0.0E+00	mg/kg
********	0.0E+00	mg/kg	***	0.0E+00	mg/kg
********	0.0E+00	mg/kg	***	0.0E+00	mg/kg
********	0.0E+00	mg/kg	***	0.0E+00	mg/kg
********	0.0E+00	mg/kg			

References

000732

Table C.III–175 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: On–Property Farmer (Child)
Via Ingestion of Dairy Products

Compound	HQ Calculation CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	4.0E–04	NA
arsenic	NA	3.0E–04	NA
beryllium	NA	5.0E–03	NA
uranium–total	9.3E–09	3.0E–03	3.1E–06
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	5.0E–05	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
	HQ Summation =		3.1E–06

Compound	ILCR Calculation CDI (mg/kg–day)	CSF (mg/kg–day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium–total	8.0E–10	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E–02	NA
aroclor–1254	NA	7.7E+00	NA
aroclor–1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
	ILCR Summation =		0.0E+00

Table C.III–176
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Private Ownership: On–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	0.0E+00	pCi/kg	$Th_{232+10d}$	0.0E+00	pCi/kg
Np_{237+1d}	2.6E−05	pCi/kg	U_{234}	1.2E−01	pCi/kg
Pu_{238}	0.0E+00	pCi/kg	U_{235+1d}	5.0E−02	pCi/kg
Ra_{226+8d}	0.0E+00	pCi/kg	U_{238+2d}	7.2E−05	pCi/kg
Ra_{228+1d}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Sr_{90+1d}	1.1E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Tc_{99}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Th_{228+7d}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Th_{230}	1.4E−03	pCi/kg	0.0E+00	0.0E+00	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	3.6E−02	2.2E−10	8.0E−12
Pu_{238}	NA	2.2E−10	NA
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	1.5E+03	3.6E−11	5.4E−08
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	2.0E+00	1.3E−11	2.6E−11
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	1.7E+02	1.6E−11	2.8E−09
U_{235+1d}	7.1E+01	1.6E−11	1.1E−09
U_{238+2d}	1.0E−01	2.0E−11	2.0E−12
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA

ILCR Summation = 5.8E−08

Table C.III-177
Summary of Intake and Risk Quantitation (chemicals) Alternative 6
Lime Sludge Pond with Private Ownership: On-Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.1	kg/day
FI	Fraction ingested from contaminated source	1	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non-carcinogens	6	Year
EDc	Exposure duration for carcinogens	6	Year
BW	Body weight	15	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non-carcinogens (EDn x365)	2190	days
CS	Concentration of chemicals in vegetables		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	0.0E+00	mg/kg	***	0.0E+00	mg/kg
arsenic	0.0E+00	mg/kg	***	0.0E+00	mg/kg
beryllium	0.0E+00	mg/kg	***	0.0E+00	mg/kg
uranium-total	2.9E-05	mg/kg	***	0.0E+00	mg/kg
benzo(a)pyrene	0.0E+00	mg/kg	***	0.0E+00	mg/kg
carbazole	0.0E+00	mg/kg	***	0.0E+00	mg/kg
arodor-1254	0.0E+00	mg/kg	***	0.0E+00	mg/kg
arodor-1260	0.0E+00	mg/kg	***	0.0E+00	mg/kg
dieldrin	0.0E+00	mg/kg	***	0.0E+00	mg/kg
********	0.0E+00	mg/kg	***	0.0E+00	mg/kg
********	0.0E+00	mg/kg	***	0.0E+00	mg/kg
********	0.0E+00	mg/kg	***	0.0E+00	mg/kg
********	0.0E+00	mg/kg	***	0.0E+00	mg/kg
********	0.0E+00	mg/kg	***	0.0E+00	mg/kg
********	0.0E+00	mg/kg	***	0.0E+00	mg/kg
********	0.0E+00	mg/kg	***	0.0E+00	mg/kg

References

Table C.III–177 (continued)
Summary of Risk Characterization (chemicals)
Lime Sludge Pond with Private Ownership: On–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Compound	HQ Calculation CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	4.0E–04	NA
arsenic	NA	3.0E–04	NA
beryllium	NA	5.0E–03	NA
uranium–total	1.9E–07	3.0E–03	6.3E–05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	5.0E–05	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
HQ Summation =			6.3E–05

Compound	ILCR Calculation CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium–total	1.6E–08	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E–02	NA
aroclor–1254	NA	7.7E+00	NA
aroclor–1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
ILCR Summation =			0.0E+00

5860

Table C.III–178
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Private Ownership: On–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	0.0E+00	pCi/kg	$Th_{232+10d}$	0.0E+00	pCi/kg
Np_{237+1d}	5.1E−02	pCi/kg	U_{234}	1.9E+00	pCi/kg
Pu_{238}	0.0E+00	pCi/kg	U_{235+1d}	7.7E−01	pCi/kg
Ra_{226+8d}	0.0E+00	pCi/kg	U_{238+2d}	9.8E−03	pCi/kg
Ra_{228+1d}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Sr_{90+1d}	1.4E+01	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Tc_{99}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Th_{228+7d}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Th_{230}	4.7E−01	pCi/kg	0.0E+00	0.0E+00	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	1.1E+01	2.2E−10	2.4E−09
Pu_{238}	NA	2.2E−10	NA
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	2.9E+03	3.6E−11	1.1E−07
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	9.9E+01	1.3E−11	1.3E−09
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	3.9E+02	1.6E−11	6.3E−09
U_{235+1d}	1.6E+02	1.6E−11	2.6E−09
U_{238+2d}	2.1E+00	2.0E−11	4.1E−11
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA

ILCR Summation = 1.2E−07

Table C.III-179
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Lime Sludge Pond with Private Ownership: On-Property Farmer (Child)
Via External Radiation

Dose Equivalency Equat: = $[DR \times EF \times EDn \times ET_i \times (1-SH_i)] + [DR \times EF \times EDn \times ET_o \times (1-SH_o)]$

EF	Fraction of year spent exposured	0.96 (unitless)
ED	Exposure duration	6 Year
ET_i	Fraction of day spent indoors	0.92 (unitless)
ET_o	Fraction of day spent outdoors	0.08 (unitless)
SH_i	Shield factor indoors	0.5 (unitless)
SH_o	Shield factor outdoors	0 (unitless)
DR	Radionuclide specific dose concentrations	(see table below)

Cs_{137+1d}	NA	pCi/g	$Th_{232+10d}$	NA	pCi/g
Np_{237+1d}	5.10E-03	pCi/g	U_{234}	2.20E-01	pCi/g
Pu_{238}	NA	pCi/g	U_{235+1d}	9.00E-02	pCi/g
Ra_{226+8d}	NA	pCi/g	U_{238+2d}	NA	pCi/g
Ra_{228+1d}	NA	pCi/g	0	NA	pCi/g
Rn_{222+4d}	NA	pCi/g	0	NA	pCi/g
Sr_{90+1d}	5.60E-03	pCi/g	0	NA	pCi/g
Tc_{99}	NA	pCi/g	0	NA	pCi/g
Th_{228+7d}	NA	pCi/g	0	NA	pCi/g
Th_{230}	5.20E-01	pCi/g	0	NA	pCi/g

Radionuclides	CDI (year pCi/g)	CSF $(g/pCi-year)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.0E-06	NA
Np_{237+1d}	1.6E-02	4.3E-07	6.8E-09
Pu_{238}	NA	2.8E-11	NA
Ra_{226+8d}	NA	6.0E-06	NA
Ra_{228+1d}	NA	2.9E-06	NA
Rn_{222+4d}	NA	5.9E-06	NA
Sr_{90+1d}	1.7E-02	NA	0.0E+00
Tc_{99}	NA	6.0E-13	NA
Th_{228+7d}	NA	5.6E-06	NA
Th_{230}	1.6E+00	5.4E-11	8.7E-11
$Th_{232+10d}$	NA	8.5E-06	NA
U_{234}	6.8E-01	3.0E-11	2.1E-11
U_{235+1d}	2.8E-01	2.4E-07	6.7E-08
U_{238+2d}	NA	5.1E-08	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
		ILCR Summation =	7.4E-08

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Table C.III-180
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
Solid Waste Landfill with Federal Ownership: Expanded Trespasser
Via Inhalation of Gases and Particulates

Intake Equation = CA X EFa X EDa X IR X ETa + CA X EFc EDc X IR X ETc

IR	Inhalation rate of gases	0.83 m^3/hour
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure duration	32 Year
EDc	Exposure duration	12 Year
ETa	Exposure time (adult)	1 hour/day
ETc	Exposure time (child)	2 hour/day
CA	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	NA	pCi/m^3	U_{234}	NA	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	4.1E-07	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	NA	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E-11	NA
Np_{237+1d}	NA	2.9E-08	NA
Pu_{238}	NA	3.9E-08	NA
Ra_{226+8d}	NA	7.0E-09	NA
Ra_{228+1d}	NA	6.9E-10	NA
Rn_{222+4d}	1.3E-03	7.7E-12	1.0E-14
Sr_{90+1d}	NA	6.2E-11	NA
Tc_{99}	NA	8.3E-12	NA
Th_{228+7d}	NA	7.8E-08	NA
Th_{230}	NA	2.9E-08	NA
$Th_{232+10d}$	NA	1.1E-07	NA
U_{234}	NA	2.6E-08	NA
U_{235+1d}	NA	2.5E-08	NA
U_{238+2d}	NA	2.4E-08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.0E-14

Table C.III-181
Summary of Intake Quantitation (chemicals) Alternative 2
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Adult)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium-total	2.00E-06	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
aroclor-1254	NA	mg/l	NA	NA	mg/l
aroclor-1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

Table C.III–181 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Adult)
Via Drinking Water Ingestion

Compound	HQ Calculation CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	4.00E–04	NA
arsenic	NA	3.00E–04	NA
beryllium	NA	5.00E–03	NA
uranium–total	5.48E–08	3.00E–03	1.83E–05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	5.00E–05	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	HQ Summation =		1.83E–05

Compound	ILCR Calculation CDI (mg/kg–day)	CSF (mg/kg–day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium–total	5.48E–08	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E–02	NA
aroclor–1254	NA	7.70E+00	NA
aroclor–1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	ILCR Summation =		NA

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Table C.III–182
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	7.0E–04	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	7.0E–04	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	7.0E–04	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	3.4E+01	1.6E–11	5.5E–10
U_{235+1d}	3.4E+01	1.6E–11	5.5E–10
U_{238+2d}	3.4E+01	2.0E–11	6.9E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.8E–09

Table C.III-183
Summary of Intake Quantitation (chemicals) Alternative 2
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Adult)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2-day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	25550 days
SA	Skin surface area available for contact	23000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arsenic	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
beryllium	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
uranium-total	5.00E-13	mg/cm^2-day	NA	NA	mg/cm^2-day
benzo(a)pyrene	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
carbazole	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
aroclor-1254	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
aroclor-1260	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
dieldrin	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day			

References

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Table C.III–183 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Adult)
Via Dermal Contact while Bathing

	HQ Calculation		
Compound	CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	6.00E–05	NA
arsenic	NA	2.85E–04	NA
beryllium	NA	5.00E–03	NA
uranium–total	1.58E–10	1.50E–04	1.05E–06
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	4.50E–05	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	HQ Summation =		1.05E–06

	ILCR Calculation		
Compound	CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium–total	1.58E–10	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E–02	NA
aroclor–1254	NA	1.03E+01	NA
aroclor–1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	ILCR Summation =		NA

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Table C.III–184
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Adult)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	NA	pCi/m^3	U_{234}	NA	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	1.1E–08	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	NA	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	NA	2.9E–08	NA
Pu_{238}	NA	3.9E–08	NA
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	5.5E–03	7.7E–12	4.2E–14
Sr_{90+1d}	NA	6.2E–11	NA
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	NA	2.9E–08	NA
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	NA	2.6E–08	NA
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	NA	2.4E–08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 4.2E–14

Table C.III–185
Summary of Intake Quantitation (chemicals) Alternative 2
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.101	kg/day
FI	Fraction ingested from contaminated source	0.75	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x 365)	25550	days
CS	Concentration of chemicals in meat		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	2.0E–08	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-185 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Meat Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	2.1E-11	3.0E-03	6.9E-09
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		6.9E-09

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	2.1E-11	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

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Table C.III–186
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	NA	pCi/kg	U_{234}	7.0E−06	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	7.0E−06	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	7.0E−06	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	NA	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	NA	2.2E−10	NA
Pu_{238}	NA	2.2E−10	NA
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	NA	3.6E−11	NA
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	NA	1.3E−11	NA
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	1.3E−02	1.6E−11	2.1E−13
U_{235+1d}	1.3E−02	1.6E−11	2.1E−13
U_{238+2d}	1.3E−02	2.0E−11	2.6E−13
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	6.8E−13

Table C.III – 187
Summary of Intake Quantitation (chemicals) Alternative 2
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	7.2E–08	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III-187 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Dairy Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	3.0E-10	3.0E-03	9.9E-08
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		9.9E-08

Compound	ILCR Calculation CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	3.0E-10	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

Table C.III–188
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	NA	pCi/kg	U_{234}	2.5E–05	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	2.5E–05	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.5E–05	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	NA	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.9E–01	1.6E–11	3.0E–12
U_{235+1d}	1.9E–01	1.6E–11	3.0E–12
U_{238+2d}	1.9E–01	2.0E–11	3.7E–12
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	9.6E–12

Table C.III-189
Summary of Intake Quantitation (chemicals) Alternative 2
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium-total	9.8E-06	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor-1254	NA	mg/kg	NA	NA	mg/kg
aroclor-1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-189 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.6E-08	3.0E-03	5.5E-06
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		5.5E-06

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.6E-08	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

5860

Table C.III–190
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	NA	pCi/kg	U_{234}	3.4E–03	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	3.4E–03	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	3.4E–03	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	NA	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.0E+01	1.6E–11	1.6E–10
U_{235+1d}	1.0E+01	1.6E–11	1.6E–10
U_{238+2d}	1.0E+01	2.0E–11	2.0E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 5.3E–10

Table C.III–191
Summary of Intake Quantitation (chemicals) Alternative 2
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Child)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium–total	2.00E–06	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
aroclor–1254	NA	mg/l	NA	NA	mg/l
aroclor–1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

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Table C.III-191 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Child)
Via Drinking Water Ingestion

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	1.28E-07	3.00E-03	4.26E-05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	HQ Summation =		4.26E-05

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	1.10E-08	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	ILCR Summation =		NA

Table C.III–192
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	7.0E–04	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	7.0E–04	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	7.0E–04	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.5E+00	1.6E–11	2.4E–11
U_{235+1d}	1.5E+00	1.6E–11	2.4E–11
U_{238+2d}	1.5E+00	2.0E–11	2.9E–11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	7.6E–11

Table C.III–193
Summary of Intake Quantitation (chemicals) Alternative 2
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Child)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2–day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
SA	Skin surface area available for contact	8000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
arsenic	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
beryllium	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
uranium–total	5.00E–13	mg/cm^2–day	NA	NA	mg/cm^2–day
benzo(a)pyrene	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
carbazole	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1254	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1260	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
dieldrin	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day			

References

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Table C.III-193 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Child)
Via Dermal Contact while Bathing

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	2.56E-10	1.50E-04	1.70E-06
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.70E-06

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	2.19E-11	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000770

5860

Table C.III-194
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Child)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	NA	pCi/m^3	U_{234}	NA	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	1.1E-08	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	NA	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E-11	NA
Np_{237+1d}	NA	2.9E-08	NA
Pu_{238}	NA	3.9E-08	NA
Ra_{226+8d}	NA	7.0E-09	NA
Ra_{228+1d}	NA	6.9E-10	NA
Rn_{222+4d}	2.8E-04	7.7E-12	2.2E-15
Sr_{90+1d}	NA	6.2E-11	NA
Tc_{99}	NA	8.3E-12	NA
Th_{228+7d}	NA	7.8E-08	NA
Th_{230}	NA	2.9E-08	NA
$Th_{232+10d}$	NA	1.1E-07	NA
U_{234}	NA	2.6E-08	NA
U_{235+1d}	NA	2.5E-08	NA
U_{238+2d}	NA	2.4E-08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.2E-15

Table C.III–195
Summary of Intake Quantitation (chemicals) Alternative 2
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	2.0E–08	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III-195 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Meat Products

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	3.7E-11	3.0E-03	1.2E-08
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	HQ Summation =		1.2E-08

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	3.2E-12	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	ILCR Summation =		NA

Table C.III–196
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	NA	pCi/kg	U_{234}	7.0E–06	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	7.0E–06	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	7.0E–06	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	NA	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	4.3E–04	1.6E–11	6.9E–15
U_{235+1d}	4.3E–04	1.6E–11	6.9E–15
U_{238+2d}	4.3E–04	2.0E–11	8.6E–15
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	2.2E–14

5860

Table C.III–197
Summary of Intake Quantitation (chemicals) Alternative 2
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	7.2E–08	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

0086

Table C.III-197 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Dairy Products

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	3.1E-09	3.0E-03	1.0E-06
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.0E-06

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	2.7E-10	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000776

5860

Table C.III–198
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	NA	pCi/kg	U_{234}	2.5E–05	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	2.5E–05	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.5E–05	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	NA	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	3.6E–02	1.6E–11	5.7E–13
U_{235+1d}	3.6E–02	1.6E–11	5.7E–13
U_{238+2d}	3.6E–02	2.0E–11	7.1E–13
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	1.9E–12

Table C.III–199
Summary of Risk Characterization (chemicals) Alternative 2
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	9.8E–06	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III−199 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off−Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

	HQ Calculation		
Compound	CDI (mg/kg−day)	RfD (mg/kg−day)	HQ (unitless)
antimony	NA	4.0E−04	NA
arsenic	NA	3.0E−04	NA
beryllium	NA	5.0E−03	NA
uranium−total	6.3E−08	3.0E−03	2.1E−05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor−1254	NA	NA	NA
aroclor−1260	NA	NA	NA
dieldrin	NA	5.0E−05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.1E−05

	ILCR Calculation		
Compound	CDI (mg/kg−day)	CSF (mg/kg−day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium−total	5.4E−09	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E−02	NA
aroclor−1254	NA	7.7E+00	NA
aroclor−1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

0082

Table C.III–200
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	NA	pCi/kg	U_{234}	3.4E–03	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	3.4E–03	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	3.4E–03	pCi/kg.
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	NA	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	7.2E–01	1.6E–11	1.2E–11
U_{235+1d}	7.2E–01	1.6E–11	1.2E–11
U_{238+2d}	7.2E–01	2.0E–11	1.4E–11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 3.7E–11

000780

Table C.III–201
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Federal Ownership: Expanded Trespasser
Via Incidental Ingestion of Soil/Sediment

Intake Equation

$$= \frac{CS \times EFa \times EDa \times CF \times IRa}{BWa \times ATa} + \frac{CS \times EFc \times EDc \times CF \times IRc}{BWc \times ATc}$$

IRa	Ingestion rate of soil (adult)	12.5 mg/day
IRc	Ingestion rate of soil (child)	12.5 mg/day
CF	Conversion factor	1.00E–06 kg/mg
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure duration (adult)	32 Year
EDc	Exposure duration (child)	12 Year
BWa	Body weight (adult)	70 kg
BWc	Body weight (child)	43 kg
AT	Average time for carcinogens	25550 days
ATa	Average time for non–carcinogens (adult)	11680 days
ATc	Average time for non–carcinogens (child)	4380 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	1.3E+00	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	4.0E–01	mg/kg	NA	NA	mg/kg
uranium–total	4.3E+00	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	2.9E–01	mg/kg	NA	NA	mg/kg
carbazole	2.1E–01	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III−201 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Expanded Trespasser
Via Incidental Ingestion of Soil/Sediment

	HQ Calculation		
Compound	CDI (mg/kg−day)	RfD (mg/kg−day)	HQ (unitless)
antimony	1.4E−07	4.0E−04	3.6E−04
arsenic	NA	3.0E−04	NA
beryllium	4.3E−08	5.0E−03	8.6E−06
uranium−total	4.6E−07	3.0E−03	1.5E−04
benzo(a)pyrene	3.1E−08	NA	NA
carbazole	2.3E−08	NA	NA
aroclor−1254	NA	NA	NA
aroclor−1260	NA	NA	NA
dieldrin	NA	5.0E−05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		5.2E−04

	ILCR Calculation		
Compound	CDI (mg/kg−day)	CSF (mg/kg−day)$^{-1}$	ILCR (unitless)
antimony	3.2E−08	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	9.6E−09	4.3E+00	4.1E−08
uranium−total	1.0E−07	NA	NA
benzo(a)pyrene	6.9E−09	7.3E+00	5.1E−08
carbazole	5.0E−09	2.0E−02	1.0E−10
aroclor−1254	NA	7.7E+00	NA
aroclor−1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		9.2E−08

000782

5860

Table C.III-202
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Federal Ownership: Expanded Trespasser
Via Incidental Ingestion of Soil/Sediment

Intake Equation = CS X EFa X EDa X FI X IRa + CS X EFc X EDc X FI X IRc

IRa	Ingestion rate of soil (adult)	12.5 mg/day
IRc	Ingestion rate of soil (child)	12.5 mg/day
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure Duration	32 Year
EDc	Exposure Duration	12 Year
FI	Fractional Intake	1 (unitless)
CS	Concentration of radionuclides in soil	(see table below)

Cs_{137+1d}	NA	pCi/mg	$Th_{232+10d}$	NA	pCi/mg
Np_{237+1d}	4.0E-04	pCi/mg	U_{234}	2.6E-04	pCi/mg
Pu_{238}	2.0E-04	pCi/mg	U_{235+1d}	NA	pCi/mg
Ra_{226+8d}	NA	pCi/mg	U_{238+2d}	2.4E-03	pCi/mg
Ra_{228+1d}	NA	pCi/mg	NA	NA	pCi/mg
Rn_{222+4d}	NA	pCi/mg	NA	NA	pCi/mg
Sr_{90+1d}	NA	pCi/mg	NA	NA	pCi/mg
Tc_{99}	NA	pCi/mg	NA	NA	pCi/mg
Th_{228+7d}	NA	pCi/mg	NA	NA	pCi/mg
Th_{230}	1.1E-03	pCi/mg	NA	NA	pCi/mg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	1.3E+01	2.2E-10	2.9E-09
Pu_{238}	6.5E+00	2.2E-10	1.4E-09
Ra_{226+8d}	NA	7.8E-10	NA
Ra_{228+1d}	NA	1.0E-10	NA
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	NA	3.6E-11	NA
Tc_{99}	NA	1.3E-12	NA
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	3.7E+01	1.3E-11	4.8E-10
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	8.5E+00	1.6E-11	1.4E-10
U_{235+1d}	NA	1.6E-11	NA
U_{238+2d}	7.7E+01	2.0E-11	1.5E-09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 6.4E-09

Table C.III–203
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Federal Ownership: Expanded Trespasser
Via Dermal Contact with Soil/Sediment

Intake Equation = $\frac{CS \times EFa \times EDa \times CF \times ABS \times AF \times SAa}{BWa \times ATa}$ + $\frac{CS \times EFc \times EDc \times CF \times ABS \times AF \times SAc}{BWc \times ATc}$

SA	Surface area of exposed skin (adult)	5750 cm^2/day
SA	Surface area of exposed skin (child)	4200 cm^2/day
AF	Soil to skin adherence factor	1 mg/cm^2
ABS	chemicals specific absorbtion factor (see table below)	csv
CF	Conversion factor	1E–06 kg/mg
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure duration (adult)	32 Year
EDc	Exposure duration (child)	12 Year
BWa	Body weight (adult)	70 kg
BWc	Body weight (child)	43 kg
AT	Average time for carcinogens	25550 days
ATa	Average time for non–carcinogens (adult)	11680 days
ATc	Average time for non–carcinogens (child)	4380 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	ABS	Concentrati	Units	Compound	ABS	Concentrati	Units
antimony	1.0E–02	1.3E+00	mg/kg	NA	NA	NA	mg/kg
arsenic	1.0E–03	NA	mg/kg	NA	NA	NA	mg/kg
beryllium	1.0E–02	4.0E–01	mg/kg	NA	NA	NA	mg/kg
uranium–total	1.0E–02	4.3E+00	mg/kg	NA	NA	NA	mg/kg
benzo(a)pyrene	3.0E–01	2.9E–01	mg/kg	NA	NA	NA	mg/kg
carbazole	3.0E–01	2.1E–01	mg/kg	NA	NA	NA	mg/kg
aroclor–1254	6.0E–02	NA	mg/kg	NA	NA	NA	mg/kg
aroclor–1260	6.0E–02	NA	mg/kg	NA	NA	NA	mg/kg
dieldrin	3.0E–01	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg				

References

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Table C.III−203 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Expanded Trespasser
Via Dermal Contact with Soil/Sediment

	HQ Calculation		
Compound	CDI (mg/kg−day)	RfD (mg/kg−day)	HQ (unitless)
antimony	5.1E−07	6.0E−05	8.5E−03
arsenic	NA	2.9E−04	NA
beryllium	1.5E−07	5.0E−03	3.1E−05
uranium−total	1.7E−06	1.5E−04	1.1E−02
benzo(a)pyrene	3.3E−06	NA	NA
carbazole	2.4E−06	NA	NA
aroclor−1254	NA	NA	NA
aroclor−1260	NA	NA	NA
dieldrin	NA	4.5E−05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.0E−02

	ILCR Calculation		
Compound	CDI (mg/kg−day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	1.2E−07	NA	NA
arsenic	NA	1.9E+00	NA
beryllium	3.7E−08	4.3E+00	1.6E−07
uranium−total	3.9E−07	NA	NA
benzo(a)pyrene	8.0E−07	NA	NA
carbazole	5.8E−07	2.2E−02	1.3E−08
aroclor−1254	NA	1.0E+01	NA
aroclor−1260	NA	1.0E+01	NA
dieldrin	NA	1.8E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		1.7E−07

000785

Table C.III–204
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Federal Ownership: Expanded Trespasser
Via Inhalation of Particulates

Intake Equation $= \frac{CS \times EFa \times EDa \times IR \times ETa}{BWa \times ATa} + \frac{CS \times EFc \times EDc \times IR \times ETc}{BWc \times ATc}$

IR	Inhalation rate of gases	0.83 m^3/hour
ETa	Exposure time (adult)	1 hour/day
ETc	Exposure time (child)	2 hour/day
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure duration (adult)	32 Year
EDc	Exposure duration (child)	12 Year
BWa	Body weight (adult)	70 kg
BWc	Body weight (child)	43 kg
AT	Average time for carcinogens	25550 days
ATa	Average time for non–carcinogens (adult)	11680 days
ATc	Average time for non–carcinogens (child)	4380 days
CS	Concentration of chemicals in particulate as modeled	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	2.7E–09	mg/m^3	NA	NA	mg/m^3
arsenic	NA	mg/m^3	NA	NA	mg/m^3
beryllium	9.4E–10	mg/m^3	NA	NA	mg/m^3
uranium–total	1.0E–08	mg/m^3	NA	NA	mg/m^3
benzo(a)pyrene	6.8E–10	mg/m^3	NA	NA	mg/m^3
carbazole	4.9E–10	mg/m^3	NA	NA	mg/m^3
aroclor–1254	NA	mg/m^3	NA	NA	mg/m^3
aroclor–1260	NA	mg/m^3	NA	NA	mg/m^3
dieldrin	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3			

References

000786

Table C.III–204 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Expanded Trespasser
Via Inhalation of Particulates

Compound	HQ Calculation CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	3.4E–11	NA	NA
arsenic	NA	NA	NA
beryllium	1.2E–11	NA	NA
uranium–total	1.3E–10	NA	NA
benzo(a)pyrene	8.8E–12	NA	NA
carbazole	6.4E–12	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
HQ Summation =			NA

Compound	ILCR Calculation CDI (mg/kg–day)	CSF (mg/kg–day)$^{-1}$	ILCR (unitless)
antimony	6.9E–12	NA	NA
arsenic	NA	1.5E+01	NA
beryllium	2.4E–12	8.4E+00	2.0E–11
uranium–total	2.6E–11	NA	NA
benzo(a)pyrene	1.8E–12	6.1E+00	1.1E–11
carbazole	1.3E–12	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
ILCR Summation =			3.1E–11

Table C.III–205
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Federal Ownership: Expanded Trespasser
Via Inhalation of Gases and Particulates

Intake Equation = CA X EFa X EDa X IR X ETa + CA X EFc EDc X IR X ETc

IR	Inhalation rate of gases	0.83 m^3/hour
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure duration	32 Year
EDc	Exposure duration	12 Year
ETa	Exposure time (adult)	1 hour/day
ETc	Exposure time (child)	2 hour/day
CA	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	9.4E−07	pCi/m^3	U_{234}	6.1E−07	pCi/m^3
Pu_{238}	4.7E−07	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	5.6E−06	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	2.6E−06	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E−11	NA
Np_{237+1d}	3.0E−03	2.9E−08	8.8E−11
Pu_{238}	1.5E−03	3.9E−08	5.9E−11
Ra_{226+8d}	NA	7.0E−09	NA
Ra_{228+1d}	NA	6.9E−10	NA
Rn_{222+4d}	NA	7.7E−12	NA
Sr_{90+1d}	NA	6.2E−11	NA
Tc_{99}	NA	8.3E−12	NA
Th_{228+7d}	NA	7.8E−08	NA
Th_{230}	8.6E−03	2.9E−08	2.5E−10
$Th_{232+10d}$	NA	1.1E−07	NA
U_{234}	2.0E−03	2.6E−08	5.1E−11
U_{235+1d}	NA	2.5E−08	NA
U_{238+2d}	1.8E−02	2.4E−08	4.3E−10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 8.8E−10

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Table C.III–206
Summary of Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Federal Ownership: Expanded Trespasser
Via External Radiation

Exposure Equation = $[CR \times EFa \times EDa \times ET_{oa} \times (1-SH_o)]+[CR \times EFc \times EDc \times ET_{oc} \times (1-SH_o)]$

EFa	Fraction of year spent exposured (adult)	0.11 (unitless)
EFc	Fraction of year spent exposured (child)	0.3 (unitless)
EDa	Exposure duration (adult)	32 Year
EDc	Exposure duration (child)	12 Year
ET_{oa}	Fraction of day spent outdoors (adult)	0.04 (unitless)
ET_{oc}	Fraction of day spent outdoors (child)	0.08 (unitless)
SH_o	Shield factor outdoors	NA (unitless)
CR	Radionuclide specific concentrations	(see table below)

Cs_{137+1d}	NA	pCi/g	$Th_{232+10d}$	NA	pCi/g
Np_{237+1d}	4.0E−01	pCi/g	U_{234}	2.6E−01	pCi/g
Pu_{238}	2.0E−01	pCi/g	U_{235+1d}	NA	pCi/g
Ra_{226+8d}	NA	pCi/g	U_{238+2d}	2.4E+00	pCi/g
Ra_{228+1d}	NA	pCi/g	NA	NA	pCi/g
Rn_{222+4d}	NA	pCi/g	NA	NA	pCi/g
Sr_{90+1d}	NA	pCi/g	NA	NA	pCi/g
Tc_{99}	NA	pCi/g	NA	NA	pCi/g
Th_{228+7d}	NA	pCi/g	NA	NA	pCi/g
Th_{230}	1.1E+00	pCi/g	NA	NA	pCi/g

Radionuclides	CDI (year pCi/g)	CSF $(g/pCi-year)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.0E−06	NA
Np_{237+1d}	1.7E−01	4.3E−07	7.4E−08
Pu_{238}	8.6E−02	2.8E−11	2.4E−12
Ra_{226+8d}	NA	6.0E−06	NA
Ra_{228+1d}	NA	2.9E−06	NA
Rn_{222+4d}	NA	5.9E−06	NA
Sr_{90+1d}	NA	NA	NA
Tc_{99}	NA	6.0E−13	NA
Th_{228+7d}	NA	5.6E−06	NA
Th_{230}	4.8E−01	5.4E−11	2.6E−11
$Th_{232+10d}$	NA	8.5E−06	NA
U_{234}	1.1E−01	3.0E−11	3.3E−12
U_{235+1d}	NA	2.4E−07	NA
U_{238+2d}	1.0E+00	5.1E−08	5.2E−08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.3E−07

Table C.III-206
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Adult)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens'(lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium-total	6.90E-04	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
aroclor-1254	NA	mg/l	NA	NA	mg/l
aroclor-1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l

References

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Table C.III-206 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Adult)
Via Drinking Water Ingestion

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	1.89E-05	3.00E-03	6.30E-03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		6.30E-03

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	1.89E-05	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000791

0086

Table C.III–207
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	2.1E–01	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	1.1E–02	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	2.3E–01	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.0E+04	1.6E–11	1.6E–07
U_{235+1d}	5.4E+02	1.6E–11	8.6E–09
U_{238+2d}	1.1E+04	2.0E–11	2.3E–07
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 4.0E–07

000792

5860

Table C.III–208
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Adult)
Via Dermal Contact while Bathing

Intake Equation

$$= \frac{DA \times EF \times ED \times SA}{BW \times AT}$$

DA	Dermal absorbed dose	csv mg/cm^2–day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
SA	Skin surface area available for contact	23000 cm^2

Chemical Concentrations

Compound	DA	Units
antimony	NA	mg/cm^2–day
arsenic	NA	mg/cm^2–day
beryllium	NA	mg/cm^2–day
uranium–total	1.73E–10	mg/cm^2–day
benzo(a)pyrene	NA	mg/cm^2–day
carbazole	NA	mg/cm^2–day
aroclor–1254	NA	mg/cm^2–day
aroclor–1260	NA	mg/cm^2–day
dieldrin	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day

References

0286

Table C.III-208 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Adult)
Via Dermal Contact while Bathing

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	5.43E-08	1.50E-04	3.62E-04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		3.62E-04

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	5.43E-08	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000794

Table C.III–209
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Adult)
Via Inhalation of Particulates

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units
antimony	7.2E–11	mg/m^3
arsenic	NA	mg/m^3
beryllium	2.6E–11	mg/m^3
uranium–total	2.7E–10	mg/m^3
benzo(a)pyrene	1.9E–11	mg/m^3
carbazole	1.3E–11	mg/m^3
aroclor–1254	NA	mg/m^3
aroclor–1260	NA	mg/m^3
dieldrin	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3

Compound	Concentration	Units
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3

References

Table C.III-209 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Adult)
Via Inhalation of Particulates

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	2.0E-11	NA	NA
arsenic	NA	NA	NA
beryllium	7.0E-12	NA	NA
uranium-total	7.5E-11	NA	NA
benzo(a)pyrene	5.1E-12	NA	NA
carbazole	3.7E-12	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	Hazard Quotient Sum =		NA

Compound	ILCR Calculation CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	2.0E-11	NA	NA
arsenic	NA	1.5E+01	NA
beryllium	7.0E-12	8.4E+00	5.9E-11
uranium-total	7.5E-11	NA	NA
benzo(a)pyrene	5.1E-12	6.1E+00	3.1E-11
carbazole	3.7E-12	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		9.0E-11

5860

Table C.III-210
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Adult)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	2.6E-08	pCi/m^3	U_{234}	1.7E-08	pCi/m^3
Pu_{238}	1.3E-08	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	1.5E-07	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	7.2E-08	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E-11	NA
Np_{237+1d}	1.2E-02	2.9E-08	3.6E-10
Pu_{238}	6.3E-03	3.9E-08	2.4E-10
Ra_{226+8d}	NA	7.0E-09	NA
Ra_{228+1d}	NA	6.9E-10	NA
Rn_{222+4d}	NA	7.7E-12	NA
Sr_{90+1d}	NA	6.2E-11	NA
Tc_{99}	NA	8.3E-12	NA
Th_{228+7d}	NA	7.8E-08	NA
Th_{230}	3.5E-02	2.9E-08	1.0E-09
$Th_{232+10d}$	NA	1.1E-07	NA
U_{234}	8.1E-03	2.6E-08	2.1E-10
U_{235+1d}	NA	2.5E-08	NA
U_{238+2d}	7.4E-02	2.4E-08	1.8E-09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 3.6E-09

000797

Table C.III–211
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units
antimony	9.1E–09	mg/kg
arsenic	NA	mg/kg
beryllium	4.0E–09	mg/kg
uranium–total	6.9E–06	mg/kg
benzo(a)pyrene	4.5E–08	mg/kg
carbazole	8.4E–11	mg/kg
aroclor–1254	NA	mg/kg
aroclor–1260	NA	mg/kg
dieldrin	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg

Compound	Concentration	Units
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg

References

5860

Table C.III−211 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off−Property Farmer (Adult)
Via Ingestion of Meat Products

	HQ Calculation		
Compound	CDI (mg/kg−day)	RfD (mg/kg−day)	HQ (unitless)
antimony	9.5E−12	4.0E−04	2.4E−08
arsenic	NA	3.0E−04	NA
beryllium	4.2E−12	5.0E−03	8.3E−10
uranium−total	7.2E−09	3.0E−03	2.4E−06
benzo(a)pyrene	4.7E−11	NA	NA
carbazole	8.7E−14	NA	NA
aroclor−1254	NA	NA	NA
aroclor−1260	NA	NA	NA
dieldrin	NA	5.0E−05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.4E−06

	ILCR Calculation		
Compound	CDI (mg/kg−day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	9.5E−12	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	4.2E−12	4.3E+00	1.8E−11
uranium−total	7.2E−09	NA	NA
benzo(a)pyrene	4.7E−11	7.3E+00	3.4E−10
carbazole	8.7E−14	2.0E−02	1.7E−15
aroclor−1254	NA	7.7E+00	NA
aroclor−1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		3.6E−10

0845

Table C.III–212
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	1.1E–07	pCi/kg	U_{234}	2.1E–03	pCi/kg
Pu_{238}	4.9E–10	pCi/kg	U_{235+1d}	1.1E–04	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.3E–03	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	3.9E–08	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	2.0E–04	2.2E–10	4.4E–14
Pu_{238}	9.0E–07	2.2E–10	2.0E–16
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	7.2E–05	1.3E–11	9.4E–16
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	3.9E+00	1.6E–11	6.2E–11
U_{235+1d}	2.0E–01	1.6E–11	3.3E–12
U_{238+2d}	4.3E+00	2.0E–11	8.5E–11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.5E–10

000800

Table C.III–213
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	9.1E–10	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	3.6E–12	mg/kg	NA	NA	mg/kg
uranium–total	2.5E–05	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	1.4E–08	mg/kg	NA	NA	mg/kg
carbazole	2.6E–11	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg

References

Table C.III-213 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Dairy Products

Compound	HQ Calculation CDI (mg/kg-day)	HQ Calculation RfD (mg/kg-day)	HQ Calculation HQ (unitless)
antimony	3.7E-12	4.0E-04	9.4E-09
arsenic	NA	3.0E-04	NA
beryllium	1.5E-14	5.0E-03	3.0E-12
uranium-total	1.0E-07	3.0E-03	3.4E-05
benzo(a)pyrene	5.9E-11	NA	NA
carbazole	1.1E-13	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		3.4E-05

Compound	ILCR Calculation CDI (mg/kg-day)	ILCR Calculation CSF $(mg/kg-day)^{-1}$	ILCR Calculation ILCR (unitless)
antimony	3.7E-12	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	1.5E-14	4.3E+00	6.4E-14
uranium-total	1.0E-07	NA	NA
benzo(a)pyrene	5.9E-11	7.3E+00	4.3E-10
carbazole	1.1E-13	2.0E-02	2.2E-15
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		4.3E-10

5860

Table C.III-214
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	9.8E-09	pCi/kg	U_{234}	7.6E-03	pCi/kg
Pu_{238}	9.7E-11	pCi/kg	U_{235+1d}	4.0E-04	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	8.3E-03	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	3.2E-08	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	7.2E-05	2.2E-10	1.6E-14
Pu_{238}	7.1E-07	2.2E-10	1.6E-16
Ra_{226+8d}	NA	7.8E-10	NA
Ra_{228+1d}	NA	1.0E-10	NA
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	NA	3.6E-11	NA
Tc_{99}	NA	1.3E-12	NA
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	2.4E-04	1.3E-11	3.1E-15
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	5.6E+01	1.6E-11	8.9E-10
U_{235+1d}	2.9E+00	1.6E-11	4.7E-11
U_{238+2d}	6.1E+01	2.0E-11	1.2E-09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
		ILCR Summation =	2.2E-09

000803

Table C.III–215
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation

$$= \frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$$

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units
antimony	1.0E–07	mg/kg
arsenic	NA	mg/kg
beryllium	4.3E–08	mg/kg
uranium–total	3.4E–03	mg/kg
benzo(a)pyrene	1.8E–08	mg/kg
carbazole	1.3E–08	mg/kg
aroclor–1254	NA	mg/kg
aroclor–1260	NA	mg/kg
dieldrin	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg

Compound	Concentration	Units
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg

References

5860

Table C.III-215 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	1.7E-10	4.0E-04	4.3E-07
arsenic	NA	3.0E-04	NA
beryllium	7.2E-11	5.0E-03	1.4E-08
uranium-total	5.6E-06	3.0E-03	1.9E-03
benzo(a)pyrene	3.1E-11	NA	NA
carbazole	2.2E-11	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.9E-03

Compound	ILCR Calculation CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	1.7E-10	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	7.2E-11	4.3E+00	3.1E-10
uranium-total	5.6E-06	NA	NA
benzo(a)pyrene	3.1E-11	7.3E+00	2.3E-10
carbazole	2.2E-11	2.0E-02	4.4E-13
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		5.3E-10

000805

Table C.III–216
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	2.5E–05	pCi/kg	U_{234}	1.0E+00	pCi/kg
Pu_{238}	1.3E–05	pCi/kg	U_{235+1d}	5.4E–02	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	1.1E+00	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	8.0E–05	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	7.6E–02	2.2E–10	1.7E–11
Pu_{238}	3.8E–02	2.2E–10	8.3E–12
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	2.4E–01	1.3E–11	3.1E–12
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	3.1E+03	1.6E–11	4.9E–08
U_{235+1d}	1.6E+02	1.6E–11	2.6E–09
U_{238+2d}	3.4E+03	2.0E–11	6.7E–08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.2E–07

000806

5860

Table C.III-217
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Child)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units
antimony	NA	mg/l
arsenic	NA	mg/l
beryllium	NA	mg/l
uranium-total	6.90E-04	mg/l
benzo(a)pyrene	NA	mg/l
carbazole	NA	mg/l
aroclor-1254	NA	mg/l
aroclor-1260	NA	mg/l
dieldrin	NA	mg/l
NA	NA	mg/l
NA	NA	mg/l
NA	NA	mg/l
NA	NA	mg/l
NA	NA	mg/l
NA	NA	mg/l
NA	NA	mg/l

Compound	Concentration	Units
NA	NA	mg/l
NA	NA	mg/l
NA	NA	mg/l
NA	NA	mg/l
NA	NA	mg/l
NA	NA	mg/l
NA	NA	mg/l
NA	NA	mg/l
NA	NA	mg/l
NA	NA	mg/l
NA	NA	mg/l
NA	NA	mg/l
NA	NA	mg/l
NA	NA	mg/l
NA	NA	mg/l
NA	NA	mg/l

References

Table C.III-217 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Child)
Via Drinking Water Ingestion

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	4.41E-05	3.00E-03	1.47E-02
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.47E-02

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg\text{-}day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	3.78E-06	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000808

5860

Table C.III–218
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	2.1E–01	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	1.1E–02	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	2.3E–01	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	4.4E+02	1.6E–11	7.1E–09
U_{235+1d}	2.3E+01	1.6E–11	3.7E–10
U_{238+2d}	4.8E+02	2.0E–11	9.7E–09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	1.7E–08

Table C.III–219
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Child)
Via Dermal Contact while Bathing

Intake Equation

$$= \frac{DA \times EF \times ED \times SA}{BW \times AT}$$

DA	Dermal absorbed dose	csv mg/cm^2–day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
SA	Skin surface area available for contact	8000 cm^2

Chemical Concentrations

Compound	DA	Units
antimony	NA	mg/cm^2–day
arsenic	NA	mg/cm^2–day
beryllium	NA	mg/cm^2–day
uranium–total	1.73E–10	mg/cm^2–day
benzo(a)pyrene	NA	mg/cm^2–day
carbazole	NA	mg/cm^2–day
aroclor–1254	NA	mg/cm^2–day
aroclor–1260	NA	mg/cm^2–day
dieldrin	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day

References

000810

Table C.III–220
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Child)
Via Inhalation of Particulates

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Inhalation rate of gases (RAGS, 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units
antimony	7.2E–11	mg/m^3
arsenic	NA	mg/m^3
beryllium	2.6E–11	mg/m^3
uranium–total	2.7E–10	mg/m^3
benzo(a)pyrene	1.9E–11	mg/m^3
carbazole	1.3E–11	mg/m^3
aroclor–1254	NA	mg/m^3
aroclor–1260	NA	mg/m^3
dieldrin	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3

Compound	Concentration	Units
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3

References

Table C.III-220 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Child)
Via Inhalation of Particulates

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	5.5E-11	NA	NA
arsenic	NA	NA	NA
beryllium	2.0E-11	NA	NA
uranium-total	2.1E-10	NA	NA
benzo(a)pyrene	1.4E-11	NA	NA
carbazole	1.0E-11	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	Hazard Quotient Sum =		NA

Compound	ILCR Calculation CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	4.7E-12	NA	NA
arsenic	NA	1.5E+01	NA
beryllium	1.7E-12	8.4E+00	1.4E-11
uranium-total	1.8E-11	NA	NA
benzo(a)pyrene	1.2E-12	6.1E+00	7.4E-12
carbazole	8.8E-13	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		2.2E-11

000812

5860

Table C.III-221
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Child)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	2.6E-08	pCi/m^3	U_{234}	1.7E-08	pCi/m^3
Pu_{238}	1.3E-08	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	1.5E-07	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	7.2E-08	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E-11	NA
Np_{237+1d}	6.4E-04	2.9E-08	1.9E-11
Pu_{238}	3.2E-04	3.9E-08	1.3E-11
Ra_{226+8d}	NA	7.0E-09	NA
Ra_{228+1d}	NA	6.9E-10	NA
Rn_{222+4d}	NA	7.7E-12	NA
Sr_{90+1d}	NA	6.2E-11	NA
Tc_{99}	NA	8.3E-12	NA
Th_{228+7d}	NA	7.8E-08	NA
Th_{230}	1.8E-03	2.9E-08	5.3E-11
$Th_{232+10d}$	NA	1.1E-07	NA
U_{234}	4.2E-04	2.6E-08	1.1E-11
U_{235+1d}	NA	2.5E-08	NA
U_{238+2d}	3.8E-03	2.4E-08	9.2E-11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.9E-10

000813

Table C.III–222
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	9.1E–09	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	4.0E–09	mg/kg	NA	NA	mg/kg
uranium–total	6.9E–06	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	4.5E–08	mg/kg	NA	NA	mg/kg
carbazole	8.4E–11	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg

References

5860

Table C.III–223
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	1.1E–07	pCi/kg	U_{234}	2.1E–03	pCi/kg
Pu_{238}	4.9E–10	pCi/kg	U_{235+1d}	1.1E–04	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.3E–03	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	3.9E–08	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	6.6E–06	2.2E–10	1.5E–15
Pu_{238}	3.0E–08	2.2E–10	6.6E–18
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	2.4E–06	1.3E–11	3.1E–17
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.3E–01	1.6E–11	2.1E–12
U_{235+1d}	6.8E–03	1.6E–11	1.1E–13
U_{238+2d}	1.4E–01	2.0E–11	2.8E–12
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 5.0E–12

000815

Table C.III–224
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units
antimony	9.1E–10	mg/kg
arsenic	NA	mg/kg
beryllium	3.6E–12	mg/kg
uranium–total	2.5E–05	mg/kg
benzo(a)pyrene	1.4E–08	mg/kg
carbazole	2.6E–11	mg/kg
aroclor–1254	NA	mg/kg
aroclor–1260	NA	mg/kg
dieldrin	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg

Compound	Concentration	Units
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg

References

5860

Table C.III-224 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Dairy Products

Compound	HQ Calculation: CDI (mg/kg-day)	HQ Calculation: RfD (mg/kg-day)	HQ Calculation: HQ (unitless)
antimony	3.9E-11	4.0E-04	9.8E-08
arsenic	NA	3.0E-04	NA
beryllium	1.6E-13	5.0E-03	3.1E-11
uranium-total	1.1E-06	3.0E-03	3.6E-04
benzo(a)pyrene	6.2E-10	NA	NA
carbazole	1.1E-12	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		3.6E-04

Compound	ILCR Calculation: CDI (mg/kg-day)	ILCR Calculation: CSF $(mg/kg-day)^{-1}$	ILCR Calculation: ILCR (unitless)
antimony	3.4E-12	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	1.3E-14	4.3E+00	5.7E-14
uranium-total	9.2E-08	NA	NA
benzo(a)pyrene	5.3E-11	7.3E+00	3.9E-10
carbazole	9.8E-14	2.0E-02	2.0E-15
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		3.9E-10

Table C.III-225
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	9.8E-09	pCi/kg	U_{234}	7.6E-03	pCi/kg
Pu_{238}	9.7E-11	pCi/kg	U_{235+1d}	4.0E-04	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	8.3E-03	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	3.2E-08	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	1.4E-05	2.2E-10	3.1E-15
Pu_{238}	1.4E-07	2.2E-10	3.0E-17
Ra_{226+8d}	NA	7.8E-10	NA
Ra_{228+1d}	NA	1.0E-10	NA
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	NA	3.6E-11	NA
Tc_{99}	NA	1.3E-12	NA
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	4.6E-05	1.3E-11	6.0E-16
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	1.1E+01	1.6E-11	1.7E-10
U_{235+1d}	5.6E-01	1.6E-11	9.0E-12
U_{238+2d}	1.2E+01	2.0E-11	2.3E-10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 4.2E-10

Table C.III–226
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units
antimony	1.0E–07	mg/kg
arsenic	NA	mg/kg
beryllium	4.3E–08	mg/kg
uranium–total	3.4E–03	mg/kg
benzo(a)pyrene	1.8E–08	mg/kg
carbazole	1.3E–08	mg/kg
aroclor–1254	NA	mg/kg
aroclor–1260	NA	mg/kg
dieldrin	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg

Compound	Concentration	Units
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg
NA	NA	mg/kg

References

Table C.III-226 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	6.5E-10	4.0E-04	1.6E-06
arsenic	NA	3.0E-04	NA
beryllium	2.7E-10	5.0E-03	5.5E-08
uranium-total	2.2E-05	3.0E-03	7.2E-03
benzo(a)pyrene	1.2E-10	NA	NA
carbazole	8.5E-11	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		7.2E-03

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	5.6E-11	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	2.3E-11	4.3E+00	1.0E-10
uranium-total	1.9E-06	NA	NA
benzo(a)pyrene	1.0E-11	7.3E+00	7.4E-11
carbazole	7.3E-12	2.0E-02	1.5E-13
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		1.8E-10

000820

5860

Table C.III–227
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	2.5E–05	pCi/kg	U_{234}	1.0E+00	pCi/kg
Pu_{238}	1.3E–05	pCi/kg	U_{235+1d}	5.4E–02	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	1.1E+00	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	8.0E–05	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	5.3E–03	2.2E–10	1.2E–12
Pu_{238}	2.6E–03	2.2E–10	5.8E–13
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	1.7E–02	1.3E–11	2.2E–13
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	2.2E+02	1.6E–11	3.5E–09
U_{235+1d}	1.1E+01	1.6E–11	1.8E–10
U_{238+2d}	2.4E+02	2.0E–11	4.7E–09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		8.4E–09

000821

Table C.III-228
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Adult)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	0.00E+00	mg/l	0	0.00E+00	mg/l
arsenic	0.00E+00	mg/l	0	0.00E+00	mg/l
beryllium	0.00E+00	mg/l	0	0.00E+00	mg/l
uranium-total	2.70E-06	mg/l	0	0.00E+00	mg/l
benzo(a)pyrene	0.00E+00	mg/l	0	0.00E+00	mg/l
carbazole	0.00E+00	mg/l	0	0.00E+00	mg/l
aroclor-1254	0.00E+00	mg/l	0	0.00E+00	mg/l
aroclor-1260	0.00E+00	mg/l	0	0.00E+00	mg/l
dieldrin	0.00E+00	mg/l	0	0.00E+00	mg/l
0	0.00E+00	mg/l	0	0.00E+00	mg/l
0	0.00E+00	mg/l	0	0.00E+00	mg/l
0	0.00E+00	mg/l	0	0.00E+00	mg/l
0	0.00E+00	mg/l	0	0.00E+00	mg/l
0	0.00E+00	mg/l	0	0.00E+00	mg/l
0	0.00E+00	mg/l	0	0.00E+00	mg/l
0	0.00E+00	mg/l	0	0.00E+00	mg/l
0	0.00E+00	mg/l	0	0.00E+00	mg/l
0	0.00E+00	mg/l	0	0.00E+00	mg/l

References

000322

Pages C-III-334 through C-III-367
have been intentionally deleted
due to revisions in the tables.

0882

Table C.III–229
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	0.0E+00	pCi/l	$Th_{232+10d}$	0.0E+00	pCi/l
Np_{237+1d}	0.0E+00	pCi/l	U_{234}	8.0E−04	pCi/l
Pu_{238}	0.0E+00	pCi/l	U_{235+1d}	4.0E−05	pCi/l
Ra_{226+8d}	0.0E+00	pCi/l	U_{238+2d}	9.0E−04	pCi/l
Ra_{228+1d}	0.0E+00	pCi/l	0.0E+00	0.0E+00	pCi/l
Rn_{222+4d}	0.0E+00	pCi/l	0.0E+00	0.0E+00	pCi/l
Sr_{90+1d}	0.0E+00	pCi/l	0.0E+00	0.0E+00	pCi/l
Tc_{99}	0.0E+00	pCi/l	0.0E+00	0.0E+00	pCi/l
Th_{228+7d}	0.0E+00	pCi/l	0.0E+00	0.0E+00	pCi/l
Th_{230}	0.0E+00	pCi/l	0.0E+00	0.0E+00	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	NA	2.2E−10	NA
Pu_{238}	NA	2.2E−10	NA
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	NA	3.6E−11	NA
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	NA	1.3E−11	NA
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	3.9E+01	1.6E−11	6.3E−10
U_{235+1d}	2.0E+00	1.6E−11	3.1E−11
U_{238+2d}	4.4E+01	2.0E−11	8.8E−10
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
	ILCR Summation	=	1.5E−09

000824

Table C.III–230
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Adult)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2–day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
SA	Skin surface area available for contact	23000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	0.00E+00	mg/cm^2–day	0	0.00E+00	mg/cm^2–day
arsenic	0.00E+00	mg/cm^2–day	0	0.00E+00	mg/cm^2–day
beryllium	0.00E+00	mg/cm^2–day	0	0.00E+00	mg/cm^2–day
uranium–total	6.75E–13	mg/cm^2–day	0	0.00E+00	mg/cm^2–day
benzo(a)pyrene	0.00E+00	mg/cm^2–day	0	0.00E+00	mg/cm^2–day
carbazole	0.00E+00	mg/cm^2–day	0	0.00E+00	mg/cm^2–day
aroclor–1254	0.00E+00	mg/cm^2–day	0	0.00E+00	mg/cm^2–day
aroclor–1260	0.00E+00	mg/cm^2–day	0	0.00E+00	mg/cm^2–day
dieldrin	0.00E+00	mg/cm^2–day	0	0.00E+00	mg/cm^2–day
0	0.00E+00	mg/cm^2–day	0	0.00E+00	mg/cm^2–day
0	0.00E+00	mg/cm^2–day	0	0.00E+00	mg/cm^2–day
0	0.00E+00	mg/cm^2–day	0	0.00E+00	mg/cm^2–day
0	0.00E+00	mg/cm^2–day	0	0.00E+00	mg/cm^2–day
0	0.00E+00	mg/cm^2–day	0	0.00E+00	mg/cm^2–day
0	0.00E+00	mg/cm^2–day	0	0.00E+00	mg/cm^2–day
0	0.00E+00	mg/cm^2–day	0	0.00E+00	mg/cm^2–day

References

0086

Table C.III-230 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Adult)
Via Dermal Contact while Showering

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	2.13E-10	1.50E-04	1.42E-06
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
	HQ Summation =		1.42E-06

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	2.13E-10	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
	ILCR Summation =		0.00E+00

000826

Table C.III–231
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Adult)
Via Inhalation of Particulates

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	9.5E–10	mg/m^3	•••	0.0E+00	mg/m^3
arsenic	0.0E+00	mg/m^3	•••	0.0E+00	mg/m^3
beryllium	0.0E+00	mg/m^3	•••	0.0E+00	mg/m^3
uranium–total	0.0E+00	mg/m^3	•••	0.0E+00	mg/m^3
benzo(a)pyrene	1.3E–12	mg/m^3	•••	0.0E+00	mg/m^3
carbazole	5.4E–12	mg/m^3	•••	0.0E+00	mg/m^3
aroclor–1254	0.0E+00	mg/m^3	•••	0.0E+00	mg/m^3
aroclor–1260	0.0E+00	mg/m^3	•••	0.0E+00	mg/m^3
dieldrin	0.0E+00	mg/m^3	•••	0.0E+00	mg/m^3
••••••••	0.0E+00	mg/m^3	•••	0.0E+00	mg/m^3
••••••••	0.0E+00	mg/m^3	•••	0.0E+00	mg/m^3
••••••••	0.0E+00	mg/m^3	•••	0.0E+00	mg/m^3
••••••••	0.0E+00	mg/m^3	•••	0.0E+00	mg/m^3
••••••••	0.0E+00	mg/m^3	•••	0.0E+00	mg/m^3
••••••••	0.0E+00	mg/m^3	•••	0.0E+00	mg/m^3
••••••••	0.0E+00	mg/m^3			

References

Table C.III-231 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Adult)
Via Inhalation of Particulates

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	2.6E-10	NA	NA
arsenic	NA	NA	NA
beryllium	NA	NA	NA
uranium-total	NA	NA	NA
benzo(a)pyrene	3.5E-13	NA	NA
carbazole	1.5E-12	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
	Hazard Quotient Sum =		0.0E+00

Compound	ILCR Calculation CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	2.6E-10	NA	NA
arsenic	NA	1.5E+01	NA
beryllium	NA	8.4E+00	NA
uranium-total	NA	NA	NA
benzo(a)pyrene	3.5E-13	6.1E+00	2.1E-12
carbazole	1.5E-12	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	1.6E+01	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
	ILCR Summation =		2.1E-12

000828

5860

Table C.III–232
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Adult)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	0.0E+00	pCi/m^3	$Th_{232+10d}$	0.0E+00	pCi/m^3
Np_{237+1d}	3.6E−08	pCi/m^3	U_{234}	6.7E−08	pCi/m^3
Pu_{238}	1.7E−07	pCi/m^3	U_{235+1d}	0.0E+00	pCi/m^3
Ra_{226+8d}	0.0E+00	pCi/m^3	U_{238+2d}	0.0E+00	pCi/m^3
Ra_{228+1d}	0.0E+00	pCi/m^3	0.0E+00	0.0E+00	pCi/m^3
Rn_{222+4d}	0.0E+00	pCi/m^3	0.0E+00	0.0E+00	pCi/m^3
Sr_{90+1d}	0.0E+00	pCi/m^3	0.0E+00	0.0E+00	pCi/m^3
Tc_{99}	0.0E+00	pCi/m^3	0.0E+00	0.0E+00	pCi/m^3
Th_{228+7d}	0.0E+00	pCi/m^3	0.0E+00	0.0E+00	pCi/m^3
Th_{230}	6.5E−07	pCi/m^3	0.0E+00	0.0E+00	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E−11	NA
Np_{237+1d}	1.8E−02	2.9E−08	5.1E−10
Pu_{238}	8.2E−02	3.9E−08	3.2E−09
Ra_{226+8d}	NA	7.0E−09	NA
Ra_{228+1d}	NA	6.9E−10	NA
Rn_{222+4d}	NA	7.7E−12	NA
Sr_{90+1d}	NA	6.2E−11	NA
Tc_{99}	NA	8.3E−12	NA
Th_{228+7d}	NA	7.8E−08	NA
Th_{230}	3.2E−01	2.9E−08	9.2E−09
$Th_{232+10d}$	NA	1.1E−07	NA
U_{234}	3.3E−02	2.6E−08	8.5E−10
U_{235+1d}	NA	2.5E−08	NA
U_{238+2d}	NA	2.4E−08	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA

ILCR Summation = 1.4E−08

000829

Table C.III–233
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	1.2E–07	mg/kg	•••	0.0E+00	mg/kg
arsenic	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
beryllium	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
uranium–total	2.7E–08	mg/kg	•••	0.0E+00	mg/kg
benzo(a)pyrene	3.1E–09	mg/kg	•••	0.0E+00	mg/kg
carbazole	3.4E–11	mg/kg	•••	0.0E+00	mg/kg
aroclor–1254	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
aroclor–1260	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
dieldrin	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
0	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
0	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
0	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
0	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
0	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
0	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
0	0.0E+00	mg/kg			

References

Table C.III-233 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Adult)
Via Ingestion of Meat Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	1.2E-10	4.0E-04	3.1E-07
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	2.8E-11	3.0E-03	9.3E-09
benzo(a)pyrene	3.2E-12	NA	NA
carbazole	3.5E-14	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
	HQ Summation =		3.2E-07

Compound	ILCR Calculation CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	1.2E-10	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	2.8E-11	NA	NA
benzo(a)pyrene	3.2E-12	7.3E+00	2.3E-11
carbazole	3.5E-14	2.0E-02	7.0E-16
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
	ILCR Summation =		2.3E-11

Table C.III-234
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	0.0E+00	pCi/kg	$Th_{232+10d}$	0.0E+00	pCi/kg
Np_{237+1d}	1.5E-07	pCi/kg	U_{234}	9.0E-06	pCi/kg
Pu_{238}	6.4E-09	pCi/kg	U_{235+1d}	4.0E-07	pCi/kg
Ra_{226+8d}	0.0E+00	pCi/kg	U_{238+2d}	9.0E-06	pCi/kg
Ra_{228+1d}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Sr_{90+1d}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Tc_{99}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Th_{228+7d}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Th_{230}	3.5E-07	pCi/kg	0.0E+00	0.0E+00	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	2.8E-04	2.2E-10	6.2E-14
Pu_{238}	1.2E-05	2.2E-10	2.6E-15
Ra_{226+8d}	NA	7.8E-10	NA
Ra_{228+1d}	NA	1.0E-10	NA
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	NA	3.6E-11	NA
Tc_{99}	NA	1.3E-12	NA
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	6.5E-04	1.3E-11	8.4E-15
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	1.7E-02	1.6E-11	2.7E-13
U_{235+1d}	7.4E-04	1.6E-11	1.2E-14
U_{238+2d}	1.7E-02	2.0E-11	3.3E-13
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA

ILCR Summation = 6.9E-13

000832

5860

Table C.III–235
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	1.2E–08	mg/kg	•••	0.0E+00	mg/kg
arsenic	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
beryllium	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
uranium–total	7.5E–05	mg/kg	•••	0.0E+00	mg/kg
benzo(a)pyrene	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
carbazole	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
aroclor–1254	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
aroclor–1260	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
dieldrin	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
••••••••	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
••••••••	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
••••••••	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
••••••••	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
••••••••	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
••••••••	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
••••••••	0.0E+00	mg/kg	•••	0.0E+00	mg/kg

References

000833

Table C.III-235 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Adult)
Via Ingestion of Dairy Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	4.9E-11	4.0E-04	1.2E-07
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	3.1E-07	3.0E-03	1.0E-04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
HQ Summation =			1.0E-04

Compound	ILCR Calculation CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	4.9E-11	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	3.1E-07	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
ILCR Summation =			0.0E+00

5860

Table C.III–236
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	0.0E+00	pCi/kg	$Th_{232+10d}$	0.0E+00	pCi/kg
Np_{237+1d}	0.0E+00	pCi/kg	U_{234}	2.3E−02	pCi/kg
Pu_{238}	0.0E+00	pCi/kg	U_{235+1d}	1.2E−03	pCi/kg
Ra_{226+8d}	0.0E+00	pCi/kg	U_{238+2d}	2.5E−02	pCi/kg
Ra_{228+1d}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Sr_{90+1d}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Tc_{99}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Th_{228+7d}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Th_{230}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	NA	2.2E−10	NA
Pu_{238}	NA	2.2E−10	NA
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	NA	3.6E−11	NA
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	NA	1.3E−11	NA
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	1.7E+02	1.6E−11	2.7E−09
U_{235+1d}	8.7E+00	1.6E−11	1.4E−10
U_{238+2d}	1.8E+02	2.0E−11	3.7E−09
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA

ILCR Summation = 6.5E−09

000835

Table C.III–237
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	1.3E–06	mg/kg	•••	0.0E+00	mg/kg
arsenic	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
beryllium	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
uranium–total	1.3E–05	mg/kg	•••	0.0E+00	mg/kg
benzo(a)pyrene	1.3E–09	mg/kg	•••	0.0E+00	mg/kg
carbazole	5.3E–09	mg/kg	•••	0.0E+00	mg/kg
aroclor–1254	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
aroclor–1260	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
dieldrin	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
••••••••	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
••••••••	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
••••••••	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
••••••••	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
••••••••	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
••••••••	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
••••••••	0.0E+00	mg/kg	•••	0.0E+00	mg/kg

References

000836

Table C.III–237 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Compound	HQ Calculation CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	2.2E–09	4.0E–04	5.6E–06
arsenic	NA	3.0E–04	NA
beryllium	NA	5.0E–03	NA
uranium–total	2.2E–08	3.0E–03	7.4E–06
benzo(a)pyrene	2.1E–12	NA	NA
carbazole	8.9E–12	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	5.0E–05	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
HQ Summation =			13E–05

Compound	ILCR Calculation CDI (mg/kg–day)	CSF (mg/kg–day)$^{-1}$	ILCR (unitless)
antimony	2.2E–09	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium–total	2.2E–08	NA	NA
benzo(a)pyrene	2.1E–12	7.3E+00	1.5E–11
carbazole	8.9E–12	2.0E–02	1.8E–13
aroclor–1254	NA	7.7E+00	NA
aroclor–1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
ILCR Summation =			1.6E–11

Table C.III–238
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	0.0E+00	pCi/kg	$Th_{232+10d}$	0.0E+00	pCi/kg
Np_{237+1d}	3.6E−05	pCi/kg	U_{234}	4.0E−03	pCi/kg
Pu_{238}	1.7E−04	pCi/kg	U_{235+1d}	2.0E−04	pCi/kg
Ra_{226+8d}	0.0E+00	pCi/kg	U_{238+2d}	4.4E−03	pCi/kg
Ra_{228+1d}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Sr_{90+1d}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Tc_{99}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Th_{228+7d}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Th_{230}	7.1E−04	pCi/kg	0.0E+00	0.0E+00	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	1.1E−01	2.2E−10	2.4E−11
Pu_{238}	4.9E−01	2.2E−10	1.1E−10
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	NA	3.6E−11	NA
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	2.1E+00	1.3E−11	2.8E−11
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	1.2E+01	1.6E−11	1.9E−10
U_{235+1d}	5.9E−01	1.6E−11	9.4E−12
U_{238+2d}	1.3E+01	2.0E−11	2.6E−10
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
		ILCR Summation =	6.2E−10

000838

Table C.III–239
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium – total	2.70E–06	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
aroclor – 1254	NA	mg/l	NA	NA	mg/l
aroclor – 1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

008839

5860

Table C.III-239 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Drinking Water Ingestion

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	1.73E-07	3.00E-03	5.75E-05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		5.75E-05

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	1.48E-08	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000840

Table C.III–240
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	8.0E–04	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	4.0E–05	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	9.0E–04	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.7E+00	1.6E–11	2.7E–11
U_{235+1d}	8.4E–02	1.6E–11	1.3E–12
U_{238+2d}	1.9E+00	2.0E–11	3.8E–11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 6.6E–11

000841

Table C.III–241
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2–day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
SA	Skin surface area available for contact	8000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
arsenic	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
beryllium	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
uranium–total	6.75E–13	mg/cm^2–day	NA	NA	mg/cm^2–day
benzo(a)pyrene	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
carbazole	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1254	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1260	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
dieldrin	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day			

References

Table C.III–241 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Dermal Contact while Bathing

Compound	HQ Calculation CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	6.00E–05	NA
arsenic	NA	2.85E–04	NA
beryllium	NA	5.00E–03	NA
uranium–total	3.45E–10	1.50E–04	2.30E–06
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	4.50E–05	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
HQ Summation =			2.30E–06

Compound	ILCR Calculation CDI (mg/kg–day)	CSF (mg/kg–day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium–total	2.96E–11	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E–02	NA
aroclor–1254	NA	1.03E+01	NA
aroclor–1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
ILCR Summation =			NA

Table C.III–242a
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Inhalation of Particulates

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Inhalation rate of gases (RAGS, 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	9.5E–10	mg/m^3	NA	NA	mg/m^3
arsenic	NA	mg/m^3	NA	NA	mg/m^3
beryllium	NA	mg/m^3	NA	NA	mg/m^3
uranium–total	NA	mg/m^3	NA	NA	mg/m^3
benzo(a)pyrene	1.3E–12	mg/m^3	NA	NA	mg/m^3
carbazole	5.4E–12	mg/m^3	NA	NA	mg/m^3
aroclor–1254	NA	mg/m^3	NA	NA	mg/m^3
aroclor–1260	NA	mg/m^3	NA	NA	mg/m^3
dieldrin	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3			

References

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Table C.III-242a (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Inhalation of Particulates

Compound	HQ Calculation		
	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	7.2E-10	NA	NA
arsenic	NA	NA	NA
beryllium	NA	NA	NA
uranium-total	NA	NA	NA
benzo(a)pyrene	9.7E-13	NA	NA
carbazole	4.1E-12	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	Hazard Quotient Sum =		NA

Compound	ILCR Calculation		
	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	6.2E-11	NA	NA
arsenic	NA	1.5E+01	NA
beryllium	NA	8.4E+00	NA
uranium-total	NA	NA	NA
benzo(a)pyrene	8.3E-14	6.1E+00	5.1E-13
carbazole	3.5E-13	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		5.1E-13

000845

Table C.III–242b
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	3.6E–08	pCi/m^3	U_{234}	6.7E–08	pCi/m^3
Pu_{238}	1.7E–07	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	6.5E–07	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	9.1E–04	2.9E–08	2.6E–11
Pu_{238}	4.2E–03	3.9E–08	1.7E–10
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	NA	7.7E–12	NA
Sr_{90+1d}	NA	6.2E–11	NA
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	1.6E–02	2.9E–08	4.7E–10
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	1.7E–03	2.6E–08	4.4E–11
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	NA	2.4E–08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		7.1E–10

000848

Table C.III–243a
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	1.2E–07	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	2.7E–08	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	3.1E–09	mg/kg	NA	NA	mg/kg
carbazole	3.4E–11	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg

References

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Table C.III-243a (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Meat Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	2.2E-10	4.0E-04	5.6E-07
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	5.0E-11	3.0E-03	1.7E-08
benzo(a)pyrene	5.8E-12	NA	NA
carbazole	6.3E-14	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		5.8E-07

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	1.9E-11	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	4.3E-12	NA	NA
benzo(a)pyrene	4.9E-13	7.3E+00	3.6E-12
carbazole	5.4E-15	2.0E-02	1.1E-16
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		3.6E-12

000848

Table C.III-243b
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	1.5E-07	pCi/kg	U_{234}	9.0E-06	pCi/kg
Pu_{238}	6.4E-09	pCi/kg	U_{235+1d}	4.0E-07	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	9.0E-06	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	3.5E-07	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	9.4E-06	2.2E-10	2.1E-15
Pu_{238}	3.9E-07	2.2E-10	8.6E-17
Ra_{226+8d}	NA	7.8E-10	NA
Ra_{228+1d}	NA	1.0E-10	NA
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	NA	3.6E-11	NA
Tc_{99}	NA	1.3E-12	NA
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	2.1E-05	1.3E-11	2.8E-16
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	5.5E-04	1.6E-11	8.9E-15
U_{235+1d}	2.5E-05	1.6E-11	3.9E-16
U_{238+2d}	5.5E-04	2.0E-11	1.1E-14
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.3E-14

Table C.III–244a
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	1.2E–08	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	7.5E–05	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

000850

Table C.III-244a (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Dairy Products

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	5.2E-10	4.0E-04	1.3E-06
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	3.2E-06	3.0E-03	1.1E-03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.1E-03

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	4.4E-11	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	2.8E-07	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

Table C.III–244b
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	NA	pCi/kg	U_{234}	2.3E–02	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.2E–03	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.5E–02	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	NA	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	3.2E+01	1.6E–11	5.2E–10
U_{235+1d}	1.7E+00	1.6E–11	2.7E–11
U_{238+2d}	3.5E+01	2.0E–11	7.1E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.3E–09

000852

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Table C.III–245
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	1.3E–06	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	1.3E–05	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	1.3E–09	mg/kg	NA	NA	mg/kg
carbazole	5.3E–09	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III-245 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	8.6E-09	4.0E-04	2.1E-05
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	8.4E-08	3.0E-03	2.8E-05
benzo(a)pyrene	8.1E-12	NA	NA
carbazole	3.4E-11	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		5.0E-05

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	7.3E-10	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	7.2E-09	NA	NA
benzo(a)pyrene	6.9E-13	7.3E+00	5.0E-12
carbazole	2.9E-12	2.0E-02	5.9E-14
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		5.1E-12

000854

Table C.III–246
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	3.6E–05	pCi/kg	U_{234}	4.0E–03	pCi/kg
Pu_{238}	1.7E–04	pCi/kg	U_{235+1d}	2.0E–04	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	4.4E–03	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	7.1E–04	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	7.5E–03	2.2E–10	1.7E–12
Pu_{238}	3.5E–02	2.2E–10	7.6E–12
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	1.5E–01	1.3E–11	1.9E–12
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	8.4E–01	1.6E–11	1.3E–11
U_{235+1d}	4.1E–02	1.6E–11	6.6E–13
U_{238+2d}	9.2E–01	2.0E–11	1.8E–11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		4.4E–11

000855

Table C.III–247
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Private Ownership: On–Property Perched Groundwater User
Via Incidental Ingestion of Soil

Intake Equation = $\frac{CS \times EF \times ED \times CF \times IR}{BW \times AT}$

IRs	Ingestion rate of soil (RAGS, 1989)	180 mg/day
CF	Conversion factor	1.0E–06 kg/mg
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	1.3E+00	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	NA	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	1.5E–03	mg/kg	NA	NA	mg/kg
carbazole	6.4E–03	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

000856

Table C.III-247 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: On-Property Perched Groundwater User
Via Incidental Ingestion of Soil

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	3.3E-06	4.0E-04	8.2E-03
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	NA	3.0E-03	NA
benzo(a)pyrene	3.7E-09	NA	NA
carbazole	1.6E-08	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		8.2E-03

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	3.3E-06	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	NA	NA	NA
benzo(a)pyrene	3.7E-09	7.3E+00	2.7E-08
carbazole	1.6E-08	2.0E-02	3.2E-10
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		2.7E-08

0086

Table C.III-248
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Private Ownership: On-Property Perched Groundwater User
Via Incidental Ingestion of Soil

Intake Equation = CS X EF X EDn X FI X IR

IRs	Ingestion rate of soil (RAGS, 1989)	180 mg/day
EF	Exposure frequency	350 days/year
EDn	Exposure Duration	70 Year
FI	Fractional Intake	1 (unitless)
CS	Concentration of radionuclides in soil	

Cs_{137+1d}	NA	pCi/mg	$Th_{232+10d}$	NA	pCi/mg
Np_{237+1d}	4.30E-05	pCi/mg	U_{234}	8.00E-05	pCi/mg
Pu_{238}	2.00E-04	pCi/mg	U_{235+1d}	NA	pCi/mg
Ra_{226+8d}	NA	pCi/mg	U_{238+2d}	NA	pCi/mg
Ra_{228+1d}	NA	pCi/mg	NA	NA	pCi/mg
Rn_{222+4d}	NA	pCi/mg	NA	NA	pCi/mg
Sr_{90+1d}	NA	pCi/mg	NA	NA	pCi/mg
Tc_{99}	NA	pCi/mg	NA	NA	pCi/mg
Th_{228+7d}	NA	pCi/mg	NA	NA	pCi/mg
Th_{230}	7.70E-04	pCi/mg	NA	NA	pCi/mg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.80E-11	NA
Np_{237+1d}	1.90E+02	2.20E-10	4.17E-08
Pu_{238}	8.82E+02	2.20E-10	1.94E-07
Ra_{226+8d}	NA	7.80E-10	NA
Ra_{228+1d}	NA	1.00E-10	NA
Rn_{222+4d}	NA	1.70E-12	NA
Sr_{90+1d}	NA	3.60E-11	NA
Tc_{99}	NA	1.30E-12	NA
Th_{228+7d}	NA	5.50E-11	NA
Th_{230}	3.40E+03	1.30E-11	4.41E-08
$Th_{232+10d}$	NA	1.70E-10	NA
U_{234}	3.53E+02	1.60E-11	5.64E-09
U_{235+1d}	NA	1.60E-11	NA
U_{238+2d}	NA	2.00E-11	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.86E-07

000858

Table C.III-249
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Private Ownership: On-Property Perched Groundwater User
Via Dermal Contact with Soil

Intake Equation = $\frac{CS \times EF \times ED \times CF \times ABS \times AF \times SA}{BW \times AT}$

SA	Surface area of exposed skin (50th percentile, hands only)	5750 cm^2/day
AF	Soil to skin adherence factor (RAGS, 1989)	1 mg/cm^2
ABS	chemicals specific absorbtion factor (see table below)	csv
CF	Conversion factor	1E-06 kg/mg
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in soil	

Chemical Concentrations

Compound	ABS	Concentrati	Units	Compound		Concentrati	Units
antimony	1.00E-02	1.33E+00	mg/kg	NA	NA	NA	mg/kg
arsenic	1.00E-03	NA	mg/kg	NA	NA	NA	mg/kg
beryllium	1.00E-02	NA	mg/kg	NA	NA	NA	mg/kg
uranium-total	1.00E-02	NA	mg/kg	NA	NA	NA	mg/kg
benzo(a)pyrene	3.00E-01	1.50E-03	mg/kg	NA	NA	NA	mg/kg
carbazole	3.00E-01	6.40E-03	mg/kg	NA	NA	NA	mg/kg
aroclor-1254	6.00E-02	NA	mg/kg	NA	NA	NA	mg/kg
aroclor-1260	6.00E-02	NA	mg/kg	NA	NA	NA	mg/kg
dieldrin	3.00E-01	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg				

References

0086

Table C.III-249 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: On-Property Perched Groundwater User
Via Dermal Contact with Soil

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	1.05E-06	6.00E-05	1.75E-02
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	NA	1.50E-04	NA
benzo(a)pyrene	3.54E-08	NA	NA
carbazole	1.51E-07	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.75E-02

Compound	ILCR Calculation CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	1.05E-06	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	NA	NA	NA
benzo(a)pyrene	3.54E-08	NA	NA
carbazole	1.51E-07	2.22E-02	3.36E-09
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		3.36E-09

000860

Table C.III–250
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Private Ownership: On–Property Perched Groundwater User
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium–total	NA	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	4.70E–04	mg/l	NA	NA	mg/l
aroclor–1254	NA	mg/l	NA	NA	mg/l
aroclor–1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

0385

Table C.III−250 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: On−Property Perched Groundwater User
Via Drinking Water Ingestion

Compound	HQ Calculation CDI (mg/kg−day)	RfD (mg/kg−day)	HQ (unitless)
antimony	NA	4.00E−04	NA
arsenic	NA	3.00E−04	NA
beryllium	NA	5.00E−03	NA
uranium−total	NA	3.00E−03	NA
benzo(a)pyrene	NA	NA	NA
carbazole	1.29E−05	NA	NA
aroclor−1254	NA	NA	NA
aroclor−1260	NA	NA	NA
dieldrin	NA	5.00E−05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		NA

Compound	ILCR Calculation CDI (mg/kg−day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium−total	NA	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	1.29E−05	2.00E−02	2.58E−07
aroclor−1254	NA	7.70E+00	NA
aroclor−1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		2.58E−07

000862

Table C.III-251
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Private Ownership: On-Property Perched Groundwater User Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	6.1E-01	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	3.2E-02	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	6.7E-01	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	1.6E-02	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	NA	2.2E-10	NA
Pu_{238}	NA	2.2E-10	NA
Ra_{226+8d}	NA	7.8E-10	NA
Ra_{228+1d}	NA	1.0E-10	NA
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	NA	3.6E-11	NA
Tc_{99}	7.8E+02	1.3E-12	1.0E-09
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	NA	1.3E-11	NA
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	3.0E+04	1.6E-11	4.8E-07
U_{235+1d}	1.6E+03	1.6E-11	2.5E-08
U_{238+2d}	3.3E+04	2.0E-11	6.6E-07
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.2E-06

Table C.III–252
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Private Ownership: On–Property Perched Groundwater User
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2–day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
SA	Skin surface area available for contact	23000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
arsenic	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
beryllium	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
uranium–total	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
benzo(a)pyrene	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
carbazole	1.17E–09	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1254	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1260	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
dieldrin	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day

References

000864

Table C.III–252 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: On–Property Perched Groundwater User
Via Dermal Contact while Bathing

	HQ Calculation		
Compound	CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	6.00E–05	NA
arsenic	NA	2.85E–04	NA
beryllium	NA	5.00E–03	NA
uranium–total	NA	1.50E–04	NA
benzo(a)pyrene	NA	NA	NA
carbazole	3.70E–07	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	4.50E–05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		NA

	ILCR Calculation		
Compound	CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium–total	NA	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	3.70E–07	2.22E–02	8.23E–09
aroclor–1254	NA	1.03E+01	NA
aroclor–1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		8.23E–09

Table C.III–253
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Private Ownership: On–Property Perched Groundwater User
Via Inhalation of Particulates

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	3.5E–08	mg/m^3	NA	NA	mg/m^3
arsenic	NA	mg/m^3	NA	NA	mg/m^3
beryllium	NA	mg/m^3	NA	NA	mg/m^3
uranium–total	NA	mg/m^3	NA	NA	mg/m^3
benzo(a)pyrene	4.6E–11	mg/m^3	NA	NA	mg/m^3
carbazole	2.0E–10	mg/m^3	NA	NA	mg/m^3
aroclor–1254	NA	mg/m^3	NA	NA	mg/m^3
aroclor–1260	NA	mg/m^3	NA	NA	mg/m^3
dieldrin	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3			

References

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Table C.III-253 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: On-Property Perched Groundwater User
Via Inhalation of Particulates

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	9.5E-09	NA	NA
arsenic	NA	NA	NA
beryllium	NA	NA	NA
uranium-total	NA	NA	NA
benzo(a)pyrene	1.3E-11	NA	NA
carbazole	5.4E-11	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	Hazard Quotient Sum =		NA

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	9.5E-09	NA	NA
arsenic	NA	1.5E+01	NA
beryllium	NA	8.4E+00	NA
uranium-total	NA	NA	NA
benzo(a)pyrene	1.3E-11	6.1E+00	7.7E-11
carbazole	5.4E-11	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		7.7E-11

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Table C.III–254
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Private Ownership: On–Property Perched Groundwater User
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	1.3E–06	pCi/m^3	U_{234}	2.5E–06	pCi/m^3
Pu_{238}	6.2E–06	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	2.4E–05	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	6.5E–01	2.9E–08	1.9E–08
Pu_{238}	3.0E+00	3.9E–08	1.2E–07
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	NA	7.7E–12	NA
Sr_{90+1d}	NA	6.2E–11	NA
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	1.2E+01	2.9E–08	3.4E–07
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	1.2E+00	2.6E–08	3.1E–08
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	NA	2.4E–08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 5.0E–07

000868

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Table C.III–255
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Private Ownership: On–Property Perched Groundwater User
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	2.7E–03	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	8.0E–07	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	5.1E–05	mg/kg	NA	NA	mg/kg
carbazole	9.7E–06	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

000869

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Table C.III−255 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: On−Property Perched Groundwater User
Via Ingestion of Meat Products

Compound	HQ Calculation		
	CDI (mg/kg−day)	RfD (mg/kg−day)	HQ (unitless)
antimony	2.8E−06	4.0E−04	6.9E−03
arsenic	NA	3.0E−04	NA
beryllium	NA	5.0E−03	NA
uranium−total	8.3E−10	3.0E−03	2.8E−07
benzo(a)pyrene	5.3E−08	NA	NA
carbazole	1.0E−08	NA	NA
aroclor−1254	NA	NA	NA
aroclor−1260	NA	NA	NA
dieldrin	NA	5.0E−05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		6.9E−03

Compound	ILCR Calculation		
	CDI (mg/kg−day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	2.8E−06	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium−total	8.3E−10	NA	NA
benzo(a)pyrene	5.3E−08	7.3E+00	3.9E−07
carbazole	1.0E−08	2.0E−02	2.0E−10
aroclor−1254	NA	7.7E+00	NA
aroclor−1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		3.9E−07

5860

Table C.III–256
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Private Ownership: On–Property Perched Groundwater User
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	2.4E–03	pCi/kg	U_{234}	1.5E–02	pCi/kg
Pu_{238}	5.2E–05	pCi/kg	U_{235+1d}	1.2E–05	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.6E–04	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	2.5E–03	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	4.4E+00	2.2E–10	9.7E–10
Pu_{238}	9.7E–02	2.2E–10	2.1E–11
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	4.7E+00	1.3E–11	6.1E–11
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	2.8E+01	1.6E–11	4.5E–10
U_{235+1d}	2.2E–02	1.6E–11	3.6E–13
U_{238+2d}	4.8E–01	2.0E–11	9.7E–12
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		1.5E–09

000871

Table C.III–257
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Private Ownership: On–Property Perched Groundwater User
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	2.7E–04	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	4.7E–04	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

000872

Table C.III-257 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: On-Property Perched Groundwater User
Via Ingestion of Dairy Products

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	1.1E-06	4.0E-04	2.7E-03
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.9E-06	3.0E-03	6.5E-04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		3.4E-03

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	1.1E-06	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.9E-06	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

0082

Table C.III–258
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Private Ownership: On–Property Perched Groundwater User
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	7.9E–05	pCi/kg	U_{234}	2.4E–02	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	3.6E–04	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.3E–02	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	2.4E+00	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	3.5E–04	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	5.8E–01	2.2E–10	1.3E–10
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	1.8E+04	3.6E–11	6.4E–07
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	2.6E+00	1.3E–11	3.4E–11
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.8E+02	1.6E–11	2.8E–09
U_{235+1d}	2.6E+00	1.6E–11	4.2E–11
U_{238+2d}	1.7E+02	2.0E–11	3.3E–09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
		ILCR Summation =	6.4E–07

000874

Table C.III–259
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Private Ownership: On–Property Perched Groundwater User
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	4.0E–02	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	3.9E–04	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	1.7E–05	mg/kg	NA	NA	mg/kg
carbazole	2.3E–03	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-259 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: On-Property Perched Groundwater User
Via Ingestion of Vegetables and Fruits

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	6.7E-05	4.0E-04	1.7E-01
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	6.5E-07	3.0E-03	2.2E-04
benzo(a)pyrene	2.9E-08	NA	NA
carbazole	3.9E-06	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.7E-01

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	6.7E-05	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	6.5E-07	NA	NA
benzo(a)pyrene	2.9E-08	7.3E+00	2.1E-07
carbazole	3.9E-06	2.0E-02	7.7E-08
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		2.9E-07

000876

Table C.III-260
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Private Ownership: On-Property Perched Groundwater User
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	4.3E-01	pCi/kg	U_{234}	8.0E-01	pCi/kg
Pu_{238}	9.6E-02	pCi/kg	U_{235+1d}	5.9E-03	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	1.3E-01	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	6.8E-01	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	1.3E+03	2.2E-10	2.8E-07
Pu_{238}	2.9E+02	2.2E-10	6.3E-08
Ra_{226+8d}	NA	7.8E-10	NA
Ra_{228+1d}	NA	1.0E-10	NA
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	NA	3.6E-11	NA
Tc_{99}	NA	1.3E-12	NA
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	2.0E+03	1.3E-11	2.7E-08
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	2.4E+03	1.6E-11	3.8E-08
U_{235+1d}	1.8E+01	1.6E-11	2.8E-10
U_{238+2d}	3.8E+02	2.0E-11	7.6E-09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 4.2E-07

000877

Table C.III–261
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Private Ownership: On–Property Perched Groundwater User
Via External Radiation

Dose Equivalency Equat = $[DR \times EF \times EDn \times ET_i \times (1-SH_i)] + [DR \times EF \times EDn \times ET_o \times (1-SH_o)]$

EF	Fraction of year spent exposured	0.96 (unitless)
ED	Exposure duration	70 Year
ET_i	Fraction of day spent indoors	0.76 (unitless)
ET_o	Fraction of day spent outdoors	0.24 (unitless)
SH_i	Shield factor indoors	0.5 (unitless)
SH_o	Shield factor outdoors	NA (unitless)
DR	Radionuclide specific dose concentrations	(see table below)

Cs_{137+1d}	NA	pCi/g	$Th_{232+10d}$	NA	pCi/g
Np_{237+1d}	4.30E–02	pCi/g	U_{234}	8.00E–02	pCi/g
Pu_{238}	2.00E–01	pCi/g	U_{235+1d}	NA	pCi/g
Ra_{226+8d}	NA	pCi/g	U_{238+2d}	NA	pCi/g
Ra_{228+1d}	NA	pCi/g	NA	NA	pCi/g
Rn_{222+4d}	NA	pCi/g	NA	NA	pCi/g
Sr_{90+1d}	NA	pCi/g	NA	NA	pCi/g
Tc_{99}	NA	pCi/g	NA	NA	pCi/g
Th_{228+7d}	NA	pCi/g	NA	NA	pCi/g
Th_{230}	7.70E–01	pCi/g	NA	NA	pCi/g

Radionuclides	CDI (year pCi/g)	CSF $(g/pCi-year)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.0E–06	NA
Np_{237+1d}	1.8E+00	4.3E–07	7.7E–07
Pu_{238}	8.3E+00	2.8E–11	2.3E–10
Ra_{226+8d}	NA	6.0E–06	NA
Ra_{228+1d}	NA	2.9E–06	NA
Rn_{222+4d}	NA	5.9E–06	NA
Sr_{90+1d}	NA	NA	NA
Tc_{99}	NA	6.0E–13	NA
Th_{228+7d}	NA	5.6E–06	NA
Th_{230}	3.2E+01	5.4E–11	1.7E–09
$Th_{232+10d}$	NA	8.5E–06	NA
U_{234}	3.3E+00	3.0E–11	1.0E–10
U_{235+1d}	NA	2.4E–07	NA
U_{238+2d}	NA	5.1E–08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
		ILCR Summation =	7.7E–07

000878

Table C.III–262
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Incidental Ingestion of Soil

Intake Equation = $\frac{CS \times EF \times ED \times CF \times IR}{BW \times AT}$

IRs	Ingestion rate of soil (RAGS, 1989)	180 mg/day
CF	Conversion factor	1.0E–06 kg/mg
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	1.3E+00	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	NA	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	1.5E–03	mg/kg	NA	NA	mg/kg
carbazole	6.4E–03	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III-262 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Incidental Ingestion of Soil

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	3.3E-06	4.0E-04	8.2E-03
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	NA	3.0E-03	NA
benzo(a)pyrene	3.7E-09	NA	NA
carbazole	1.6E-08	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		8.2E-03

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	3.3E-06	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	NA	NA	NA
benzo(a)pyrene	3.7E-09	7.3E+00	2.7E-08
carbazole	1.6E-08	2.0E-02	3.2E-10
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		2.7E-08

000880

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Table C.III-263
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Incidental Ingestion of Soil

Intake Equation = CS X EF X EDn X FI X IR

IRs	Ingestion rate of soil (RAGS, 1989)	180 mg/day
EF	Exposure frequency	350 days/year
EDn	Exposure Duration	70 Year
FI	Fractional Intake	1 (unitless)
CS	Concentration of radionuclides in soil	

Cs_{137+1d}	NA	pCi/mg	$Th_{232+10d}$	NA	pCi/mg
Np_{237+1d}	4.30E-05	pCi/mg	U_{234}	8.00E-05	pCi/mg
Pu_{238}	2.00E-04	pCi/mg	U_{235+1d}	NA	pCi/mg
Ra_{226+8d}	NA	pCi/mg	U_{238+2d}	NA	pCi/mg
Ra_{228+1d}	NA	pCi/mg	NA	NA	pCi/mg
Rn_{222+4d}	NA	pCi/mg	NA	NA	pCi/mg
Sr_{90+1d}	NA	pCi/mg	NA	NA	pCi/mg
Tc_{99}	NA	pCi/mg	NA	NA	pCi/mg
Th_{228+7d}	NA	pCi/mg	NA	NA	pCi/mg
Th_{230}	7.70E-04	pCi/mg	NA	NA	pCi/mg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.80E-11	NA
Np_{237+1d}	1.90E+02	2.20E-10	4.17E-08
Pu_{238}	8.82E+02	2.20E-10	1.94E-07
Ra_{226+8d}	NA	7.80E-10	NA
Ra_{228+1d}	NA	1.00E-10	NA
Rn_{222+4d}	NA	1.70E-12	NA
Sr_{90+1d}	NA	3.60E-11	NA
Tc_{99}	NA	1.30E-12	NA
Th_{228+7d}	NA	5.50E-11	NA
Th_{230}	3.40E+03	1.30E-11	4.41E-08
$Th_{232+10d}$	NA	1.70E-10	NA
U_{234}	3.53E+02	1.60E-11	5.64E-09
U_{235+1d}	NA	1.60E-11	NA
U_{238+2d}	NA	2.00E-11	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.86E-07

000881

Table C.III–264
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Dermal Contact with Soil

Intake Equation = $\frac{CS \times EF \times ED \times CF \times ABS \times AF \times SA}{BW \times AT}$

SA	Surface area of exposed skin (50th percentile, hands only)	5750 cm^2/day
AF	Soil to skin adherence factor (RAGS, 1989)	1 mg/cm^2
ABS	chemicals specific absorbtion factor (see table below)	csv
CF	Conversion factor	1E–06 kg/mg
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in soil	

Chemical Concentrations

Compound	ABS	Concentrati	Units	Compound		Concentrati	Units
antimony	1.00E–02	1.33E+00	mg/kg	NA	NA	NA	mg/kg
arsenic	1.00E–03	NA	mg/kg	NA	NA	NA	mg/kg
beryllium	1.00E–02	NA	mg/kg	NA	NA	NA	mg/kg
uranium–total	1.00E–02	NA	mg/kg	NA	NA	NA	mg/kg
benzo(a)pyrene	3.00E–01	1.50E–03	mg/kg	NA	NA	NA	mg/kg
carbazole	3.00E–01	6.40E–03	mg/kg	NA	NA	NA	mg/kg
aroclor–1254	6.00E–02	NA	mg/kg	NA	NA	NA	mg/kg
aroclor–1260	6.00E–02	NA	mg/kg	NA	NA	NA	mg/kg
dieldrin	3.00E–01	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg				

References

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Table C.III-264 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Dermal Contact with Soil

Compound	HQ Calculation		
	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	1.05E-06	6.00E-05	1.75E-02
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	NA	1.50E-04	NA
benzo(a)pyrene	3.54E-08	NA	NA
carbazole	1.51E-07	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.75E-02

Compound	ILCR Calculation		
	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	1.05E-06	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	NA	NA	NA
benzo(a)pyrene	3.54E-08	NA	NA
carbazole	1.51E-07	2.22E-02	3.36E-09
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		3.36E-09

000883

Table C.III–265
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium–total	8.00E–05	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
aroclor–1254	NA	mg/l	NA	NA	mg/l
aroclor–1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

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Table C.III-265 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Drinking Water Ingestion

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	2.19E-06	3.00E-03	7.31E-04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		7.31E-04

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	2.19E-06	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000885

Table C.III–266
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	2.4E–02	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	1.2E–03	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	2.6E–02	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.2E+03	1.6E–11	1.9E–08
U_{235+1d}	5.9E+01	1.6E–11	9.4E–10
U_{238+2d}	1.3E+03	2.0E–11	2.5E–08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 4.5E–08

000886

Table C.III-267
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2-day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	25550 days
SA	Skin surface area available for contact	23000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arsenic	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
beryllium	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
uranium-total	2.00E-11	mg/cm^2-day	NA	NA	mg/cm^2-day
benzo(a)pyrene	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
carbazole	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
aroclor-1254	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
aroclor-1260	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
dieldrin	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day			

References

Table C.III-267 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Dermal Contact while Bathing

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	6.30E-09	1.50E-04	4.20E-05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		4.20E-05

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	6.30E-09	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000888

Table C.III–268
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Inhalation of Particulates

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	3.5E–08	mg/m^3	NA	NA	mg/m^3
arsenic	NA	mg/m^3	NA	NA	mg/m^3
beryllium	NA	mg/m^3	NA	NA	mg/m^3
uranium–total	NA	mg/m^3	NA	NA	mg/m^3
benzo(a)pyrene	4.6E–11	mg/m^3	NA	NA	mg/m^3
carbazole	2.0E–10	mg/m^3	NA	NA	mg/m^3
aroclor–1254	NA	mg/m^3	NA	NA	mg/m^3
aroclor–1260	NA	mg/m^3	NA	NA	mg/m^3
dieldrin	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3			

References

Table C.III-268 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Inhalation of Particulates

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	9.5E-09	NA	NA
arsenic	NA	NA	NA
beryllium	NA	NA	NA
uranium-total	NA	NA	NA
benzo(a)pyrene	1.3E-11	NA	NA
carbazole	5.4E-11	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	Hazard Quotient Sum =		NA

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	9.5E-09	NA	NA
arsenic	NA	1.5E+01	NA
beryllium	NA	8.4E+00	NA
uranium-total	NA	NA	NA
benzo(a)pyrene	1.3E-11	6.1E+00	7.7E-11
carbazole	5.4E-11	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		7.7E-11

000890

5860

Table C.III–269
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	1.3E–06	pCi/m^3	U_{234}	2.5E–06	pCi/m^3
Pu_{238}	6.2E–06	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	2.4E–05	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	6.5E–01	2.9E–08	1.9E–08
Pu_{238}	3.0E+00	3.9E–08	1.2E–07
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	NA	7.7E–12	NA
Sr_{90+1d}	NA	6.2E–11	NA
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	1.2E+01	2.9E–08	3.4E–07
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	1.2E+00	2.6E–08	3.1E–08
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	NA	2.4E–08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	5.0E–07

000891

Table C.III–270
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	2.7E–03	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	8.0E–07	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	5.1E–05	mg/kg	NA	NA	mg/kg
carbazole	9.7E–06	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-270 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Ingestion of Meat Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	2.8E-06	4.0E-04	6.9E-03
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	8.3E-10	3.0E-03	2.8E-07
benzo(a)pyrene	5.3E-08	NA	NA
carbazole	1.0E-08	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		6.9E-03

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	2.8E-06	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	8.3E-10	NA	NA
benzo(a)pyrene	5.3E-08	7.3E+00	3.9E-07
carbazole	1.0E-08	2.0E-02	2.0E-10
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		3.9E-07

Table C.III-271
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	2.4E-03	pCi/kg	U_{234}	1.5E-02	pCi/kg
Pu_{238}	5.2E-05	pCi/kg	U_{235+1d}	1.2E-05	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.6E-04	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	2.5E-03	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	4.4E+00	2.2E-10	9.7E-10
Pu_{238}	9.7E-02	2.2E-10	2.1E-11
Ra_{226+8d}	NA	7.8E-10	NA
Ra_{228+1d}	NA	1.0E-10	NA
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	NA	3.6E-11	NA
Tc_{99}	NA	1.3E-12	NA
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	4.7E+00	1.3E-11	6.1E-11
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	2.8E+01	1.6E-11	4.5E-10
U_{235+1d}	2.2E-02	1.6E-11	3.6E-13
U_{238+2d}	4.8E-01	2.0E-11	9.7E-12
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	1.5E-09

000894

Table C.III-272
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	2.7E-04	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium-total	4.7E-04	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor-1254	NA	mg/kg	NA	NA	mg/kg
aroclor-1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-272 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Ingestion of Dairy Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	1.1E-06	4.0E-04	2.7E-03
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.9E-06	3.0E-03	6.5E-04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		3.4E-03

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	1.1E-06	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.9E-06	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000896

Table C.III-273
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	7.9E-05	pCi/kg	U_{234}	2.4E-02	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	3.6E-04	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.3E-02	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	2.4E+00	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	3.5E-04	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	5.8E-01	2.2E-10	1.3E-10
Pu_{238}	NA	2.2E-10	NA
Ra_{226+8d}	NA	7.8E-10	NA
Ra_{228+1d}	NA	1.0E-10	NA
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	1.8E+04	3.6E-11	6.4E-07
Tc_{99}	NA	1.3E-12	NA
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	2.6E+00	1.3E-11	3.4E-11
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	1.8E+02	1.6E-11	2.8E-09
U_{235+1d}	2.6E+00	1.6E-11	4.2E-11
U_{238+2d}	1.7E+02	2.0E-11	3.3E-09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
		ILCR Summation =	6.4E-07

Table C.III–274
Summary of Intake Quantitation (chemicals) Alternative 3
Solid Waste Landfill with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	4.0E–02	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	3.9E–04	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	1.7E–05	mg/kg	NA	NA	mg/kg
carbazole	2.3E–03	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

008698

Table C.III-274 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Compound	HQ Calculation		
	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	6.7E-05	4.0E-04	1.7E-01
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	6.5E-07	3.0E-03	2.2E-04
benzo(a)pyrene	2.9E-08	NA	NA
carbazole	3.9E-06	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.7E-01

Compound	ILCR Calculation		
	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	6.7E-05	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	6.5E-07	NA	NA
benzo(a)pyrene	2.9E-08	7.3E+00	2.1E-07
carbazole	3.9E-06	2.0E-02	7.7E-08
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		2.9E-07

Table C.III–275
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	4.3E–01	pCi/kg	U_{234}	8.0E–01	pCi/kg
Pu_{238}	9.6E–02	pCi/kg	U_{235+1d}	5.9E–03	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	1.3E–01	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	6.8E–01	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	1.3E+03	2.2E–10	2.8E–07
Pu_{238}	2.9E+02	2.2E–10	6.3E–08
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	2.0E+03	1.3E–11	2.7E–08
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	2.4E+03	1.6E–11	3.8E–08
U_{235+1d}	1.8E+01	1.6E–11	2.8E–10
U_{238+2d}	3.8E+02	2.0E–11	7.6E–09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	4.2E–07

000300

5860

Table C.III–276
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
Solid Waste Landfill with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via External Radiation

Dose Equivalency Equat = $[DR \times EF \times EDn \times ET_i \times (1-SH_i)] + [DR \times EF \times EDn \times ET_o \times (1-SH_o)]$

EF	Fraction of year spent exposured	0.96 (unitless)
ED	Exposure duration	70 Year
ET_i	Fraction of day spent indoors	0.76 (unitless)
ET_o	Fraction of day spent outdoors	0.24 (unitless)
SH_i	Shield factor indoors	0.5 (unitless)
SH_o	Shield factor outdoors	NA (unitless)
DR	Radionuclide specific dose concentrations	(see table below)

Cs_{137+1d}	NA	pCi/g	$Th_{232+10d}$	NA	pCi/g
Np_{237+1d}	4.30E–02	pCi/g	U_{234}	8.00E–02	pCi/g
Pu_{238}	2.00E–01	pCi/g	U_{235+1d}	NA	pCi/g
Ra_{226+8d}	NA	pCi/g	U_{238+2d}	NA	pCi/g
Ra_{228+1d}	NA	pCi/g	NA	NA	pCi/g
Rn_{222+4d}	NA	pCi/g	NA	NA	pCi/g
Sr_{90+1d}	NA	pCi/g	NA	NA	pCi/g
Tc_{99}	NA	pCi/g	NA	NA	pCi/g
Th_{228+7d}	NA	pCi/g	NA	NA	pCi/g
Th_{230}	7.70E–01	pCi/g	NA	NA	pCi/g

Radionuclides	CDI (year pCi/g)	CSF $(g/pCi-year)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.0E–06	NA
Np_{237+1d}	1.8E+00	4.3E–07	7.7E–07
Pu_{238}	8.3E+00	2.8E–11	2.3E–10
Ra_{226+8d}	NA	6.0E–06	NA
Ra_{228+1d}	NA	2.9E–06	NA
Rn_{222+4d}	NA	5.9E–06	NA
Sr_{90+1d}	NA	NA	NA
Tc_{99}	NA	6.0E–13	NA
Th_{228+7d}	NA	5.6E–06	NA
Th_{230}	3.2E+01	5.4E–11	1.7E–09
$Th_{232+10d}$	NA	8.5E–06	NA
U_{234}	3.3E+00	3.0E–11	1.0E–10
U_{235+1d}	NA	2.4E–07	NA
U_{238+2d}	NA	5.1E–08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 7.7E–07

000301

Table C.III-277
Summary of Intake Quantitation (chemicals) Alternatives 3
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Incidental Ingestion of Soil

Intake Equation = $\frac{CS \times EF \times ED \times CF \times IR}{BW \times AT}$

IRs	Ingestion rate of soil (RAGS, 1989)	200 mg/day
CF	Conversion factor	1.0E-06 kg/mg
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	1.3E+00	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium-total	NA	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	1.5E-03	mg/kg	NA	NA	mg/kg
carbazole	6.4E-03	mg/kg	NA	NA	mg/kg
aroclor-1254	NA	mg/kg	NA	NA	mg/kg
aroclor-1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

000802

Table C.III-277 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Incidental Ingestion of Soil

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	1.7E-05	4.0E-04	4.3E-02
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	NA	3.0E-03	NA
benzo(a)pyrene	1.9E-08	NA	NA
carbazole	8.2E-08	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		4.3E-02

Compound	ILCR Calculation CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	1.5E-06	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	NA	NA	NA
benzo(a)pyrene	1.6E-09	7.3E+00	1.2E-08
carbazole	7.0E-09	2.0E-02	1.4E-10
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		1.2E-08

Table C.III−278
Summary of Intake and Risk Quantitation (radionuclides) Alternatives 3
Solid Waste Landfill with Private Ownership: Off−Property Farmer (Child)
Via Incidental Ingestion of Soil

Intake Equation = CS X EF X EDn X FI X IR

IRs	Ingestion rate of soil (RAGS, 1989)	200 mg/day
EF	Exposure frequency	350 days/year
EDn	Exposure Duration	6 Year
FI	Fractional Intake	1 (unitless)
CS	Concentration of radionuclides in soil	

Cs_{137+1d}	NA	pCi/mg	$Th_{232+10d}$	NA	pCi/mg
Np_{237+1d}	4.30E−05	pCi/mg	U_{234}	8.00E−05	pCi/mg
Pu_{238}	2.00E−04	pCi/mg	U_{235+1d}	NA	pCi/mg
Ra_{226+8d}	NA	pCi/mg	U_{238+2d}	NA	pCi/mg
Ra_{228+1d}	NA	pCi/mg	NA	NA	pCi/mg
Rn_{222+4d}	NA	pCi/mg	NA	NA	pCi/mg
Sr_{90+1d}	NA	pCi/mg	NA	NA	pCi/mg
Tc_{99}	NA	pCi/mg	NA	NA	pCi/mg
Th_{228+7d}	NA	pCi/mg	NA	NA	pCi/mg
Th_{230}	7.70E−04	pCi/mg	NA	NA	pCi/mg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.80E−11	NA
Np_{237+1d}	1.81E+01	2.20E−10	3.97E−09
Pu_{238}	8.40E+01	2.20E−10	1.85E−08
Ra_{226+8d}	NA	7.80E−10	NA
Ra_{228+1d}	NA	1.00E−10	NA
Rn_{222+4d}	NA	1.70E−12	NA
Sr_{90+1d}	NA	3.60E−11	NA
Tc_{99}	NA	1.30E−12	NA
Th_{228+7d}	NA	5.50E−11	NA
Th_{230}	3.23E+02	1.30E−11	4.20E−09
$Th_{232+10d}$	NA	1.70E−10	NA
U_{234}	3.36E+01	1.60E−11	5.38E−10
U_{235+1d}	NA	1.60E−11	NA
U_{238+2d}	NA	2.00E−11	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.72E−08

Table C.III–279
Summary of Intake Quantitation (chemicals) Alternatives 3
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Dermal Contact with Soil

Intake Equation = $\frac{CS \times EF \times ED \times CF \times ABS \times AF \times SA}{BW \times AT}$

SA	Surface area of exposed skin (50th percentile, hands only)	2000 cm^2/day
AF	Soil to skin adherence factor (RAGS, 1989)	1 mg/cm^2
ABS	chemicals specific absorbtion factor (see table below)	csv
CF	Conversion factor	1E–06 kg/mg
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in soil	

Chemical Concentrations

Compound	ABS	Concentrati	Units	Compound		Concentrati	Units
antimony	1.00E–02	1.33E+00	mg/kg	NA	NA	NA	mg/kg
arsenic	1.00E–03	NA	mg/kg	NA	NA	NA	mg/kg
beryllium	1.00E–02	NA	mg/kg	NA	NA	NA	mg/kg
uranium–total	1.00E–02	NA	mg/kg	NA	NA	NA	mg/kg
benzo(a)pyrene	3.00E–01	1.50E–03	mg/kg	NA	NA	NA	mg/kg
carbazole	3.00E–01	6.40E–03	mg/kg	NA	NA	NA	mg/kg
aroclor–1254	6.00E–02	NA	mg/kg	NA	NA	NA	mg/kg
aroclor–1260	6.00E–02	NA	mg/kg	NA	NA	NA	mg/kg
dieldrin	3.00E–01	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg				

References

Table C.III-279 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Dermal Contact with Soil

Compound	HQ Calculation: CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	1.70E-06	6.00E-05	2.83E-02
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	NA	1.50E-04	NA
benzo(a)pyrene	5.75E-08	NA	NA
carbazole	2.45E-07	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.83E-02

Compound	ILCR Calculation: CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	1.46E-07	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	NA	NA	NA
benzo(a)pyrene	4.93E-09	NA	NA
carbazole	2.10E-08	2.22E-02	4.68E-10
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		4.68E-10

000906

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Table C.III–280
Summary of Intake Quantitation (chemicals) Alternatives 3
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium–total	8.00E–05	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
aroclor–1254	NA	mg/l	NA	NA	mg/l
aroclor–1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

Table C.III–280 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Drinking Water Ingestion

Compound	HQ Calculation CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	4.00E–04	NA
arsenic	NA	3.00E–04	NA
beryllium	NA	5.00E–03	NA
uranium–total	5.11E–06	3.00E–03	1.70E–03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	5.00E–05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
HQ Summation =			1.70E–03

Compound	ILCR Calculation CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium–total	4.38E–07	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E–02	NA
aroclor–1254	NA	7.70E+00	NA
aroclor–1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
ILCR Summation =			NA

Table C.III−281
Summary of Intake and Risk Quantitation (radionuclides) Alternatives 3
Solid Waste Landfill with Private Ownership: Off−Property Farmer (Child)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	2.4E−02	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	1.2E−03	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	2.6E−02	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	NA	2.2E−10	NA
Pu_{238}	NA	2.2E−10	NA
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	NA	3.6E−11	NA
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	NA	1.3E−11	NA
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	5.0E+01	1.6E−11	8.1E−10
U_{235+1d}	2.5E+00	1.6E−11	4.0E−11
U_{238+2d}	5.5E+01	2.0E−11	1.1E−09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
		ILCR Summation =	1.9E−09

000910

Table C.III–282
Summary of Intake Quantitation (chemicals) Alternatives 3
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2–day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
SA	Skin surface area available for contact	8000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
arsenic	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
beryllium	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
uranium–total	2.00E–11	mg/cm^2–day	NA	NA	mg/cm^2–day
benzo(a)pyrene	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
carbazole	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1254	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1260	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
dieldrin	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day			

References

000911

5860

Table C.III-282 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Dermal Contact while Bathing

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	1.02E-08	1.50E-04	6.82E-05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		6.82E-05

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	8.77E-10	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

Table C.III–283
Summary of Intake Quantitation (chemicals) Alternatives 3
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Inhalation of Particulates

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Inhalation rate of gases (RAGS, 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	3.5E–08	mg/m^3	NA	NA	mg/m^3
arsenic	NA	mg/m^3	NA	NA	mg/m^3
beryllium	NA	mg/m^3	NA	NA	mg/m^3
uranium–total	NA	mg/m^3	NA	NA	mg/m^3
benzo(a)pyrene	4.6E–11	mg/m^3	NA	NA	mg/m^3
carbazole	2.0E–10	mg/m^3	NA	NA	mg/m^3
aroclor–1254	NA	mg/m^3	NA	NA	mg/m^3
aroclor–1260	NA	mg/m^3	NA	NA	mg/m^3
dieldrin	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3			

References

Table C.III-283 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Inhalation of Particulates

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	2.7E-08	NA	NA
arsenic	NA	NA	NA
beryllium	NA	NA	NA
uranium-total	NA	NA	NA
benzo(a)pyrene	3.5E-11	NA	NA
carbazole	1.5E-10	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	Hazard Quotient Sum =		NA

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	2.3E-09	NA	NA
arsenic	NA	1.5E+01	NA
beryllium	NA	8.4E+00	NA
uranium-total	NA	NA	NA
benzo(a)pyrene	3.0E-12	6.1E+00	1.8E-11
carbazole	1.3E-11	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		1.8E-11

000914

Table C.III–284
Summary of Intake and Risk Quantitation (radionuclides) Alternatives 3
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	1.3E–06	pCi/m^3	U_{234}	2.5E–06	pCi/m^3
Pu_{238}	6.2E–06	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	2.4E–05	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	3.3E–02	2.9E–08	9.6E–10
Pu_{238}	1.5E–01	3.9E–08	6.0E–09
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	NA	7.7E–12	NA
Sr_{90+1d}	NA	6.2E–11	NA
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	6.0E–01	2.9E–08	1.7E–08
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	6.2E–02	2.6E–08	1.6E–09
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	NA	2.4E–08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.6E–08

000915

Table C.III–285
Summary of Intake Quantitation (chemicals) Alternatives 3
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	2.7E–03	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	8.0E–07	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	5.1E–05	mg/kg	NA	NA	mg/kg
carbazole	9.7E–06	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

000916

Table C.III-285 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Meat Products

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	5.0E-06	4.0E-04	1.2E-02
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.5E-09	3.0E-03	5.0E-07
benzo(a)pyrene	9.5E-08	NA	NA
carbazole	1.8E-08	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.2E-02

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	4.3E-07	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.3E-10	NA	NA
benzo(a)pyrene	8.2E-09	7.3E+00	6.0E-08
carbazole	1.6E-09	2.0E-02	3.1E-11
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		6.0E-08

000917

Table C.III–286
Summary of Intake and Risk Quantitation (radionuclides) Alternatives 3
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	2.4E–03	pCi/kg	U_{234}	1.5E–02	pCi/kg
Pu_{238}	5.2E–05	pCi/kg	U_{235+1d}	1.2E–05	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.6E–04	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	2.5E–03	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	1.5E–01	2.2E–10	3.2E–11
Pu_{238}	3.2E–03	2.2E–10	7.1E–13
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	1.5E–01	1.3E–11	2.0E–12
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	9.3E–01	1.6E–11	1.5E–11
U_{235+1d}	7.4E–04	1.6E–11	1.2E–14
U_{238+2d}	1.6E–02	2.0E–11	3.2E–13
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 5.0E–11

Table C.III-287
Summary of Intake Quantitation (chemicals) Alternatives 3
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	2.7E-04	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium-total	4.7E-04	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor-1254	NA	mg/kg	NA	NA	mg/kg
aroclor-1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

0 8 8 3

Table C.III−287 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off−Property Farmer (Child)
Via Ingestion of Dairy Products

	HQ Calculation		
Compound	CDI (mg/kg−day)	RfD (mg/kg−day)	HQ (unitless)
antimony	1.1E−05	4.0E−04	2.9E−02
arsenic	NA	3.0E−04	NA
beryllium	NA	5.0E−03	NA
uranium−total	2.0E−05	3.0E−03	6.8E−03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor−1254	NA	NA	NA
aroclor−1260	NA	NA	NA
dieldrin	NA	5.0E−05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		3.6E−02

	ILCR Calculation		
Compound	CDI (mg/kg−day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	9.9E−07	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium−total	1.8E−06	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E−02	NA
aroclor−1254	NA	7.7E+00	NA
aroclor−1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000920

Table C.III–288
Summary of Intake and Risk Quantitation (radionuclides) Alternatives 3
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	7.9E–05	pCi/kg	U_{234}	2.4E–02	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	3.6E–04	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.3E–02	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	2.4E+00	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	3.5E–04	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	1.1E–01	2.2E–10	2.5E–11
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	3.4E+03	3.6E–11	1.2E–07
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	5.0E–01	1.3E–11	6.5E–12
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	3.4E+01	1.6E–11	5.5E–10
U_{235+1d}	5.1E–01	1.6E–11	8.2E–12
U_{238+2d}	3.2E+01	2.0E–11	6.5E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.2E–07

000921

Table C.III–289
Summary of Intake Quantitation (chemicals) Alternatives 3
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	4.0E–02	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	3.9E–04	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	1.7E–05	mg/kg	NA	NA	mg/kg
carbazole	2.3E–03	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

009922

Table C.III-289 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	2.6E-04	4.0E-04	6.4E-01
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	2.5E-06	3.0E-03	8.3E-04
benzo(a)pyrene	1.1E-07	NA	NA
carbazole	1.5E-05	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		6.4E-01

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	2.2E-05	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	2.1E-07	NA	NA
benzo(a)pyrene	9.5E-09	7.3E+00	6.9E-08
carbazole	1.3E-06	2.0E-02	2.5E-08
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		9.5E-08

Table C.III–290
Summary of Intake and Risk Quantitation (radionuclides) Alternatives 3
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	4.3E–01	pCi/kg	U_{234}	8.0E–01	pCi/kg
Pu_{238}	9.6E–02	pCi/kg	U_{235+1d}	5.9E–03	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	1.3E–01	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	6.8E–01	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	9.1E+01	2.2E–10	2.0E–08
Pu_{238}	2.0E+01	2.2E–10	4.4E–09
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	1.4E+02	1.3E–11	1.9E–09
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.7E+02	1.6E–11	2.7E–09
U_{235+1d}	1.2E+00	1.6E–11	2.0E–11
U_{238+2d}	2.7E+01	2.0E–11	5.3E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.9E–08

000924

Table C.III–291
Summary of Intake and Risk Quantitation (radionuclides) Alternatives 3
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via External Radiation

Dose Equivalency Equat = $[DR \times EF \times EDn \times ET_i \times (1-SH_i)] + [DR \times EF \times EDn \times ET_o \times (1-SH_o)]$

EF	Fraction of year spent exposured	0.96 (unitless)
ED	Exposure duration	6 Year
ET_i	Fraction of day spent indoors	0.92 (unitless)
ET_o	Fraction of day spent outdoors	0.08 (unitless)
SH_i	Shield factor indoors	0.5 (unitless)
SH_o	Shield factor outdoors	NA (unitless)
DR	Radionuclide specific dose concentrations	(see table below)

Cs_{137+1d}	NA	pCi/g	$Th_{232+10d}$	NA	pCi/g
Np_{237+1d}	4.30E–02	pCi/g	U_{234}	8.00E–02	pCi/g
Pu_{238}	2.00E–01	pCi/g	U_{235+1d}	NA	pCi/g
Ra_{226+8d}	NA	pCi/g	U_{238+2d}	NA	pCi/g
Ra_{228+1d}	NA	pCi/g	NA	NA	pCi/g
Rn_{222+4d}	NA	pCi/g	NA	NA	pCi/g
Sr_{90+1d}	NA	pCi/g	NA	NA	pCi/g
Tc_{99}	NA	pCi/g	NA	NA	pCi/g
Th_{228+7d}	NA	pCi/g	NA	NA	pCi/g
Th_{230}	7.70E–01	pCi/g	NA	NA	pCi/g

Radionuclides	CDI (year pCi/g)	CSF $(g/pCi-year)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.0E–06	NA
Np_{237+1d}	1.3E–01	4.3E–07	5.8E–08
Pu_{238}	6.2E–01	2.8E–11	1.7E–11
Ra_{226+8d}	NA	6.0E–06	NA
Ra_{228+1d}	NA	2.9E–06	NA
Rn_{222+4d}	NA	5.9E–06	NA
Sr_{90+1d}	NA	NA	NA
Tc_{99}	NA	6.0E–13	NA
Th_{228+7d}	NA	5.6E–06	NA
Th_{230}	2.4E+00	5.4E–11	1.3E–10
$Th_{232+10d}$	NA	8.5E–06	NA
U_{234}	2.5E–01	3.0E–11	7.5E–12
U_{235+1d}	NA	2.4E–07	NA
U_{238+2d}	NA	5.1E–08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 5.8E–08

000925

Table C.III–292
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Federal Ownership: Expanded Trespasser
Via Incidental Ingestion of Soil/Sediment

Intake Equation $= \frac{CS \times EFa \times EDa \times CF \times IRa}{BWa \times ATa} + \frac{CS \times EFc \times EDc \times CF \times IRc}{BWc \times ATc}$

IRa	Ingestion rate of soil (adult)	12.5 mg/day
IRc	Ingestion rate of soil (child)	12.5 mg/day
CF	Conversion factor	1.00E–06 kg/mg
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure duration (adult)	32 Year
EDc	Exposure duration (child)	12 Year
BWa	Body weight (adult)	70 kg
BWc	Body weight (child)	43 kg
AT	Average time for carcinogens	25550 days
ATa	Average time for non–carcinogens (adult)	11680 days
ATc	Average time for non–carcinogens (child)	4380 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	1.3E+00	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	4.0E–01	mg/kg	NA	NA	mg/kg
uranium–total	4.3E+00	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	2.9E–01	mg/kg	NA	NA	mg/kg
carbazole	2.1E–01	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

000926

Table C.III-292 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Expanded Trespasser
Via Incidental Ingestion of Soil/Sediment

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	1.4E-07	4.0E-04	3.6E-04
arsenic	NA	3.0E-04	NA
beryllium	4.3E-08	5.0E-03	8.6E-06
uranium-total	4.6E-07	3.0E-03	1.5E-04
benzo(a)pyrene	3.1E-08	NA	NA
carbazole	2.3E-08	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		5.2E-04

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	3.2E-08	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	9.6E-09	4.3E+00	4.1E-08
uranium-total	1.0E-07	NA	NA
benzo(a)pyrene	6.9E-09	7.3E+00	5.1E-08
carbazole	5.0E-09	2.0E-02	1.0E-10
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		9.2E-08

Table C.III−293
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Federal Ownership: Expanded Trespasser
Via Incidental Ingestion of Soil/Sediment

Intake Equation = CS X EFa X EDa X FI X IRa + CS X EFc X EDc X FI X IRc

IRa	Ingestion rate of soil (adult)	12.5 mg/day
IRc	Ingestion rate of soil (child)	12.5 mg/day
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure Duration	32 Year
EDc	Exposure Duration	12 Year
FI	Fractional Intake	1 (unitless)
CS	Concentration of radionuclides in soil	(see table below)

Cs_{137+1d}	NA	pCi/mg	$Th_{232+10d}$	NA	pCi/mg
Np_{237+1d}	4.0E−04	pCi/mg	U_{234}	2.6E−04	pCi/mg
Pu_{238}	2.0E−04	pCi/mg	U_{235+1d}	NA	pCi/mg
Ra_{226+8d}	NA	pCi/mg	U_{238+2d}	2.4E−03	pCi/mg
Ra_{228+1d}	NA	pCi/mg	NA	NA	pCi/mg
Rn_{222+4d}	NA	pCi/mg	NA	NA	pCi/mg
Sr_{90+1d}	NA	pCi/mg	NA	NA	pCi/mg
Tc_{99}	NA	pCi/mg	NA	NA	pCi/mg
Th_{228+7d}	NA	pCi/mg	NA	NA	pCi/mg
Th_{230}	1.1E−03	pCi/mg	NA	NA	pCi/mg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	1.3E+01	2.2E−10	2.9E−09
Pu_{238}	6.5E+00	2.2E−10	1.4E−09
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	NA	3.6E−11	NA
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	3.7E+01	1.3E−11	4.8E−10
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	8.5E+00	1.6E−11	1.4E−10
U_{235+1d}	NA	1.6E−11	NA
U_{238+2d}	7.7E+01	2.0E−11	1.5E−09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 6.4E−09

000928

Table C.III–294
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Federal Ownership: Expanded Trespasser
Via Dermal Contact with Soil/Sediment

Intake Equation = $\frac{CS \times EFa \times EDa \times CF \times ABS \times AF \times SAa}{BWa \times ATa}$ + $\frac{CS \times EFc \times EDc \times CF \times ABS \times AF \times SAc}{BWc \times ATc}$

SA	Surface area of exposed skin (adult)	5750 cm^2/day
SA	Surface area of exposed skin (child)	4200 cm^2/day
AF	Soil to skin adherence factor	1 mg/cm^2
ABS	chemicals specific absorbtion factor (see table below)	csv
CF	Conversion factor	1E–06 kg/mg
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure duration (adult)	32 Year
EDc	Exposure duration (child)	12 Year
BWa	Body weight (adult)	70 kg
BWc	Body weight (child)	43 kg
AT	Average time for carcinogens	25550 days
ATa	Average time for non–carcinogens (adult)	11680 days
ATc	Average time for non–carcinogens (child)	4380 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	ABS	Concentrati	Units	Compound	ABS	Concentrati	Units
antimony	1.0E–02	1.3E+00	mg/kg	NA	NA	NA	mg/kg
arsenic	1.0E–03	NA	mg/kg	NA	NA	NA	mg/kg
beryllium	1.0E–02	4.0E–01	mg/kg	NA	NA	NA	mg/kg
uranium–total	1.0E–02	4.3E+00	mg/kg	NA	NA	NA	mg/kg
benzo(a)pyrene	3.0E–01	2.9E–01	mg/kg	NA	NA	NA	mg/kg
carbazole	3.0E–01	2.1E–01	mg/kg	NA	NA	NA	mg/kg
aroclor–1254	6.0E–02	NA	mg/kg	NA	NA	NA	mg/kg
aroclor–1260	6.0E–02	NA	mg/kg	NA	NA	NA	mg/kg
dieldrin	3.0E–01	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg				

References

Table C.III–294 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Expanded Trespasser
Via Dermal Contact with Soil/Sediment

	HQ Calculation		
Compound	CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	5.1E–07	6.0E–05	8.5E–03
arsenic	NA	2.9E–04	NA
beryllium	1.5E–07	5.0E–03	3.1E–05
uranium–total	1.7E–06	1.5E–04	1.1E–02
benzo(a)pyrene	3.3E–06	NA	NA
carbazole	2.4E–06	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	4.5E–05	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	HQ Summation =		2.0E–02

	ILCR Calculation		
Compound	CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	1.2E–07	NA	NA
arsenic	NA	1.9E+00	NA
beryllium	3.7E–08	4.3E+00	1.6E–07
uranium–total	3.9E–07	NA	NA
benzo(a)pyrene	8.0E–07	NA	NA
carbazole	5.8E–07	2.2E–02	1.3E–08
aroclor–1254	NA	1.0E+01	NA
aroclor–1260	NA	1.0E+01	NA
dieldrin	NA	1.8E+01	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	ILCR Summation =		1.7E–07

Table C.III–295
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Federal Ownership: Expanded Trespasser
Via Inhalation of Particulates

Intake Equation $= \frac{CS \times EFa \times EDa \times IR \times ETa}{BWa \times ATa} + \frac{CS \times EFc \times EDc \times IR \times ETc}{BWc \times ATc}$

IR	Inhalation rate of gases	0.83 m^3/hour
ETa	Exposure time (adult)	1 hour/day
ETc	Exposure time (child)	2 hour/day
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure duration (adult)	32 Year
EDc	Exposure duration (child)	12 Year
BWa	Body weight (adult)	70 kg
BWc	Body weight (child)	43 kg
AT	Average time for carcinogens	25550 days
ATa	Average time for non–carcinogens (adult)	11680 days
ATc	Average time for non–carcinogens (child)	4380 days
CS	Concentration of chemicals in particulate as modeled	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	2.7E–09	mg/m^3	NA	NA	mg/m^3
arsenic	NA	mg/m^3	NA	NA	mg/m^3
beryllium	9.4E–10	mg/m^3	NA	NA	mg/m^3
uranium–total	1.0E–08	mg/m^3	NA	NA	mg/m^3
benzo(a)pyrene	6.8E–10	mg/m^3	NA	NA	mg/m^3
carbazole	4.9E–10	mg/m^3	NA	NA	mg/m^3
aroclor–1254	NA	mg/m^3	NA	NA	mg/m^3
aroclor–1260	NA	mg/m^3	NA	NA	mg/m^3
dieldrin	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3			

References

Table C.III–295 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Expanded Trespasser
Via Inhalation of Particulates

	HQ Calculation		
Compound	CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	3.4E–11	NA	NA
arsenic	NA	NA	NA
beryllium	1.2E–11	NA	NA
uranium–total	1.3E–10	NA	NA
benzo(a)pyrene	8.8E–12	NA	NA
carbazole	6.4E–12	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
HQ Summation =			NA

	ILCR Calculation		
Compound	CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	6.9E–12	NA	NA
arsenic	NA	1.5E+01	NA
beryllium	2.4E–12	8.4E+00	2.0E–11
uranium–total	2.6E–11	NA	NA
benzo(a)pyrene	1.8E–12	6.1E+00	1.1E–11
carbazole	1.3E–12	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
ILCR Summation =			3.1E–11

Table C.III–296
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Federal Ownership: Expanded Trespasser
Via Inhalation of Gases and Particulates

Intake Equation = CA X EFa X EDa X IR X ETa + CA X EFc EDc X IR X ETc

IR	Inhalation rate of gases	0.83 m^3/hour
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure duration	32 Year
EDc	Exposure duration	12 Year
ETa	Exposure time (adult)	1 hour/day
ETc	Exposure time (child)	2 hour/day
CA	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	9.4E−07	pCi/m^3	U_{234}	6.1E−07	pCi/m^3
Pu_{238}	4.7E−07	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	5.6E−06	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	2.6E−06	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E−11	NA
Np_{237+1d}	3.0E−03	2.9E−08	8.8E−11
Pu_{238}	1.5E−03	3.9E−08	5.9E−11
Ra_{226+8d}	NA	7.0E−09	NA
Ra_{228+1d}	NA	6.9E−10	NA
Rn_{222+4d}	NA	7.7E−12	NA
Sr_{90+1d}	NA	6.2E−11	NA
Tc_{99}	NA	8.3E−12	NA
Th_{228+7d}	NA	7.8E−08	NA
Th_{230}	8.6E−03	2.9E−08	2.5E−10
$Th_{232+10d}$	NA	1.1E−07	NA
U_{234}	2.0E−03	2.6E−08	5.1E−11
U_{235+1d}	NA	2.5E−08	NA
U_{238+2d}	1.8E−02	2.4E−08	4.3E−10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	8.8E−10

000933

Table C.III–297
Summary of Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Federal Ownership: Expanded Trespasser
Via External Radiation

Exposure Equation = $[CR \times EFa \times EDa \times ET_{oa} \times (1-SH_o)]+[CR \times EFc \times EDc \times ET_{oc} \times (1-SH_o)]$

EFa	Fraction of year spent exposured (adult)	0.11 (unitless)
EFc	Fraction of year spent exposured (child)	0.3 (unitless)
EDa	Exposure duration (adult)	32 Year
EDc	Exposure duration (child)	12 Year
ET_{oa}	Fraction of day spent outdoors (adult)	0.04 (unitless)
ET_{oc}	Fraction of day spent outdoors (child)	0.08 (unitless)
SH_o	Shield factor outdoors	NA (unitless)
CR	Radionuclide specific concentrations	(see table below)

Cs_{137+1d}	NA	pCi/g	$Th_{232+10d}$	NA	pCi/g
Np_{237+1d}	4.0E−01	pCi/g	U_{234}	2.6E−01	pCi/g
Pu_{238}	2.0E−01	pCi/g	U_{235+1d}	NA	pCi/g
Ra_{226+8d}	NA	pCi/g	U_{238+2d}	2.4E+00	pCi/g
Ra_{228+1d}	NA	pCi/g	NA	NA	pCi/g
Rn_{222+4d}	NA	pCi/g	NA	NA	pCi/g
Sr_{90+1d}	NA	pCi/g	NA	NA	pCi/g
Tc_{99}	NA	pCi/g	NA	NA	pCi/g
Th_{228+7d}	NA	pCi/g	NA	NA	pCi/g
Th_{230}	1.1E+00	pCi/g	NA	NA	pCi/g

Radionuclides	CDI (year pCi/g)	CSF $(g/pCi-year)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.0E−06	NA
Np_{237+1d}	1.7E−01	4.3E−07	7.4E−08
Pu_{238}	8.6E−02	2.8E−11	2.4E−12
Ra_{226+8d}	NA	6.0E−06	NA
Ra_{228+1d}	NA	2.9E−06	NA
Rn_{222+4d}	NA	5.9E−06	NA
Sr_{90+1d}	NA	NA	NA
Tc_{99}	NA	6.0E−13	NA
Th_{228+7d}	NA	5.6E−06	NA
Th_{230}	4.8E−01	5.4E−11	2.6E−11
$Th_{232+10d}$	NA	8.5E−06	NA
U_{234}	1.1E−01	3.0E−11	3.3E−12
U_{235+1d}	NA	2.4E−07	NA
U_{238+2d}	1.0E+00	5.1E−08	5.2E−08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.3E−07

000934

Table C.III–298
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Adult)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium–total	6.90E–04	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
aroclor–1254	NA	mg/l	NA	NA	mg/l
aroclor–1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

Table C.III–298 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Adult)
Via Drinking Water Ingestion

Compound	HQ Calculation CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	4.00E–04	NA
arsenic	NA	3.00E–04	NA
beryllium	NA	5.00E–03	NA
uranium–total	1.89E–05	3.00E–03	6.30E–03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	5.00E–05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		6.30E–03

Compound	ILCR Calculation CDI (mg/kg–day)	CSF (mg/kg–day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium–total	1.89E–05	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E–02	NA
aroclor–1254	NA	7.70E+00	NA
aroclor–1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000936

Table C.III–299
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	2.1E−01	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	1.1E−02	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	2.3E−01	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	NA	2.2E−10	NA
Pu_{238}	NA	2.2E−10	NA
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	NA	3.6E−11	NA
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	NA	1.3E−11	NA
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	1.0E+04	1.6E−11	1.6E−07
U_{235+1d}	5.4E+02	1.6E−11	8.6E−09
U_{238+2d}	1.1E+04	2.0E−11	2.3E−07
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 4.0E−07

Table C.III–300
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Adult)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2–day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
SA	Skin surface area available for contact	23000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
arsenic	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
beryllium	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
uranium–total	1.73E–10	mg/cm^2–day	NA	NA	mg/cm^2–day
benzo(a)pyrene	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
carbazole	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1254	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1260	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
dieldrin	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day			

References

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Table C.III–300 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Adult)
Via Dermal Contact while Bathing

	HQ Calculation		
Compound	CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	6.00E–05	NA
arsenic	NA	2.85E–04	NA
beryllium	NA	5.00E–03	NA
uranium–total	5.43E–08	1.50E–04	3.62E–04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	4.50E–05	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	HQ Summation =		3.62E–04

	ILCR Calculation		
Compound	CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium–total	5.43E–08	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E–02	NA
aroclor–1254	NA	1.03E+01	NA
aroclor–1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	ILCR Summation =		NA

Table C.III–301
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Adult)
Via Inhalation of Particulates

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	7.2E–11	mg/m^3	NA	NA	mg/m^3
arsenic	NA	mg/m^3	NA	NA	mg/m^3
beryllium	2.6E–11	mg/m^3	NA	NA	mg/m^3
uranium–total	2.7E–10	mg/m^3	NA	NA	mg/m^3
benzo(a)pyrene	1.9E–11	mg/m^3	NA	NA	mg/m^3
carbazole	1.3E–11	mg/m^3	NA	NA	mg/m^3
aroclor–1254	NA	mg/m^3	NA	NA	mg/m^3
aroclor–1260	NA	mg/m^3	NA	NA	mg/m^3
dieldrin	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3			

References

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Table C.III-301 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Adult)
Via Inhalation of Particulates

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	2.0E-11	NA	NA
arsenic	NA	NA	NA
beryllium	7.0E-12	NA	NA
uranium-total	7.5E-11	NA	NA
benzo(a)pyrene	5.1E-12	NA	NA
carbazole	3.7E-12	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	Hazard Quotient Sum =		NA

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg\text{-}day)^{-1}$	ILCR (unitless)
antimony	2.0E-11	NA	NA
arsenic	NA	1.5E+01	NA
beryllium	7.0E-12	8.4E+00	5.9E-11
uranium-total	7.5E-11	NA	NA
benzo(a)pyrene	5.1E-12	6.1E+00	3.1E-11
carbazole	3.7E-12	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		9.0E-11

000941

Table C.III–302
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Adult)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	2.6E–08	pCi/m^3	U_{234}	1.7E–08	pCi/m^3
Pu_{238}	1.3E–08	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	1.5E–07	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	7.2E–08	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	1.2E–02	2.9E–08	3.6E–10
Pu_{238}	6.3E–03	3.9E–08	2.4E–10
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	NA	7.7E–12	NA
Sr_{90+1d}	NA	6.2E–11	NA
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	3.5E–02	2.9E–08	1.0E–09
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	8.1E–03	2.6E–08	2.1E–10
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	7.4E–02	2.4E–08	1.8E–09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 3.6E–09

Table C.III-303
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	9.1E-09	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	4.0E-09	mg/kg	NA	NA	mg/kg
uranium-total	6.9E-06	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	4.5E-08	mg/kg	NA	NA	mg/kg
carbazole	8.4E-11	mg/kg	NA	NA	mg/kg
aroclor-1254	NA	mg/kg	NA	NA	mg/kg
aroclor-1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-303 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Meat Products

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	9.5E-12	4.0E-04	2.4E-08
arsenic	NA	3.0E-04	NA
beryllium	4.2E-12	5.0E-03	8.3E-10
uranium-total	7.2E-09	3.0E-03	2.4E-06
benzo(a)pyrene	4.7E-11	NA	NA
carbazole	8.7E-14	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.4E-06

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	9.5E-12	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	4.2E-12	4.3E+00	1.8E-11
uranium-total	7.2E-09	NA	NA
benzo(a)pyrene	4.7E-11	7.3E+00	3.4E-10
carbazole	8.7E-14	2.0E-02	1.7E-15
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		3.6E-10

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Table C.III–304
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	1.1E–07	pCi/kg	U_{234}	2.1E–03	pCi/kg
Pu_{238}	4.9E–10	pCi/kg	U_{235+1d}	1.1E–04	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.3E–03	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	3.9E–08	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	2.0E–04	2.2E–10	4.4E–14
Pu_{238}	9.0E–07	2.2E–10	2.0E–16
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	7.2E–05	1.3E–11	9.4E–16
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	3.9E+00	1.6E–11	6.2E–11
U_{235+1d}	2.0E–01	1.6E–11	3.3E–12
U_{238+2d}	4.3E+00	2.0E–11	8.5E–11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
		ILCR Summation =	1.5E–10

000945

Table C.III–305
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	9.1E–10	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	3.6E–12	mg/kg	NA	NA	mg/kg
uranium–total	2.5E–05	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	1.4E–08	mg/kg	NA	NA	mg/kg
carbazole	2.6E–11	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg

References

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Table C.III-305 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Dairy Products

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	3.7E-12	4.0E-04	9.4E-09
arsenic	NA	3.0E-04	NA
beryllium	1.5E-14	5.0E-03	3.0E-12
uranium-total	1.0E-07	3.0E-03	3.4E-05
benzo(a)pyrene	5.9E-11	NA	NA
carbazole	1.1E-13	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		3.4E-05

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	3.7E-12	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	1.5E-14	4.3E+00	6.4E-14
uranium-total	1.0E-07	NA	NA
benzo(a)pyrene	5.9E-11	7.3E+00	4.3E-10
carbazole	1.1E-13	2.0E-02	2.2E-15
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		4.3E-10

0082

Table C.III−306
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Federal Ownership: Off−Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	9.8E−09	pCi/kg	U_{234}	7.6E−03	pCi/kg
Pu_{238}	9.7E−11	pCi/kg	U_{235+1d}	4.0E−04	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	8.3E−03	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	3.2E−08	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	7.2E−05	2.2E−10	1.6E−14
Pu_{238}	7.1E−07	2.2E−10	1.6E−16
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	NA	3.6E−11	NA
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	2.4E−04	1.3E−11	3.1E−15
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	5.6E+01	1.6E−11	8.9E−10
U_{235+1d}	2.9E+00	1.6E−11	4.7E−11
U_{238+2d}	6.1E+01	2.0E−11	1.2E−09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	2.2E−09

000948

Table C.III–307
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	1.0E–07	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	4.3E–08	mg/kg	NA	NA	mg/kg
uranium–total	3.4E–03	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	1.8E–08	mg/kg	NA	NA	mg/kg
carbazole	1.3E–08	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

009439

Table C.III-307 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	1.7E-10	4.0E-04	4.3E-07
arsenic	NA	3.0E-04	NA
beryllium	7.2E-11	5.0E-03	1.4E-08
uranium-total	5.6E-06	3.0E-03	1.9E-03
benzo(a)pyrene	3.1E-11	NA	NA
carbazole	2.2E-11	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.9E-03

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	1.7E-10	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	7.2E-11	4.3E+00	3.1E-10
uranium-total	5.6E-06	NA	NA
benzo(a)pyrene	3.1E-11	7.3E+00	2.3E-10
carbazole	2.2E-11	2.0E-02	4.4E-13
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		5.3E-10

Table C.III–308
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	2.5E–05	pCi/kg	U_{234}	1.0E+00	pCi/kg
Pu_{238}	1.3E–05	pCi/kg	U_{235+1d}	5.4E–02	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	1.1E+00	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	8.0E–05	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	7.6E–02	2.2E–10	1.7E–11
Pu_{238}	3.8E–02	2.2E–10	8.3E–12
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	2.4E–01	1.3E–11	3.1E–12
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	3.1E+03	1.6E–11	4.9E–08
U_{235+1d}	1.6E+02	1.6E–11	2.6E–09
U_{238+2d}	3.4E+03	2.0E–11	6.7E–08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.2E–07

Table C.III–309
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Child)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium–total	6.90E–04	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
aroclor–1254	NA	mg/l	NA	NA	mg/l
aroclor–1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

000952

5860

Table C.III−309 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off−Property Farmer (Child)
Via Drinking Water Ingestion

	HQ Calculation		
Compound	CDI (mg/kg−day)	RfD (mg/kg−day)	HQ (unitless)
antimony	NA	4.00E−04	NA
arsenic	NA	3.00E−04	NA
beryllium	NA	5.00E−03	NA
uranium−total	4.41E−05	3.00E−03	1.47E−02
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor−1254	NA	NA	NA
aroclor−1260	NA	NA	NA
dieldrin	NA	5.00E−05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.47E−02

	ILCR Calculation		
Compound	CDI (mg/kg−day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium−total	3.78E−06	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E−02	NA
aroclor−1254	NA	7.70E+00	NA
aroclor−1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000953

Table C.III–310
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	2.1E–01	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	1.1E–02	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	2.3E–01	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	4.4E+02	1.6E–11	7.1E–09
U_{235+1d}	2.3E+01	1.6E–11	3.7E–10
U_{238+2d}	4.8E+02	2.0E–11	9.7E–09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.7E–08

000954

Table C.III–311
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Child)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2–day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
SA	Skin surface area available for contact	8000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
arsenic	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
beryllium	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
uranium–total	1.73E–10	mg/cm^2–day	NA	NA	mg/cm^2–day
benzo(a)pyrene	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
carbazole	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1254	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1260	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
dieldrin	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day			

References

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Table C.III-311 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Child)
Via Dermal Contact while Bathing

Compound	HQ Calculation CDI (mg/kg-day)	 RfD (mg/kg-day)	 HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	8.82E-08	1.50E-04	5.88E-04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		5.88E-04

Compound	ILCR Calculation CDI (mg/kg-day)	 CSF $(mg/kg-day)^{-1}$	 ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	7.56E-09	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

Table C.III–312
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Child)
Via Inhalation of Particulates

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Inhalation rate of gases (RAGS, 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	7.2E–11	mg/m^3	NA	NA	mg/m^3
arsenic	NA	mg/m^3	NA	NA	mg/m^3
beryllium	2.6E–11	mg/m^3	NA	NA	mg/m^3
uranium–total	2.7E–10	mg/m^3	NA	NA	mg/m^3
benzo(a)pyrene	1.9E–11	mg/m^3	NA	NA	mg/m^3
carbazole	1.3E–11	mg/m^3	NA	NA	mg/m^3
aroclor–1254	NA	mg/m^3	NA	NA	mg/m^3
aroclor–1260	NA	mg/m^3	NA	NA	mg/m^3
dieldrin	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3			

References

000958

Table C.III-312 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Child)
Via Inhalation of Particulates

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	5.5E-11	NA	NA
arsenic	NA	NA	NA
beryllium	2.0E-11	NA	NA
uranium-total	2.1E-10	NA	NA
benzo(a)pyrene	1.4E-11	NA	NA
carbazole	1.0E-11	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	Hazard Quotient Sum =		NA

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	4.7E-12	NA	NA
arsenic	NA	1.5E+01	NA
beryllium	1.7E-12	8.4E+00	1.4E-11
uranium-total	1.8E-11	NA	NA
benzo(a)pyrene	1.2E-12	6.1E+00	7.4E-12
carbazole	8.8E-13	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		2.2E-11

000959

Table C.III–313
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Child)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	2.6E–08	pCi/m^3	U_{234}	1.7E–08	pCi/m^3
Pu_{238}	1.3E–08	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	1.5E–07	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	7.2E–08	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	6.4E–04	2.9E–08	1.9E–11
Pu_{238}	3.2E–04	3.9E–08	1.3E–11
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	NA	7.7E–12	NA
Sr_{90+1d}	NA	6.2E–11	NA
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	1.8E–03	2.9E–08	5.3E–11
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	4.2E–04	2.6E–08	1.1E–11
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	3.8E–03	2.4E–08	9.2E–11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.9E–10

000960

Table C.III–314
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	9.1E–09	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	4.0E–09	mg/kg	NA	NA	mg/kg
uranium–total	6.9E–06	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	4.5E–08	mg/kg	NA	NA	mg/kg
carbazole	8.4E–11	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III-314 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Meat Products

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	1.7E-11	4.0E-04	4.3E-08
arsenic	NA	3.0E-04	NA
beryllium	7.5E-12	5.0E-03	1.5E-09
uranium-total	1.3E-08	3.0E-03	4.3E-06
benzo(a)pyrene	8.5E-11	NA	NA
carbazole	1.6E-13	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	HQ Summation =		4.3E-06

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	1.5E-12	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	6.4E-13	4.3E+00	2.8E-12
uranium-total	1.1E-09	NA	NA
benzo(a)pyrene	7.2E-12	7.3E+00	5.3E-11
carbazole	1.3E-14	2.0E-02	2.7E-16
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	ILCR Summation =		5.6E-11

Table C.III–315
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	1.1E–07	pCi/kg	U_{234}	2.1E–03	pCi/kg
Pu_{238}	4.9E–10	pCi/kg	U_{235+1d}	1.1E–04	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.3E–03	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	3.9E–08	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	6.6E–06	2.2E–10	1.5E–15
Pu_{238}	3.0E–08	2.2E–10	6.6E–18
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	2.4E–06	1.3E–11	3.1E–17
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.3E–01	1.6E–11	2.1E–12
U_{235+1d}	6.8E–03	1.6E–11	1.1E–13
U_{238+2d}	1.4E–01	2.0E–11	2.8E–12
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		5.0E–12

Table C.III–316
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	9.1E–10	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	3.6E–12	mg/kg	NA	NA	mg/kg
uranium–total	2.5E–05	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	1.4E–08	mg/kg	NA	NA	mg/kg
carbazole	2.6E–11	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III−316 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off−Property Farmer (Child)
Via Ingestion of Dairy Products

Compound	HQ Calculation CDI (mg/kg−day)	RfD (mg/kg−day)	HQ (unitless)
antimony	3.9E−11	4.0E−04	9.8E−08
arsenic	NA	3.0E−04	NA
beryllium	1.6E−13	5.0E−03	3.1E−11
uranium−total	1.1E−06	3.0E−03	3.6E−04
benzo(a)pyrene	6.2E−10	NA	NA
carbazole	1.1E−12	NA	NA
aroclor−1254	NA	NA	NA
aroclor−1260	NA	NA	NA
dieldrin	NA	5.0E−05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		3.6E−04

Compound	ILCR Calculation CDI (mg/kg−day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	3.4E−12	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	1.3E−14	4.3E+00	5.7E−14
uranium−total	9.2E−08	NA	NA
benzo(a)pyrene	5.3E−11	7.3E+00	3.9E−10
carbazole	9.8E−14	2.0E−02	2.0E−15
aroclor−1254	NA	7.7E+00	NA
aroclor−1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		3.9E−10

Table C.III–317
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	9.8E–09	pCi/kg	U_{234}	7.6E–03	pCi/kg
Pu_{238}	9.7E–11	pCi/kg	U_{235+1d}	4.0E–04	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	8.3E–03	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	3.2E–08	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	1.4E–05	2.2E–10	3.1E–15
Pu_{238}	1.4E–07	2.2E–10	3.0E–17
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	4.6E–05	1.3E–11	6.0E–16
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.1E+01	1.6E–11	1.7E–10
U_{235+1d}	5.6E–01	1.6E–11	9.0E–12
U_{238+2d}	1.2E+01	2.0E–11	2.3E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	4.2E–10

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Table C.III–318
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	1.0E–07	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	4.3E–08	mg/kg	NA	NA	mg/kg
uranium–total	3.4E–03	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	1.8E–08	mg/kg	NA	NA	mg/kg
carbazole	1.3E–08	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III–318 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

	HQ Calculation		
Compound	CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	6.5E–10	4.0E–04	1.6E–06
arsenic	NA	3.0E–04	NA
beryllium	2.7E–10	5.0E–03	5.5E–08
uranium–total	2.2E–05	3.0E–03	7.2E–03
benzo(a)pyrene	1.2E–10	NA	NA
carbazole	8.5E–11	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	5.0E–05	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	HQ Summation =		7.2E–03

	ILCR Calculation		
Compound	CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	5.6E–11	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	2.3E–11	4.3E+00	1.0E–10
uranium–total	1.9E–06	NA	NA
benzo(a)pyrene	1.0E–11	7.3E+00	7.4E–11
carbazole	7.3E–12	2.0E–02	1.5E–13
aroclor–1254	NA	7.7E+00	NA
aroclor–1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	ILCR Summation =		1.8E–10

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Table C.III–319
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	2.5E–05	pCi/kg	U_{234}	1.0E+00	pCi/kg
Pu_{238}	1.3E–05	pCi/kg	U_{235+1d}	5.4E–02	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	1.1E+00	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	8.0E–05	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	5.3E–03	2.2E–10	1.2E–12
Pu_{238}	2.6E–03	2.2E–10	5.8E–13
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	1.7E–02	1.3E–11	2.2E–13
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	2.2E+02	1.6E–11	3.5E–09
U_{235+1d}	1.1E+01	1.6E–11	1.8E–10
U_{238+2d}	2.4E+02	2.0E–11	4.7E–09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	8.4E–09

Table C.III–320
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Adult)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	0.00E+00	mg/l	0	0.00E+00	mg/l
arsenic	0.00E+00	mg/l	0	0.00E+00	mg/l
beryllium	0.00E+00	mg/l	0	0.00E+00	mg/l
uranium–total	2.70E–06	mg/l	0	0.00E+00	mg/l
benzo(a)pyrene	0.00E+00	mg/l	0	0.00E+00	mg/l
carbazole	0.00E+00	mg/l	0	0.00E+00	mg/l
aroclor–1254	0.00E+00	mg/l	0	0.00E+00	mg/l
aroclor–1260	0.00E+00	mg/l	0	0.00E+00	mg/l
dieldrin	0.00E+00	mg/l	0	0.00E+00	mg/l
0	0.00E+00	mg/l	0	0.00E+00	mg/l
0	0.00E+00	mg/l	0	0.00E+00	mg/l
0	0.00E+00	mg/l	0	0.00E+00	mg/l
0	0.00E+00	mg/l	0	0.00E+00	mg/l
0	0.00E+00	mg/l	0	0.00E+00	mg/l
0	0.00E+00	mg/l	0	0.00E+00	mg/l
0	0.00E+00	mg/l			

References

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Table C.III−320 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off−Property Farmer (Adult)
Via Drinking Water Ingestion

Compound	HQ Calculation CDI (mg/kg−day)	HQ Calculation RfD (mg/kg−day)	HQ Calculation HQ (unitless)
antimony	NA	4.00E−04	NA
arsenic	NA	3.00E−04	NA
beryllium	NA	5.00E−03	NA
uranium−total	7.40E−08	3.00E−03	2.47E−05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor−1254	NA	NA	NA
aroclor−1260	NA	NA	NA
dieldrin	NA	5.00E−05	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
	HQ Summation =		2.47E−05

Compound	ILCR Calculation CDI (mg/kg−day)	ILCR Calculation CSF $(mg/kg-day)^{-1}$	ILCR Calculation ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium−total	7.40E−08	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E−02	NA
aroclor−1254	NA	7.70E+00	NA
aroclor−1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
	ILCR Summation =		0.00E+00

Table C.III–321
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	0.0E+00	pCi/l	$Th_{232+10d}$	0.0E+00	pCi/l
Np_{237+1d}	0.0E+00	pCi/l	U_{234}	8.0E−04	pCi/l
Pu_{238}	0.0E+00	pCi/l	U_{235+1d}	4.0E−05	pCi/l
Ra_{226+8d}	0.0E+00	pCi/l	U_{238+2d}	9.0E−04	pCi/l
Ra_{228+1d}	0.0E+00	pCi/l	0.0E+00	0.0E+00	pCi/l
Rn_{222+4d}	0.0E+00	pCi/l	0.0E+00	0.0E+00	pCi/l
Sr_{90+1d}	0.0E+00	pCi/l	0.0E+00	0.0E+00	pCi/l
Tc_{99}	0.0E+00	pCi/l	0.0E+00	0.0E+00	pCi/l
Th_{228+7d}	0.0E+00	pCi/l	0.0E+00	0.0E+00	pCi/l
Th_{230}	0.0E+00	pCi/l	0.0E+00	0.0E+00	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	NA	2.2E−10	NA
Pu_{238}	NA	2.2E−10	NA
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	NA	3.6E−11	NA
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	NA	1.3E−11	NA
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	3.9E+01	1.6E−11	6.3E−10
U_{235+1d}	2.0E+00	1.6E−11	3.1E−11
U_{238+2d}	4.4E+01	2.0E−11	8.8E−10
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
	ILCR Summation	=	1.5E−09

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Table C.III–322
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Adult)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2–day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
SA	Skin surface area available for contact	23000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	0.00E+00	mg/cm^2–day	0	0.00E+00	mg/cm^2–day
arsenic	0.00E+00	mg/cm^2–day	0	0.00E+00	mg/cm^2–day
beryllium	0.00E+00	mg/cm^2–day	0	0.00E+00	mg/cm^2–day
uranium–total	6.75E–13	mg/cm^2–day	0	0.00E+00	mg/cm^2–day
benzo(a)pyrene	0.00E+00	mg/cm^2–day	0	0.00E+00	mg/cm^2–day
carbazole	0.00E+00	mg/cm^2–day	0	0.00E+00	mg/cm^2–day
aroclor–1254	0.00E+00	mg/cm^2–day	0	0.00E+00	mg/cm^2–day
aroclor–1260	0.00E+00	mg/cm^2–day	0	0.00E+00	mg/cm^2–day
dieldrin	0.00E+00	mg/cm^2–day	0	0.00E+00	mg/cm^2–day
0	0.00E+00	mg/cm^2–day	0	0.00E+00	mg/cm^2–day
0	0.00E+00	mg/cm^2–day	0	0.00E+00	mg/cm^2–day
0	0.00E+00	mg/cm^2–day	0	0.00E+00	mg/cm^2–day
0	0.00E+00	mg/cm^2–day	0	0.00E+00	mg/cm^2–day
0	0.00E+00	mg/cm^2–day	0	0.00E+00	mg/cm^2–day
0	0.00E+00	mg/cm^2–day	0	0.00E+00	mg/cm^2–day
0	0.00E+00	mg/cm^2–day			

References

Table C.III–322 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Adult)
Via Dermal Contact while Showering

Compound	HQ Calculation CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	6.00E–05	NA
arsenic	NA	2.85E–04	NA
beryllium	NA	5.00E–03	NA
uranium–total	2.13E–10	1.50E–04	1.42E–06
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	4.50E–05	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
HQ Summation =			1.42E–06

Compound	ILCR Calculation CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium–total	2.13E–10	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E–02	NA
aroclor–1254	NA	1.03E+01	NA
aroclor–1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
ILCR Summation =			0.00E+00

Table C.III–323
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Adult)
Via Inhalation of Particulates

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	9.5E–10	mg/m^3	•••	0.0E+00	mg/m^3
arsenic	0.0E+00	mg/m^3	•••	0.0E+00	mg/m^3
beryllium	0.0E+00	mg/m^3	•••	0.0E+00	mg/m^3
uranium–total	0.0E+00	mg/m^3	•••	0.0E+00	mg/m^3
benzo(a)pyrene	1.3E–12	mg/m^3	•••	0.0E+00	mg/m^3
carbazole	5.4E–12	mg/m^3	•••	0.0E+00	mg/m^3
aroclor–1254	0.0E+00	mg/m^3	•••	0.0E+00	mg/m^3
aroclor–1260	0.0E+00	mg/m^3	•••	0.0E+00	mg/m^3
dieldrin	0.0E+00	mg/m^3	•••	0.0E+00	mg/m^3
••••••••	0.0E+00	mg/m^3	•••	0.0E+00	mg/m^3
••••••••	0.0E+00	mg/m^3	•••	0.0E+00	mg/m^3
••••••••	0.0E+00	mg/m^3	•••	0.0E+00	mg/m^3
••••••••	0.0E+00	mg/m^3	•••	0.0E+00	mg/m^3
••••••••	0.0E+00	mg/m^3	•••	0.0E+00	mg/m^3
••••••••	0.0E+00	mg/m^3	•••	0.0E+00	mg/m^3
••••••••	0.0E+00	mg/m^3			

References

Table C.III-323 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Adult)
Via Inhalation of Particulates

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	2.6E-10	NA	NA
arsenic	NA	NA	NA
beryllium	NA	NA	NA
uranium-total	NA	NA	NA
benzo(a)pyrene	3.5E-13	NA	NA
carbazole	1.5E-12	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
	Hazard Quotient Sum =		0.0E+00

Compound	ILCR Calculation CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	2.6E-10	NA	NA
arsenic	NA	1.5E+01	NA
beryllium	NA	8.4E+00	NA
uranium-total	NA	NA	NA
benzo(a)pyrene	3.5E-13	6.1E+00	2.1E-12
carbazole	1.5E-12	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	1.6E+01	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
	ILCR Summation =		2.1E-12

Table C.III–324
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Adult)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	0.0E+00	pCi/m^3	$Th_{232+10d}$	0.0E+00	pCi/m^3
Np_{237+1d}	3.6E−08	pCi/m^3	U_{234}	6.7E−08	pCi/m^3
Pu_{238}	1.7E−07	pCi/m^3	U_{235+1d}	0.0E+00	pCi/m^3
Ra_{226+8d}	0.0E+00	pCi/m^3	U_{238+2d}	0.0E+00	pCi/m^3
Ra_{228+1d}	0.0E+00	pCi/m^3	0.0E+00	0.0E+00	pCi/m^3
Rn_{222+4d}	0.0E+00	pCi/m^3	0.0E+00	0.0E+00	pCi/m^3
Sr_{90+1d}	0.0E+00	pCi/m^3	0.0E+00	0.0E+00	pCi/m^3
Tc_{99}	0.0E+00	pCi/m^3	0.0E+00	0.0E+00	pCi/m^3
Th_{228+7d}	0.0E+00	pCi/m^3	0.0E+00	0.0E+00	pCi/m^3
Th_{230}	6.5E−07	pCi/m^3	0.0E+00	0.0E+00	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E−11	NA
Np_{237+1d}	1.8E−02	2.9E−08	5.1E−10
Pu_{238}	8.2E−02	3.9E−08	3.2E−09
Ra_{226+8d}	NA	7.0E−09	NA
Ra_{228+1d}	NA	6.9E−10	NA
Rn_{222+4d}	NA	7.7E−12	NA
Sr_{90+1d}	NA	6.2E−11	NA
Tc_{99}	NA	8.3E−12	NA
Th_{228+7d}	NA	7.8E−08	NA
Th_{230}	3.2E−01	2.9E−08	9.2E−09
$Th_{232+10d}$	NA	1.1E−07	NA
U_{234}	3.3E−02	2.6E−08	8.5E−10
U_{235+1d}	NA	2.5E−08	NA
U_{238+2d}	NA	2.4E−08	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
		ILCR Summation =	1.4E−08

000977

Table C.III–325
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	1.2E–07	mg/kg	***	0.0E+00	mg/kg
arsenic	0.0E+00	mg/kg	***	0.0E+00	mg/kg
beryllium	0.0E+00	mg/kg	***	0.0E+00	mg/kg
uranium–total	2.7E–08	mg/kg	***	0.0E+00	mg/kg
benzo(a)pyrene	3.1E–09	mg/kg	***	0.0E+00	mg/kg
carbazole	3.4E–11	mg/kg	***	0.0E+00	mg/kg
aroclor–1254	0.0E+00	mg/kg	***	0.0E+00	mg/kg
aroclor–1260	0.0E+00	mg/kg	***	0.0E+00	mg/kg
dieldrin	0.0E+00	mg/kg	***	0.0E+00	mg/kg
0	0.0E+00	mg/kg	***	0.0E+00	mg/kg
0	0.0E+00	mg/kg	***	0.0E+00	mg/kg
0	0.0E+00	mg/kg	***	0.0E+00	mg/kg
0	0.0E+00	mg/kg	***	0.0E+00	mg/kg
0	0.0E+00	mg/kg	***	0.0E+00	mg/kg
0	0.0E+00	mg/kg	***	0.0E+00	mg/kg
0	0.0E+00	mg/kg	***	0.0E+00	mg/kg

References

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Table C.III-325 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Adult)
Via Ingestion of Meat Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	1.2E-10	4.0E-04	3.1E-07
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	2.8E-11	3.0E-03	9.3E-09
benzo(a)pyrene	3.2E-12	NA	NA
carbazole	3.5E-14	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
	HQ Summation =		3.2E-07

Compound	ILCR Calculation CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	1.2E-10	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	2.8E-11	NA	NA
benzo(a)pyrene	3.2E-12	7.3E+00	2.3E-11
carbazole	3.5E-14	2.0E-02	7.0E-16
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
	ILCR Summation =		2.3E-11

000979

Table C.III–326
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	0.0E+00	pCi/kg	$Th_{232+10d}$	0.0E+00	pCi/kg
Np_{237+1d}	1.5E−07	pCi/kg	U_{234}	9.0E−06	pCi/kg
Pu_{238}	6.4E−09	pCi/kg	U_{235+1d}	4.0E−07	pCi/kg
Ra_{226+8d}	0.0E+00	pCi/kg	U_{238+2d}	9.0E−06	pCi/kg
Ra_{228+1d}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Sr_{90+1d}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Tc_{99}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Th_{228+7d}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Th_{230}	3.5E−07	pCi/kg	0.0E+00	0.0E+00	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	2.8E−04	2.2E−10	6.2E−14
Pu_{238}	1.2E−05	2.2E−10	2.6E−15
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	NA	3.6E−11	NA
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	6.5E−04	1.3E−11	8.4E−15
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	1.7E−02	1.6E−11	2.7E−13
U_{235+1d}	7.4E−04	1.6E−11	1.2E−14
U_{238+2d}	1.7E−02	2.0E−11	3.3E−13
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
		ILCR Summation =	6.9E−13

000980

Table C.III-327
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units
antimony	1.2E-08	mg/kg
arsenic	0.0E+00	mg/kg
beryllium	0.0E+00	mg/kg
uranium-total	7.5E-05	mg/kg
benzo(a)pyrene	0.0E+00	mg/kg
carbazole	0.0E+00	mg/kg
aroclor-1254	0.0E+00	mg/kg
aroclor-1260	0.0E+00	mg/kg
dieldrin	0.0E+00	mg/kg
********	0.0E+00	mg/kg
********	0.0E+00	mg/kg
********	0.0E+00	mg/kg
********	0.0E+00	mg/kg
********	0.0E+00	mg/kg
********	0.0E+00	mg/kg
********	0.0E+00	mg/kg

Compound	Concentration	Units
***	0.0E+00	mg/kg
***	0.0E+00	mg/kg
***	0.0E+00	mg/kg
***	0.0E+00	mg/kg
***	0.0E+00	mg/kg
***	0.0E+00	mg/kg
***	0.0E+00	mg/kg
***	0.0E+00	mg/kg
***	0.0E+00	mg/kg
***	0.0E+00	mg/kg
***	0.0E+00	mg/kg
***	0.0E+00	mg/kg
***	0.0E+00	mg/kg
***	0.0E+00	mg/kg
***	0.0E+00	mg/kg

References

000981

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Table C.III-327 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Adult)
Via Ingestion of Dairy Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	4.9E-11	4.0E-04	1.2E-07
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	3.1E-07	3.0E-03	1.0E-04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
HQ Summation =			1.0E-04

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	4.9E-11	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	3.1E-07	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
ILCR Summation =			0.0E+00

000982

Table C.III-328
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	0.0E+00	pCi/kg	$Th_{232+10d}$	0.0E+00	pCi/kg
Np_{237+1d}	0.0E+00	pCi/kg	U_{234}	2.3E-02	pCi/kg
Pu_{238}	0.0E+00	pCi/kg	U_{235+1d}	1.2E-03	pCi/kg
Ra_{226+8d}	0.0E+00	pCi/kg	U_{238+2d}	2.5E-02	pCi/kg
Ra_{228+1d}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Sr_{90+1d}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Tc_{99}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Th_{228+7d}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Th_{230}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	NA	2.2E-10	NA
Pu_{238}	NA	2.2E-10	NA
Ra_{226+8d}	NA	7.8E-10	NA
Ra_{228+1d}	NA	1.0E-10	NA
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	NA	3.6E-11	NA
Tc_{99}	NA	1.3E-12	NA
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	NA	1.3E-11	NA
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	1.7E+02	1.6E-11	2.7E-09
U_{235+1d}	8.7E+00	1.6E-11	1.4E-10
U_{238+2d}	1.8E+02	2.0E-11	3.7E-09
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA

ILCR Summation = 6.5E-09

000983

Table C.III-329
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	1.3E-06	mg/kg	•••	0.0E+00	mg/kg
arsenic	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
beryllium	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
uranium-total	1.3E-05	mg/kg	•••	0.0E+00	mg/kg
benzo(a)pyrene	1.3E-09	mg/kg	•••	0.0E+00	mg/kg
carbazole	5.3E-09	mg/kg	•••	0.0E+00	mg/kg
aroclor-1254	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
aroclor-1260	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
dieldrin	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
••••••••	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
••••••••	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
••••••••	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
••••••••	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
••••••••	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
••••••••	0.0E+00	mg/kg	•••	0.0E+00	mg/kg
••••••••	0.0E+00	mg/kg			

References

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Table C.III-329 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	2.2E-09	4.0E-04	5.6E-06
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	2.2E-08	3.0E-03	7.4E-06
benzo(a)pyrene	2.1E-12	NA	NA
carbazole	8.9E-12	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
	HQ Summation =		1.3E-05

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	2.2E-09	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	2.2E-08	NA	NA
benzo(a)pyrene	2.1E-12	7.3E+00	1.5E-11
carbazole	8.9E-12	2.0E-02	1.8E-13
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
0.0E+00	NA	NA	NA
	ILCR Summation =		1.6E-11

Table C.III–330
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	0.0E+00	pCi/kg	$Th_{232+10d}$	0.0E+00	pCi/kg
Np_{237+1d}	3.6E−05	pCi/kg	U_{234}	4.0E−03	pCi/kg
Pu_{238}	1.7E−04	pCi/kg	U_{235+1d}	2.0E−04	pCi/kg
Ra_{226+8d}	0.0E+00	pCi/kg	U_{238+2d}	4.4E−03	pCi/kg
Ra_{228+1d}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Sr_{90+1d}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Tc_{99}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Th_{228+7d}	0.0E+00	pCi/kg	0.0E+00	0.0E+00	pCi/kg
Th_{230}	7.1E−04	pCi/kg	0.0E+00	0.0E+00	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	1.1E−01	2.2E−10	2.4E−11
Pu_{238}	4.9E−01	2.2E−10	1.1E−10
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	NA	3.6E−11	NA
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	2.1E+00	1.3E−11	2.8E−11
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	1.2E+01	1.6E−11	1.9E−10
U_{235+1d}	5.9E−01	1.6E−11	9.4E−12
U_{238+2d}	1.3E+01	2.0E−11	2.6E−10
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA
0	NA	NA	NA

ILCR Summation = 6.2E−10

000986

Table C.III-331
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium-total	2.70E-06	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
aroclor-1254	NA	mg/l	NA	NA	mg/l
aroclor-1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

000987

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Table C.III-331 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Drinking Water Ingestion

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	1.73E-07	3.00E-03	5.75E-05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		5.75E-05

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	1.48E-08	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000988

5860

Table C.III–332
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	8.0E–04	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	4.0E–05	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	9.0E–04	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.7E+00	1.6E–11	2.7E–11
U_{235+1d}	8.4E–02	1.6E–11	1.3E–12
U_{238+2d}	1.9E+00	2.0E–11	3.8E–11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 6.6E–11

000989

Table C.III–333
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2–day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
SA	Skin surface area available for contact	8000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
arsenic	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
beryllium	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
uranium–total	6.75E–13	mg/cm^2–day	NA	NA	mg/cm^2–day
benzo(a)pyrene	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
carbazole	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1254	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1260	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
dieldrin	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day			

References

Table C.III−333 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off−Property Farmer (Child)
Via Dermal Contact while Bathing

	HQ Calculation		
Compound	CDI (mg/kg−day)	RfD (mg/kg−day)	HQ (unitless)
antimony	NA	6.00E−05	NA
arsenic	NA	2.85E−04	NA
beryllium	NA	5.00E−03	NA
uranium−total	3.45E−10	1.50E−04	2.30E−06
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor−1254	NA	NA	NA
aroclor−1260	NA	NA	NA
dieldrin	NA	4.50E−05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.30E−06

	ILCR Calculation		
Compound	CDI (mg/kg−day)	CSF (mg/kg−day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium−total	2.96E−11	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E−02	NA
aroclor−1254	NA	1.03E+01	NA
aroclor−1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

Table C.III–334
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Inhalation of Particulates

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Inhalation rate of gases (RAGS, 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	9.5E–10	mg/m^3	NA	NA	mg/m^3
arsenic	NA	mg/m^3	NA	NA	mg/m^3
beryllium	NA	mg/m^3	NA	NA	mg/m^3
uranium–total	NA	mg/m^3	NA	NA	mg/m^3
benzo(a)pyrene	1.3E–12	mg/m^3	NA	NA	mg/m^3
carbazole	5.4E–12	mg/m^3	NA	NA	mg/m^3
aroclor–1254	NA	mg/m^3	NA	NA	mg/m^3
aroclor–1260	NA	mg/m^3	NA	NA	mg/m^3
dieldrin	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3			

References

Table C.III–334 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Inhalation of Particulates

Compound	HQ Calculation CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	7.2E–10	NA	NA
arsenic	NA	NA	NA
beryllium	NA	NA	NA
uranium–total	NA	NA	NA
benzo(a)pyrene	9.7E–13	NA	NA
carbazole	4.1E–12	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
Hazard Quotient Sum =			NA

Compound	ILCR Calculation CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	6.2E–11	NA	NA
arsenic	NA	1.5E+01	NA
beryllium	NA	8.4E+00	NA
uranium–total	NA	NA	NA
benzo(a)pyrene	8.3E–14	6.1E+00	5.1E–13
carbazole	3.5E–13	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
ILCR Summation =			5.1E–13

Table C.III–335
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS. 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	3.6E–08	pCi/m^3	U_{234}	6.7E–08	pCi/m^3
Pu_{238}	1.7E–07	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	6.5E–07	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	9.1E–04	2.9E–08	2.6E–11
Pu_{238}	4.2E–03	3.9E–08	1.7E–10
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	NA	7.7E–12	NA
Sr_{90+1d}	NA	6.2E–11	NA
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	1.6E–02	2.9E–08	4.7E–10
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	1.7E–03	2.6E–08	4.4E–11
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	NA	2.4E–08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 7.1E–10

000994

Table C.III-336
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	1.2E-07	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium-total	2.7E-08	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	3.1E-09	mg/kg	NA	NA	mg/kg
carbazole	3.4E-11	mg/kg	NA	NA	mg/kg
aroclor-1254	NA	mg/kg	NA	NA	mg/kg
aroclor-1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

0083

Table C.III-336 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Meat Products

Compound	HQ Calculation: CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	2.2E-10	4.0E-04	5.6E-07
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	5.0E-11	3.0E-03	1.7E-08
benzo(a)pyrene	5.8E-12	NA	NA
carbazole	6.3E-14	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		5.8E-07

Compound	ILCR Calculation: CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	1.9E-11	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	4.3E-12	NA	NA
benzo(a)pyrene	4.9E-13	7.3E+00	3.6E-12
carbazole	5.4E-15	2.0E-02	1.1E-16
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		3.6E-12

Table C.III–337
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	1.5E−07	pCi/kg	U_{234}	9.0E−06	pCi/kg
Pu_{238}	6.4E−09	pCi/kg	U_{235+1d}	4.0E−07	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	9.0E−06	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	3.5E−07	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	9.4E−06	2.2E−10	2.1E−15
Pu_{238}	3.9E−07	2.2E−10	8.6E−17
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	NA	3.6E−11	NA
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	2.1E−05	1.3E−11	2.8E−16
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	5.5E−04	1.6E−11	8.9E−15
U_{235+1d}	2.5E−05	1.6E−11	3.9E−16
U_{238+2d}	5.5E−04	2.0E−11	1.1E−14
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.3E−14

000997

Table C.III338
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	1.2E-08	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium-total	7.5E-05	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor-1254	NA	mg/kg	NA	NA	mg/kg
aroclor-1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III338 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Dairy Products

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	5.2E-10	4.0E-04	1.3E-06
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	3.2E-06	3.0E-03	1.1E-03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.1E-03

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	4.4E-11	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	2.8E-07	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

000999

Table C.III–339
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	NA	pCi/kg	U_{234}	2.3E–02	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.2E–03	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.5E–02	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	NA	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	3.2E+01	1.6E–11	5.2E–10
U_{235+1d}	1.7E+00	1.6E–11	2.7E–11
U_{238+2d}	3.5E+01	2.0E–11	7.1E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.3E–09

001000

Table C.III-340
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	1.3E-06	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium-total	1.3E-05	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	1.3E-09	mg/kg	NA	NA	mg/kg
carbazole	5.3E-09	mg/kg	NA	NA	mg/kg
aroclor-1254	NA	mg/kg	NA	NA	mg/kg
aroclor-1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-340 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	8.6E-09	4.0E-04	2.1E-05
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	8.4E-08	3.0E-03	2.8E-05
benzo(a)pyrene	8.1E-12	NA	NA
carbazole	3.4E-11	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		5.0E-05

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	7.3E-10	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	7.2E-09	NA	NA
benzo(a)pyrene	6.9E-13	7.3E+00	5.0E-12
carbazole	2.9E-12	2.0E-02	5.9E-14
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		5.1E-12

001002

5860

Table C.III–341
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	3.6E–05	pCi/kg	U_{234}	4.0E–03	pCi/kg
Pu_{238}	1.7E–04	pCi/kg	U_{235+1d}	2.0E–04	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	4.4E–03	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	7.1E–04	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	7.5E–03	2.2E–10	1.7E–12
Pu_{238}	3.5E–02	2.2E–10	7.6E–12
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	1.5E–01	1.3E–11	1.9E–12
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	8.4E–01	1.6E–11	1.3E–11
U_{235+1d}	4.1E–02	1.6E–11	6.6E–13
U_{238+2d}	9.2E–01	2.0E–11	1.8E–11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 4.4E–11

001003

Table C.III-342
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Private Ownership: On-Property Perched Groundwater User
Via Incidental Ingestion of Soil

Intake Equation = $\frac{CS \times EF \times ED \times CF \times IR}{BW \times AT}$

IRs	Ingestion rate of soil (RAGS, 1989)	180 mg/day
CF	Conversion factor	1.0E-06 kg/mg
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	1.3E+00	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium-total	NA	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	1.5E-03	mg/kg	NA	NA	mg/kg
carbazole	6.4E-03	mg/kg	NA	NA	mg/kg
aroclor-1254	NA	mg/kg	NA	NA	mg/kg
aroclor-1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-342 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: On-Property Perched Groundwater User
Via Incidental Ingestion of Soil

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	3.3E-06	4.0E-04	8.2E-03
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	NA	3.0E-03	NA
benzo(a)pyrene	3.7E-09	NA	NA
carbazole	1.6E-08	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	HQ Summation =		8.2E-03

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg\text{-}day)^{-1}$	ILCR (unitless)
antimony	3.3E-06	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	NA	NA	NA
benzo(a)pyrene	3.7E-09	7.3E+00	2.7E-08
carbazole	1.6E-08	2.0E-02	3.2E-10
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	ILCR Summation =		2.7E-08

Table C.III−343
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Private Ownership: On−Property Perched Groundwater User
Via Incidental Ingestion of Soil

Intake Equation = CS X EF X EDn X FI X IR

IRs	Ingestion rate of soil (RAGS, 1989)	180 mg/day
EF	Exposure frequency	350 days/year
EDn	Exposure Duration	70 Year
FI	Fractional Intake	1 (unitless)
CS	Concentration of radionuclides in soil	

Cs_{137+1d}	NA	pCi/mg	$Th_{232+10d}$	NA	pCi/mg
Np_{237+1d}	4.30E−05	pCi/mg	U_{234}	8.00E−05	pCi/mg
Pu_{238}	2.00E−04	pCi/mg	U_{235+1d}	NA	pCi/mg
Ra_{226+8d}	NA	pCi/mg	U_{238+2d}	NA	pCi/mg
Ra_{228+1d}	NA	pCi/mg	NA	NA	pCi/mg
Rn_{222+4d}	NA	pCi/mg	NA	NA	pCi/mg
Sr_{90+1d}	NA	pCi/mg	NA	NA	pCi/mg
Tc_{99}	NA	pCi/mg	NA	NA	pCi/mg
Th_{228+7d}	NA	pCi/mg	NA	NA	pCi/mg
Th_{230}	7.70E−04	pCi/mg	NA	NA	pCi/mg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.80E−11	NA
Np_{237+1d}	1.90E+02	2.20E−10	4.17E−08
Pu_{238}	8.82E+02	2.20E−10	1.94E−07
Ra_{226+8d}	NA	7.80E−10	NA
Ra_{228+1d}	NA	1.00E−10	NA
Rn_{222+4d}	NA	1.70E−12	NA
Sr_{90+1d}	NA	3.60E−11	NA
Tc_{99}	NA	1.30E−12	NA
Th_{228+7d}	NA	5.50E−11	NA
Th_{230}	3.40E+03	1.30E−11	4.41E−08
$Th_{232+10d}$	NA	1.70E−10	NA
U_{234}	3.53E+02	1.60E−11	5.64E−09
U_{235+1d}	NA	1.60E−11	NA
U_{238+2d}	NA	2.00E−11	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.86E−07

001006

Table C.III-344
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Private Ownership: On-Property Perched Groundwater User
Via Dermal Contact with Soil

Intake Equation = $\frac{CS \times EF \times ED \times CF \times ABS \times AF \times SA}{BW \times AT}$

SA	Surface area of exposed skin (50th percentile, hands only)	5750 cm^2/day
AF	Soil to skin adherence factor (RAGS, 1989)	1 mg/cm^2
ABS	chemicals specific absorbtion factor (see table below)	csv
CF	Conversion factor	1E-06 kg/mg
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in soil	

Chemical Concentrations

Compound	ABS	Concentrati	Units	Compound		Concentrati	Units
antimony	1.00E-02	1.33E+00	mg/kg	NA	NA	NA	mg/kg
arsenic	1.00E-03	NA	mg/kg	NA	NA	NA	mg/kg
beryllium	1.00E-02	NA	mg/kg	NA	NA	NA	mg/kg
uranium-total	1.00E-02	NA	mg/kg	NA	NA	NA	mg/kg
benzo(a)pyrene	3.00E-01	1.50E-03	mg/kg	NA	NA	NA	mg/kg
carbazole	3.00E-01	6.40E-03	mg/kg	NA	NA	NA	mg/kg
aroclor-1254	6.00E-02	NA	mg/kg	NA	NA	NA	mg/kg
aroclor-1260	6.00E-02	NA	mg/kg	NA	NA	NA	mg/kg
dieldrin	3.00E-01	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg				

References

Table C.III-344 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: On-Property Perched Groundwater User
Via Dermal Contact with Soil

Compound	HQ Calculation CDI (mg/kg-day)	HQ Calculation RfD (mg/kg-day)	HQ Calculation HQ (unitless)
antimony	1.05E-06	6.00E-05	1.75E-02
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	NA	1.50E-04	NA
benzo(a)pyrene	3.54E-08	NA	NA
carbazole	1.51E-07	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.75E-02

Compound	ILCR Calculation CDI (mg/kg-day)	ILCR Calculation CSF $(mg/kg\text{-}day)^{-1}$	ILCR Calculation ILCR (unitless)
antimony	1.05E-06	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	NA	NA	NA
benzo(a)pyrene	3.54E-08	NA	NA
carbazole	1.51E-07	2.22E-02	3.36E-09
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		3.36E-09

001008

Table C.III−345 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: On−Property Perched Groundwater User
Via Drinking Water Ingestion

Compound	HQ Calculation CDI (mg/kg−day)	RfD (mg/kg−day)	HQ (unitless)
antimony	NA	4.00E−04	NA
arsenic	NA	3.00E−04	NA
beryllium	NA	5.00E−03	NA
uranium−total	NA	3.00E−03	NA
benzo(a)pyrene	NA	NA	NA
carbazole	1.29E−05	NA	NA
aroclor−1254	NA	NA	NA
aroclor−1260	NA	NA	NA
dieldrin	NA	5.00E−05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		NA

Compound	ILCR Calculation CDI (mg/kg−day)	CSF (mg/kg−day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium−total	NA	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	1.29E−05	2.00E−02	2.58E−07
aroclor−1254	NA	7.70E+00	NA
aroclor−1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		2.58E−07

Table C.III–346
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Private Ownership: On–Property Perched Groundwater User
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	6.1E–01	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	3.2E–02	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	6.7E–01	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	1.6E–02	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	7.8E+02	1.3E–12	1.0E–09
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	3.0E+04	1.6E–11	4.8E–07
U_{235+1d}	1.6E+03	1.6E–11	2.5E–08
U_{238+2d}	3.3E+04	2.0E–11	6.6E–07
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	1.2E–06

001010

Table C.III–347
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Private Ownership: On–Property Perched Groundwater User
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2–day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
SA	Skin surface area available for contact	23000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
arsenic	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
beryllium	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
uranium–total	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
benzo(a)pyrene	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
carbazole	1.17E–09	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1254	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1260	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
dieldrin	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day			

References

001011

5860

Table C.III-347 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: On-Property Perched Groundwater User
Via Dermal Contact while Bathing

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	NA	1.50E-04	NA
benzo(a)pyrene	NA	NA	NA
carbazole	3.70E-07	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		NA

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	NA	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	3.70E-07	2.22E-02	8.23E-09
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		8.23E-09

001012

Table C.III–348
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Private Ownership: On–Property Perched Groundwater User
Via Inhalation of Particulates

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	3.5E–08	mg/m^3	NA	NA	mg/m^3
arsenic	NA	mg/m^3	NA	NA	mg/m^3
beryllium	NA	mg/m^3	NA	NA	mg/m^3
uranium–total	NA	mg/m^3	NA	NA	mg/m^3
benzo(a)pyrene	4.6E–11	mg/m^3	NA	NA	mg/m^3
carbazole	2.0E–10	mg/m^3	NA	NA	mg/m^3
aroclor–1254	NA	mg/m^3	NA	NA	mg/m^3
aroclor–1260	NA	mg/m^3	NA	NA	mg/m^3
dieldrin	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3			

References

001013

5860

Table C.III–348 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: On–Property Perched Groundwater User
Via Inhalation of Particulates

	HQ Calculation		
Compound	CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	9.5E–09	NA	NA
arsenic	NA	NA	NA
beryllium	NA	NA	NA
uranium–total	NA	NA	NA
benzo(a)pyrene	1.3E–11	NA	NA
carbazole	5.4E–11	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
Hazard Quotient Sum =			NA

	ILCR Calculation		
Compound	CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	9.5E–09	NA	NA
arsenic	NA	1.5E+01	NA
beryllium	NA	8.4E+00	NA
uranium–total	NA	NA	NA
benzo(a)pyrene	1.3E–11	6.1E+00	7.7E–11
carbazole	5.4E–11	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
ILCR Summation =			7.7E–11

001014

Table C.III–349
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Private Ownership: On–Property Perched Groundwater User
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	1.3E–06	pCi/m^3	U_{234}	2.5E–06	pCi/m^3
Pu_{238}	6.2E–06	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	2.4E–05	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	6.5E–01	2.9E–08	1.9E–08
Pu_{238}	3.0E+00	3.9E–08	1.2E–07
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	NA	7.7E–12	NA
Sr_{90+1d}	NA	6.2E–11	NA
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	1.2E+01	2.9E–08	3.4E–07
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	1.2E+00	2.6E–08	3.1E–08
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	NA	2.4E–08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 5.0E–07

001015

Table C.III-350
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Private Ownership: On-Property Perched Groundwater User
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	2.7E-03	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium-total	8.0E-07	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	5.1E-05	mg/kg	NA	NA	mg/kg
carbazole	9.7E-06	mg/kg	NA	NA	mg/kg
aroclor-1254	NA	mg/kg	NA	NA	mg/kg
aroclor-1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

001016

Table C.III-350 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: On-Property Perched Groundwater User
Via Ingestion of Meat Products

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	2.8E-06	4.0E-04	6.9E-03
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	8.3E-10	3.0E-03	2.8E-07
benzo(a)pyrene	5.3E-08	NA	NA
carbazole	1.0E-08	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		6.9E-03

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	2.8E-06	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	8.3E-10	NA	NA
benzo(a)pyrene	5.3E-08	7.3E+00	3.9E-07
carbazole	1.0E-08	2.0E-02	2.0E-10
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		3.9E-07

Table C.III−351
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Private Ownership: On−Property Perched Groundwater User
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	2.4E−03	pCi/kg	U_{234}	1.5E−02	pCi/kg
Pu_{238}	5.2E−05	pCi/kg	U_{235+1d}	1.2E−05	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.6E−04	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	2.5E−03	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	4.4E+00	2.2E−10	9.7E−10
Pu_{238}	9.7E−02	2.2E−10	2.1E−11
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	NA	3.6E−11	NA
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	4.7E+00	1.3E−11	6.1E−11
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	2.8E+01	1.6E−11	4.5E−10
U_{235+1d}	2.2E−02	1.6E−11	3.6E−13
U_{238+2d}	4.8E−01	2.0E−11	9.7E−12
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.5E−09

001018

Table C.III–352
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Private Ownership: On–Property Perched Groundwater User
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	2.7E–04	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	4.7E–04	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-352 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: On-Property Perched Groundwater User
Via Ingestion of Dairy Products

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	1.1E-06	4.0E-04	2.7E-03
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.9E-06	3.0E-03	6.5E-04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		3.4E-03

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	1.1E-06	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.9E-06	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001020

Table C.III–353
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Private Ownership: On–Property Perched Groundwater User
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	7.9E–05	pCi/kg	U_{234}	2.4E–02	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	3.6E–04	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.3E–02	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	2.4E+00	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	3.5E–04	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	5.8E–01	2.2E–10	1.3E–10
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	1.8E+04	3.6E–11	6.4E–07
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	2.6E+00	1.3E–11	3.4E–11
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.8E+02	1.6E–11	2.8E–09
U_{235+1d}	2.6E+00	1.6E–11	4.2E–11
U_{238+2d}	1.7E+02	2.0E–11	3.3E–09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		6.4E–07

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Table C.III–354
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Private Ownership: On–Property Perched Groundwater User
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	4.0E–02	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	3.9E–04	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	1.7E–05	mg/kg	NA	NA	mg/kg
carbazole	2.3E–03	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

001022

Table C.III-354 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: On-Property Perched Groundwater User
Via Ingestion of Vegetables and Fruits

Compound	HQ Calculation CDI (mg/kg-day)	HQ Calculation RfD (mg/kg-day)	HQ Calculation HQ (unitless)
antimony	6.7E-05	4.0E-04	1.7E-01
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	6.5E-07	3.0E-03	2.2E-04
benzo(a)pyrene	2.9E-08	NA	NA
carbazole	3.9E-06	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.7E-01

Compound	ILCR Calculation CDI (mg/kg-day)	ILCR Calculation CSF $(mg/kg-day)^{-1}$	ILCR Calculation ILCR (unitless)
antimony	6.7E-05	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	6.5E-07	NA	NA
benzo(a)pyrene	2.9E-08	7.3E+00	2.1E-07
carbazole	3.9E-06	2.0E-02	7.7E-08
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		2.9E-07

Table C.III–355
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Private Ownership: On–Property Perched Groundwater User
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	4.3E−01	pCi/kg	U_{234}	8.0E−01	pCi/kg
Pu_{238}	9.6E−02	pCi/kg	U_{235+1d}	5.9E−03	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	1.3E−01	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	6.8E−01	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	1.3E+03	2.2E−10	2.8E−07
Pu_{238}	2.9E+02	2.2E−10	6.3E−08
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	NA	3.6E−11	NA
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	2.0E+03	1.3E−11	2.7E−08
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	2.4E+03	1.6E−11	3.8E−08
U_{235+1d}	1.8E+01	1.6E−11	2.8E−10
U_{238+2d}	3.8E+02	2.0E−11	7.6E−09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	4.2E−07

001024

5890

References

Table C.III–356
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Private Ownership: On–Property Perched Groundwater User
Via External Radiation

Dose Equivalency Equat = $[DR \times EF \times EDn \times ET_i \times (1-SH_i)] + [DR \times EF \times EDn \times ET_o \times (1-SH_o)]$

EF	Fraction of year spent exposured	0.96 (unitless)
ED	Exposure duration	70 Year
ET_i	Fraction of day spent indoors	0.76 (unitless)
ET_o	Fraction of day spent outdoors	0.24 (unitless)
SH_i	Shield factor indoors	0.5 (unitless)
SH_o	Shield factor outdoors	NA (unitless)
DR	Radionuclide specific dose concentrations	(see table below)

Cs_{137+1d}	NA	pCi/g	$Th_{232+10d}$	NA	pCi/g
Np_{237+1d}	4.30E–02	pCi/g	U_{234}	8.00E–02	pCi/g
Pu_{238}	2.00E–01	pCi/g	U_{235+1d}	NA	pCi/g
Ra_{226+8d}	NA	pCi/g	U_{238+2d}	NA	pCi/g
Ra_{228+1d}	NA	pCi/g	NA	NA	pCi/g
Rn_{222+4d}	NA	pCi/g	NA	NA	pCi/g
Sr_{90+1d}	NA	pCi/g	NA	NA	pCi/g
Tc_{99}	NA	pCi/g	NA	NA	pCi/g
Th_{228+7d}	NA	pCi/g	NA	NA	pCi/g
Th_{230}	7.70E–01	pCi/g	NA	NA	pCi/g

Radionuclides	CDI (year pCi/g)	CSF $(g/pCi-year)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.0E–06	NA
Np_{237+1d}	1.8E+00	4.3E–07	7.7E–07
Pu_{238}	8.3E+00	2.8E–11	2.3E–10
Ra_{226+8d}	NA	6.0E–06	NA
Ra_{228+1d}	NA	2.9E–06	NA
Rn_{222+4d}	NA	5.9E–06	NA
Sr_{90+1d}	NA	NA	NA
Tc_{99}	NA	6.0E–13	NA
Th_{228+7d}	NA	5.6E–06	NA
Th_{230}	3.2E+01	5.4E–11	1.7E–09
$Th_{232+10d}$	NA	8.5E–06	NA
U_{234}	3.3E+00	3.0E–11	1.0E–10
U_{235+1d}	NA	2.4E–07	NA
U_{238+2d}	NA	5.1E–08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 7.7E–07

001025

Table C.III-357
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Incidental Ingestion of Soil

Intake Equation = $\frac{CS \times EF \times ED \times CF \times IR}{BW \times AT}$

IRs	Ingestion rate of soil (RAGS, 1989)	180 mg/day
CF	Conversion factor	1.0E-06 kg/mg
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	1.3E+00	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium-total	NA	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	1.5E-03	mg/kg	NA	NA	mg/kg
carbazole	6.4E-03	mg/kg	NA	NA	mg/kg
aroclor-1254	NA	mg/kg	NA	NA	mg/kg
aroclor-1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III-357 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Incidental Ingestion of Soil

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	3.3E-06	4.0E-04	8.2E-03
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	NA	3.0E-03	NA
benzo(a)pyrene	3.7E-09	NA	NA
carbazole	1.6E-08	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	HQ Summation =		8.2E-03

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg\text{-}day)^{-1}$	ILCR (unitless)
antimony	3.3E-06	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	NA	NA	NA
benzo(a)pyrene	3.7E-09	7.3E+00	2.7E-08
carbazole	1.6E-08	2.0E-02	3.2E-10
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	ILCR Summation =		2.7E-08

Table C.III–358
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Incidental Ingestion of Soil

Intake Equation = CS X EF X EDn X FI X IR

IRs	Ingestion rate of soil (RAGS, 1989)	180 mg/day
EF	Exposure frequency	350 days/year
EDn	Exposure Duration	70 Year
FI	Fractional Intake	1 (unitless)
CS	Concentration of radionuclides in soil	

Cs_{137+1d}	NA	pCi/mg	$Th_{232+10d}$	NA	pCi/mg
Np_{237+1d}	4.30E–05	pCi/mg	U_{234}	8.00E–05	pCi/mg
Pu_{238}	2.00E–04	pCi/mg	U_{235+1d}	NA	pCi/mg
Ra_{226+8d}	NA	pCi/mg	U_{238+2d}	NA	pCi/mg
Ra_{228+1d}	NA	pCi/mg	NA	NA	pCi/mg
Rn_{222+4d}	NA	pCi/mg	NA	NA	pCi/mg
Sr_{90+1d}	NA	pCi/mg	NA	NA	pCi/mg
Tc_{99}	NA	pCi/mg	NA	NA	pCi/mg
Th_{228+7d}	NA	pCi/mg	NA	NA	pCi/mg
Th_{230}	7.70E–04	pCi/mg	NA	NA	pCi/mg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.80E–11	NA
Np_{237+1d}	1.90E+02	2.20E–10	4.17E–08
Pu_{238}	8.82E+02	2.20E–10	1.94E–07
Ra_{226+8d}	NA	7.80E–10	NA
Ra_{228+1d}	NA	1.00E–10	NA
Rn_{222+4d}	NA	1.70E–12	NA
Sr_{90+1d}	NA	3.60E–11	NA
Tc_{99}	NA	1.30E–12	NA
Th_{228+7d}	NA	5.50E–11	NA
Th_{230}	3.40E+03	1.30E–11	4.41E–08
$Th_{232+10d}$	NA	1.70E–10	NA
U_{234}	3.53E+02	1.60E–11	5.64E–09
U_{235+1d}	NA	1.60E–11	NA
U_{238+2d}	NA	2.00E–11	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		2.86E–07

Table C.III-359
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Dermal Contact with Soil

Intake Equation = $\frac{CS \times EF \times ED \times CF \times ABS \times AF \times SA}{BW \times AT}$

SA	Surface area of exposed skin (50th percentile, hands only)	5750 cm^2/day
AF	Soil to skin adherence factor (RAGS, 1989)	1 mg/cm^2
ABS	chemicals specific absorbtion factor (see table below)	csv
CF	Conversion factor	1E-06 kg/mg
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in soil	

Chemical Concentrations

Compound	ABS	Concentrati	Units	Compound		Concentrati	Units
antimony	1.00E-02	1.33E+00	mg/kg	NA	NA	NA	mg/kg
arsenic	1.00E-03	NA	mg/kg	NA	NA	NA	mg/kg
beryllium	1.00E-02	NA	mg/kg	NA	NA	NA	mg/kg
uranium-total	1.00E-02	NA	mg/kg	NA	NA	NA	mg/kg
benzo(a)pyrene	3.00E-01	1.50E-03	mg/kg	NA	NA	NA	mg/kg
carbazole	3.00E-01	6.40E-03	mg/kg	NA	NA	NA	mg/kg
aroclor-1254	6.00E-02	NA	mg/kg	NA	NA	NA	mg/kg
aroclor-1260	6.00E-02	NA	mg/kg	NA	NA	NA	mg/kg
dieldrin	3.00E-01	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg				

References

Table C.III-359 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Dermal Contact with Soil

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	1.05E-06	6.00E-05	1.75E-02
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	NA	1.50E-04	NA
benzo(a)pyrene	3.54E-08	NA	NA
carbazole	1.51E-07	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.75E-02

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	1.05E-06	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	NA	NA	NA
benzo(a)pyrene	3.54E-08	NA	NA
carbazole	1.51E-07	2.22E-02	3.36E-09
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		3.36E-09

001030

Table C.III-360
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium-total	8.00E-05	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
aroclor-1254	NA	mg/l	NA	NA	mg/l
aroclor-1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

Table C.III-360 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Drinking Water Ingestion

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	2.19E-06	3.00E-03	7.31E-04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		7.31E-04

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	2.19E-06	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001032

Table C.III–361
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	2.4E–02	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	1.2E–03	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	2.6E–02	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.2E+03	1.6E–11	1.9E–08
U_{235+1d}	5.9E+01	1.6E–11	9.4E–10
U_{238+2d}	1.3E+03	2.0E–11	2.5E–08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 4.5E–08

001033

Table C.III–362
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2–day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
SA	Skin surface area available for contact	23000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
arsenic	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
beryllium	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
uranium–total	2.00E–11	mg/cm^2–day	NA	NA	mg/cm^2–day
benzo(a)pyrene	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
carbazole	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1254	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1260	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
dieldrin	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day			

References

Table C.III-362 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Dermal Contact while Bathing

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	6.30E-09	1.50E-04	4.20E-05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		4.20E-05

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	6.30E-09	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

Table C.III–363
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Inhalation of Particulates

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	3.5E–08	mg/m^3	NA	NA	mg/m^3
arsenic	NA	mg/m^3	NA	NA	mg/m^3
beryllium	NA	mg/m^3	NA	NA	mg/m^3
uranium–total	NA	mg/m^3	NA	NA	mg/m^3
benzo(a)pyrene	4.6E–11	mg/m^3	NA	NA	mg/m^3
carbazole	2.0E–10	mg/m^3	NA	NA	mg/m^3
aroclor–1254	NA	mg/m^3	NA	NA	mg/m^3
aroclor–1260	NA	mg/m^3	NA	NA	mg/m^3
dieldrin	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3			

References

Table C.III-363 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Inhalation of Particulates

Compound	HQ Calculation: CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	9.5E-09	NA	NA
arsenic	NA	NA	NA
beryllium	NA	NA	NA
uranium-total	NA	NA	NA
benzo(a)pyrene	1.3E-11	NA	NA
carbazole	5.4E-11	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	Hazard Quotient Sum =		NA

Compound	ILCR Calculation: CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	9.5E-09	NA	NA
arsenic	NA	1.5E+01	NA
beryllium	NA	8.4E+00	NA
uranium-total	NA	NA	NA
benzo(a)pyrene	1.3E-11	6.1E+00	7.7E-11
carbazole	5.4E-11	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		7.7E-11

Table C.III–364
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	1.3E–06	pCi/m^3	U_{234}	2.5E–06	pCi/m^3
Pu_{238}	6.2E–06	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	2.4E–05	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	6.5E–01	2.9E–08	1.9E–08
Pu_{238}	3.0E+00	3.9E–08	1.2E–07
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	NA	7.7E–12	NA
Sr_{90+1d}	NA	6.2E–11	NA
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	1.2E+01	2.9E–08	3.4E–07
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	1.2E+00	2.6E–08	3.1E–08
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	NA	2.4E–08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 5.0E–07

001038

Table C.III–365
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	2.7E–03	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	8.0E–07	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	5.1E–05	mg/kg	NA	NA	mg/kg
carbazole	9.7E–06	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-365 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Ingestion of Meat Products

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	2.8E-06	4.0E-04	6.9E-03
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	8.3E-10	3.0E-03	2.8E-07
benzo(a)pyrene	5.3E-08	NA	NA
carbazole	1.0E-08	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		6.9E-03

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	2.8E-06	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	8.3E-10	NA	NA
benzo(a)pyrene	5.3E-08	7.3E+00	3.9E-07
carbazole	1.0E-08	2.0E-02	2.0E-10
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		3.9E-07

001040

Table C.III–366
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	2.4E–03	pCi/kg	U_{234}	1.5E–02	pCi/kg
Pu_{238}	5.2E–05	pCi/kg	U_{235+1d}	1.2E–05	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.6E–04	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	2.5E–03	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	4.4E+00	2.2E–10	9.7E–10
Pu_{238}	9.7E–02	2.2E–10	2.1E–11
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	4.7E+00	1.3E–11	6.1E–11
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	2.8E+01	1.6E–11	4.5E–10
U_{235+1d}	2.2E–02	1.6E–11	3.6E–13
U_{238+2d}	4.8E–01	2.0E–11	9.7E–12
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		1.5E–09

Table C.III-367
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	2.7E-04	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium-total	4.7E-04	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor-1254	NA	mg/kg	NA	NA	mg/kg
aroclor-1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-367 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Ingestion of Dairy Products

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	1.1E-06	4.0E-04	2.7E-03
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.9E-06	3.0E-03	6.5E-04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		3.4E-03

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	1.1E-06	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.9E-06	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

Table C.III-368
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	7.9E-05	pCi/kg	U_{234}	2.4E-02	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	3.6E-04	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.3E-02	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	2.4E+00	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	3.5E-04	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	5.8E-01	2.2E-10	1.3E-10
Pu_{238}	NA	2.2E-10	NA
Ra_{226+8d}	NA	7.8E-10	NA
Ra_{228+1d}	NA	1.0E-10	NA
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	1.8E+04	3.6E-11	6.4E-07
Tc_{99}	NA	1.3E-12	NA
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	2.6E+00	1.3E-11	3.4E-11
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	1.8E+02	1.6E-11	2.8E-09
U_{235+1d}	2.6E+00	1.6E-11	4.2E-11
U_{238+2d}	1.7E+02	2.0E-11	3.3E-09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	6.4E-07

Table C.III-369
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	4.0E-02	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium-total	3.9E-04	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	1.7E-05	mg/kg	NA	NA	mg/kg
carbazole	2.3E-03	mg/kg	NA	NA	mg/kg
aroclor-1254	NA	mg/kg	NA	NA	mg/kg
aroclor-1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-369 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Ingestion of Vegetables and Fruits

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	6.7E-05	4.0E-04	1.7E-01
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	6.5E-07	3.0E-03	2.2E-04
benzo(a)pyrene	2.9E-08	NA	NA
carbazole	3.9E-06	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.7E-01

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	6.7E-05	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	6.5E-07	NA	NA
benzo(a)pyrene	2.9E-08	7.3E+00	2.1E-07
carbazole	3.9E-06	2.0E-02	7.7E-08
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		2.9E-07

000046

Table C.III–370
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	4.3E–01	pCi/kg	U_{234}	8.0E–01	pCi/kg
Pu_{238}	9.6E–02	pCi/kg	U_{235+1d}	5.9E–03	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	1.3E–01	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	6.8E–01	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	1.3E+03	2.2E–10	2.8E–07
Pu_{238}	2.9E+02	2.2E–10	6.3E–08
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	2.0E+03	1.3E–11	2.7E–08
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	2.4E+03	1.6E–11	3.8E–08
U_{235+1d}	1.8E+01	1.6E–11	2.8E–10
U_{238+2d}	3.8E+02	2.0E–11	7.6E–09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	4.2E–07

001047

Table C.III-371
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via External Radiation

Dose Equivalency Equat = $[DR \times EF \times EDn \times ET_i \times (1-SH_i)] + [DR \times EF \times EDn \times ET_o \times (1-SH_o)]$

EF	Fraction of year spent exposured	0.96 (unitless)
ED	Exposure duration	70 Year
ET_i	Fraction of day spent indoors	0.76 (unitless)
ET_o	Fraction of day spent outdoors	0.24 (unitless)
SH_i	Shield factor indoors	0.5 (unitless)
SH_o	Shield factor outdoors	NA (unitless)
DR	Radionuclide specific dose concentrations	(see table below)

Cs_{137+1d}	NA	pCi/g	$Th_{232+10d}$	NA	pCi/g
Np_{237+1d}	4.30E-02	pCi/g	U_{234}	8.00E-02	pCi/g
Pu_{238}	2.00E-01	pCi/g	U_{235+1d}	NA	pCi/g
Ra_{226+8d}	NA	pCi/g	U_{238+2d}	NA	pCi/g
Ra_{228+1d}	NA	pCi/g	NA	NA	pCi/g
Rn_{222+4d}	NA	pCi/g	NA	NA	pCi/g
Sr_{90+1d}	NA	pCi/g	NA	NA	pCi/g
Tc_{99}	NA	pCi/g	NA	NA	pCi/g
Th_{228+7d}	NA	pCi/g	NA	NA	pCi/g
Th_{230}	7.70E-01	pCi/g	NA	NA	pCi/g

Radionuclides	CDI (year pCi/g)	CSF $(g/pCi-year)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.0E-06	NA
Np_{237+1d}	1.8E+00	4.3E-07	7.7E-07
Pu_{238}	8.3E+00	2.8E-11	2.3E-10
Ra_{226+8d}	NA	6.0E-06	NA
Ra_{228+1d}	NA	2.9E-06	NA
Rn_{222+4d}	NA	5.9E-06	NA
Sr_{90+1d}	NA	NA	NA
Tc_{99}	NA	6.0E-13	NA
Th_{228+7d}	NA	5.6E-06	NA
Th_{230}	3.2E+01	5.4E-11	1.7E-09
$Th_{232+10d}$	NA	8.5E-06	NA
U_{234}	3.3E+00	3.0E-11	1.0E-10
U_{235+1d}	NA	2.4E-07	NA
U_{238+2d}	NA	5.1E-08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	7.7E-07

001048

Table C.III–372
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Incidental Ingestion of Soil

Intake Equation = $\frac{CS \times EF \times ED \times CF \times IR}{BW \times AT}$

IRs	Ingestion rate of soil (RAGS, 1989)	200 mg/day
CF	Conversion factor	1.0E–06 kg/mg
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	1.3E+00	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	NA	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	1.5E–03	mg/kg	NA	NA	mg/kg
carbazole	6.4E–03	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-372 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Incidental Ingestion of Soil

Compound	HQ Calculation		
	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	1.7E-05	4.0E-04	4.3E-02
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	NA	3.0E-03	NA
benzo(a)pyrene	1.9E-08	NA	NA
carbazole	8.2E-08	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		4.3E-02

Compound	ILCR Calculation		
	CDI (mg/kg-day)	CSF $(mg/kg\text{-}day)^{-1}$	ILCR (unitless)
antimony	1.5E-06	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	NA	NA	NA
benzo(a)pyrene	1.6E-09	7.3E+00	1.2E-08
carbazole	7.0E-09	2.0E-02	1.4E-10
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		1.2E-08

001050

Table C.III-373
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Incidental Ingestion of Soil

Intake Equation = CS X EF X EDn X FI X IR

IRs	Ingestion rate of soil (RAGS, 1989)	200 mg/day
EF	Exposure frequency	350 days/year
EDn	Exposure Duration	6 Year
FI	Fractional Intake	1 (unitless)
CS	Concentration of radionuclides in soil	

Cs_{137+1d}	NA	pCi/mg	$Th_{232+10d}$	NA	pCi/mg
Np_{237+1d}	4.30E-05	pCi/mg	U_{234}	8.00E-05	pCi/mg
Pu_{238}	2.00E-04	pCi/mg	U_{235+1d}	NA	pCi/mg
Ra_{226+8d}	NA	pCi/mg	U_{238+2d}	NA	pCi/mg
Ra_{228+1d}	NA	pCi/mg	NA	NA	pCi/mg
Rn_{222+4d}	NA	pCi/mg	NA	NA	pCi/mg
Sr_{90+1d}	NA	pCi/mg	NA	NA	pCi/mg
Tc_{99}	NA	pCi/mg	NA	NA	pCi/mg
Th_{228+7d}	NA	pCi/mg	NA	NA	pCi/mg
Th_{230}	7.70E-04	pCi/mg	NA	NA	pCi/mg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.80E-11	NA
Np_{237+1d}	1.81E+01	2.20E-10	3.97E-09
Pu_{238}	8.40E+01	2.20E-10	1.85E-08
Ra_{226+8d}	NA	7.80E-10	NA
Ra_{228+1d}	NA	1.00E-10	NA
Rn_{222+4d}	NA	1.70E-12	NA
Sr_{90+1d}	NA	3.60E-11	NA
Tc_{99}	NA	1.30E-12	NA
Th_{228+7d}	NA	5.50E-11	NA
Th_{230}	3.23E+02	1.30E-11	4.20E-09
$Th_{232+10d}$	NA	1.70E-10	NA
U_{234}	3.36E+01	1.60E-11	5.38E-10
U_{235+1d}	NA	1.60E-11	NA
U_{238+2d}	NA	2.00E-11	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.72E-08

Table C.III-374
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Dermal Contact with Soil

Intake Equation = $\frac{CS \times EF \times ED \times CF \times ABS \times AF \times SA}{BW \times AT}$

SA	Surface area of exposed skin (50th percentile, hands only)	2000 cm^2/day
AF	Soil to skin adherence factor (RAGS, 1989)	1 mg/cm^2
ABS	chemicals specific absorbtion factor (see table below)	csv
CF	Conversion factor	1E-06 kg/mg
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in soil	

Chemical Concentrations

Compound	ABS	Concentrati	Units	Compound		Concentrati	Units
antimony	1.00E-02	1.33E+00	mg/kg	NA	NA	NA	mg/kg
arsenic	1.00E-03	NA	mg/kg	NA	NA	NA	mg/kg
beryllium	1.00E-02	NA	mg/kg	NA	NA	NA	mg/kg
uranium-total	1.00E-02	NA	mg/kg	NA	NA	NA	mg/kg
benzo(a)pyrene	3.00E-01	1.50E-03	mg/kg	NA	NA	NA	mg/kg
carbazole	3.00E-01	6.40E-03	mg/kg	NA	NA	NA	mg/kg
aroclor-1254	6.00E-02	NA	mg/kg	NA	NA	NA	mg/kg
aroclor-1260	6.00E-02	NA	mg/kg	NA	NA	NA	mg/kg
dieldrin	3.00E-01	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg				

References

Table C.III-374 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Dermal Contact with Soil

Compound	HQ Calculation: CDI (mg/kg-day)	HQ Calculation: RfD (mg/kg-day)	HQ Calculation: HQ (unitless)
antimony	1.70E-06	6.00E-05	2.83E-02
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	NA	1.50E-04	NA
benzo(a)pyrene	5.75E-08	NA	NA
carbazole	2.45E-07	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.83E-02

Compound	ILCR Calculation: CDI (mg/kg-day)	ILCR Calculation: CSF $(mg/kg-day)^{-1}$	ILCR Calculation: ILCR (unitless)
antimony	1.46E-07	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	NA	NA	NA
benzo(a)pyrene	4.93E-09	NA	NA
carbazole	2.10E-08	2.22E-02	4.68E-10
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		4.68E-10

Table C.III-375
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium-total	8.00E-05	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
aroclor-1254	NA	mg/l	NA	NA	mg/l
aroclor-1260-	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

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Table C.III-375 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Drinking Water Ingestion

Compound	HQ Calculation CDI (mg/kg-day)	HQ Calculation RfD (mg/kg-day)	HQ Calculation HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	5.11E-06	3.00E-03	1.70E-03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.70E-03

Compound	ILCR Calculation CDI (mg/kg-day)	ILCR Calculation CSF $(mg/kg-day)^{-1}$	ILCR Calculation ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	4.38E-07	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

Table C.III–376
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	2.4E–02	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	1.2E–03	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	2.6E–02	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	5.0E+01	1.6E–11	8.1E–10
U_{235+1d}	2.5E+00	1.6E–11	4.0E–11
U_{238+2d}	5.5E+01	2.0E–11	1.1E–09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.9E–09

Table C.III-377
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2-day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	2190 days
SA	Skin surface area available for contact	8000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
arsenic	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
beryllium	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
uranium-total	2.00E-11	mg/cm^2-day	NA	NA	mg/cm^2-day
benzo(a)pyrene	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
carbazole	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
aroclor-1254	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
aroclor-1260	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
dieldrin	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day	NA	NA	mg/cm^2-day
NA	NA	mg/cm^2-day			

References

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Table C.III-377 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Dermal Contact while Bathing

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	1.02E-08	1.50E-04	6.82E-05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		6.82E-05

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	8.77E-10	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

Table C.III-378
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Inhalation of Particulates

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Inhalation rate of gases (RAGS, 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	3.5E-08	mg/m^3	NA	NA	mg/m^3
arsenic	NA	mg/m^3	NA	NA	mg/m^3
beryllium	NA	mg/m^3	NA	NA	mg/m^3
uranium-total	NA	mg/m^3	NA	NA	mg/m^3
benzo(a)pyrene	4.6E-11	mg/m^3	NA	NA	mg/m^3
carbazole	2.0E-10	mg/m^3	NA	NA	mg/m^3
aroclor-1254	NA	mg/m^3	NA	NA	mg/m^3
aroclor-1260	NA	mg/m^3	NA	NA	mg/m^3
dieldrin	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3			

References

Table C.III-378 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Inhalation of Particulates

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	2.7E-08	NA	NA
arsenic	NA	NA	NA
beryllium	NA	NA	NA
uranium-total	NA	NA	NA
benzo(a)pyrene	3.5E-11	NA	NA
carbazole	1.5E-10	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
Hazard Quotient Sum =			NA

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	2.3E-09	NA	NA
arsenic	NA	1.5E+01	NA
beryllium	NA	8.4E+00	NA
uranium-total	NA	NA	NA
benzo(a)pyrene	3.0E-12	6.1E+00	1.8E-11
carbazole	1.3E-11	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
ILCR Summation =			1.8E-11

Table C.III–379
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Ca	*Concentration of radionuclides in air*	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	1.3E–06	pCi/m^3	U_{234}	2.5E–06	pCi/m^3
Pu_{238}	6.2E–06	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	2.4E–05	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	3.3E–02	2.9E–08	9.6E–10
Pu_{238}	1.5E–01	3.9E–08	6.0E–09
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	NA	7.7E–12	NA
Sr_{90+1d}	NA	6.2E–11	NA
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	6.0E–01	2.9E–08	1.7E–08
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	6.2E–02	2.6E–08	1.6E–09
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	NA	2.4E–08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.6E–08

Table C.III-380
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	2.7E-03	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium-total	8.0E-07	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	5.1E-05	mg/kg	NA	NA	mg/kg
carbazole	9.7E-06	mg/kg	NA	NA	mg/kg
aroclor-1254	NA	mg/kg	NA	NA	mg/kg
aroclor-1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III–380 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Compound	HQ Calculation CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	5.0E–06	4.0E–04	1.2E–02
arsenic	NA	3.0E–04	NA
beryllium	NA	5.0E–03	NA
uranium–total	1.5E–09	3.0E–03	5.0E–07
benzo(a)pyrene	9.5E–08	NA	NA
carbazole	1.8E–08	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	5.0E–05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.2E–02

Compound	ILCR Calculation CDI (mg/kg–day)	CSF (mg/kg–day)$^{-1}$	ILCR (unitless)
antimony	4.3E–07	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium–total	1.3E–10	NA	NA
benzo(a)pyrene	8.2E–09	7.3E+00	6.0E–08
carbazole	1.6E–09	2.0E–02	3.1E–11
aroclor–1254	NA	7.7E+00	NA
aroclor–1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		6.0E–08

Table C.III–381
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	2.4E–03	pCi/kg	U_{234}	1.5E–02	pCi/kg
Pu_{238}	5.2E–05	pCi/kg	U_{235+1d}	1.2E–05	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.6E–04	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	2.5E–03	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	1.5E–01	2.2E–10	3.2E–11
Pu_{238}	3.2E–03	2.2E–10	7.1E–13
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	1.5E–01	1.3E–11	2.0E–12
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	9.3E–01	1.6E–11	1.5E–11
U_{235+1d}	7.4E–04	1.6E–11	1.2E–14
U_{238+2d}	1.6E–02	2.0E–11	3.2E–13
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 5.0E–11

Table C.III-382
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	2.7E-04	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium-total	4.7E-04	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor-1254	NA	mg/kg	NA	NA	mg/kg
aroclor-1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-382 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Dairy Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	1.1E-05	4.0E-04	2.9E-02
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	2.0E-05	3.0E-03	6.8E-03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		3.6E-02

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	9.9E-07	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.8E-06	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

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Table C.III–383
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	7.9E–05	pCi/kg	U_{234}	2.4E–02	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	3.6E–04	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.3E–02	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	2.4E+00	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	3.5E–04	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	1.1E–01	2.2E–10	2.5E–11
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	3.4E+03	3.6E–11	1.2E–07
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	5.0E–01	1.3E–11	6.5E–12
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	3.4E+01	1.6E–11	5.5E–10
U_{235+1d}	5.1E–01	1.6E–11	8.2E–12
U_{238+2d}	3.2E+01	2.0E–11	6.5E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.2E–07

Table C.III–384
Summary of Intake Quantitation (chemicals) Alternative 6
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	4.0E–02	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	3.9E–04	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	1.7E–05	mg/kg	NA	NA	mg/kg
carbazole	2.3E–03	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-384 (continued)
Summary of Risk Characterization (chemicals)
Solid Waste Landfill with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	2.6E-04	4.0E-04	6.4E-01
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	2.5E-06	3.0E-03	8.3E-04
benzo(a)pyrene	1.1E-07	NA	NA
carbazole	1.5E-05	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	HQ Summation =		6.4E-01

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	2.2E-05	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	2.1E-07	NA	NA
benzo(a)pyrene	9.5E-09	7.3E+00	6.9E-08
carbazole	1.3E-06	2.0E-02	2.5E-08
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	ILCR Summation =		9.5E-08

Table C.III–385
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	4.3E−01	pCi/kg	U_{234}	8.0E−01	pCi/kg
Pu_{238}	9.6E−02	pCi/kg	U_{235+1d}	5.9E−03	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	1.3E−01	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	6.8E−01	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	9.1E+01	2.2E−10	2.0E−08
Pu_{238}	2.0E+01	2.2E−10	4.4E−09
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	NA	3.6E−11	NA
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	1.4E+02	1.3E−11	1.9E−09
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	1.7E+02	1.6E−11	2.7E−09
U_{235+1d}	1.2E+00	1.6E−11	2.0E−11
U_{238+2d}	2.7E+01	2.0E−11	5.3E−10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	2.9E−08

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Table C.III–386
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Solid Waste Landfill with Private Ownership: Off–Property Farmer (Child)
Via External Radiation

Dose Equivalency Equat = $[DR \times EF \times EDn \times ET_i \times (1-SH_i)] + [DR \times EF \times EDn \times ET_o \times (1-SH_o)]$

EF	Fraction of year spent exposured	0.96 (unitless)
ED	Exposure duration	6 Year
ET_i	Fraction of day spent indoors	0.92 (unitless)
ET_o	Fraction of day spent outdoors	0.08 (unitless)
SH_i	Shield factor indoors	0.5 (unitless)
SH_o	Shield factor outdoors	NA (unitless)
DR	Radionuclide specific dose concentrations	(see table below)

Cs_{137+1d}	NA	pCi/g	$Th_{232+10d}$	NA	pCi/g
Np_{237+1d}	4.30E−02	pCi/g	U_{234}	8.00E−02	pCi/g
Pu_{238}	2.00E−01	pCi/g	U_{235+1d}	NA	pCi/g
Ra_{226+8d}	NA	pCi/g	U_{238+2d}	NA	pCi/g
Ra_{228+1d}	NA	pCi/g	NA	NA	pCi/g
Rn_{222+4d}	NA	pCi/g	NA	NA	pCi/g
Sr_{90+1d}	NA	pCi/g	NA	NA	pCi/g
Tc_{99}	NA	pCi/g	NA	NA	pCi/g
Th_{228+7d}	NA	pCi/g	NA	NA	pCi/g
Th_{230}	7.70E−01	pCi/g	NA	NA	pCi/g

Radionuclides	CDI (year pCi/g)	CSF $(g/pCi-year)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.0E−06	NA
Np_{237+1d}	1.3E−01	4.3E−07	5.8E−08
Pu_{238}	6.2E−01	2.8E−11	1.7E−11
Ra_{226+8d}	NA	6.0E−06	NA
Ra_{228+1d}	NA	2.9E−06	NA
Rn_{222+4d}	NA	5.9E−06	NA
Sr_{90+1d}	NA	NA	NA
Tc_{99}	NA	6.0E−13	NA
Th_{228+7d}	NA	5.6E−06	NA
Th_{230}	2.4E+00	5.4E−11	1.3E−10
$Th_{232+10d}$	NA	8.5E−06	NA
U_{234}	2.5E−01	3.0E−11	7.5E−12
U_{235+1d}	NA	2.4E−07	NA
U_{238+2d}	NA	5.1E−08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 5.8E−08

Table C.III–387
Summary of Intake Quantitation (chemicals) Alternative 2
South Field Area with Federal Ownership: Expanded Trespasser
Via Incidental Ingestion of Soil/Sediment

Intake Equation

$$= \frac{CS \times EFa \times EDa \times CF \times IRa}{BWa \times ATa} + \frac{CS \times EFc \times EDc \times CF \times IRc}{BWc \times ATc}$$

IRa	Ingestion rate of soil (adult)	12.5 mg/day
IRc	Ingestion rate of soil (child)	12.5 mg/day
CF	Conversion factor	1.00E–06 kg/mg
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure duration (adult)	32 Year
EDc	Exposure duration (child)	12 Year
BWa	Body weight (adult)	70 kg
BWc	Body weight (child)	43 kg
AT	Average time for carcinogens	25550 days
ATa	Average time for non–carcinogens (adult)	11680 days
ATc	Average time for non–carcinogens (child)	4380 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	2.9E+00	mg/kg	NA	NA	mg/kg
beryllium	2.2E–01	mg/kg	NA	NA	mg/kg
uranium–total	5.1E+01	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	1.1E–02	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-387 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Expanded Trespasser
Via Incidental Ingestion of Soil/Sediment

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	3.1E-07	3.0E-04	1.0E-03
beryllium	2.3E-08	5.0E-03	4.6E-06
uranium-total	5.5E-06	3.0E-03	1.8E-03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	1.1E-09	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.9E-03

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	7.0E-08	1.8E+00	1.2E-07
beryllium	5.2E-09	4.3E+00	2.2E-08
uranium-total	1.2E-06	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	2.5E-10	7.7E+00	2.0E-09
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		1.5E-07

Table C.III-388
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
South Field Area with Federal Ownership: Expanded Trespasser
Via Incidental Ingestion of Soil/Sediment

Intake Equation = CS X EFa X EDa X FI X IRa + CS X EFc X EDc X FI X IRc

IRa	Ingestion rate of soil (adult)	12.5 mg/day
IRc	Ingestion rate of soil (child)	12.5 mg/day
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure Duration	32 Year
EDc	Exposure Duration	12 Year
FI	Fractional Intake	1 (unitless)
CS	Concentration of radionuclides in soil	(see table below)

Cs_{137+1d}	NA	pCi/mg	$Th_{232+10d}$	NA	pCi/mg
Np_{237+1d}	2.0E-04	pCi/mg	U_{234}	4.2E-03	pCi/mg
Pu_{238}	NA	pCi/mg	U_{235+1d}	6.7E-04	pCi/mg
Ra_{226+8d}	2.1E-04	pCi/mg	U_{238+2d}	4.6E-03	pCi/mg
Ra_{228+1d}	6.5E-05	pCi/mg	NA	NA	pCi/mg
Rn_{222+4d}	NA	pCi/mg	NA	NA	pCi/mg
Sr_{90+1d}	1.1E-03	pCi/mg	NA	NA	pCi/mg
Tc_{99}	2.3E-04	pCi/mg	NA	NA	pCi/mg
Th_{228+7d}	NA	pCi/mg	NA	NA	pCi/mg
Th_{230}	9.5E-04	pCi/mg	NA	NA	pCi/mg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	6.4E+00	2.2E-10	1.4E-09
Pu_{238}	NA	2.2E-10	NA
Ra_{226+8d}	6.7E+00	7.8E-10	5.2E-09
Ra_{228+1d}	2.1E+00	1.0E-10	2.1E-10
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	3.7E+01	3.6E-11	1.3E-09
Tc_{99}	7.6E+00	1.3E-12	9.8E-12
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	3.1E+01	1.3E-11	4.0E-10
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	1.4E+02	1.6E-11	2.2E-09
U_{235+1d}	2.2E+01	1.6E-11	3.5E-10
U_{238+2d}	1.5E+02	2.0E-11	3.0E-09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	1.4E-08

Table C.III–389
Summary of Intake Quantitation (chemicals) Alternative 2
South Field Area with Federal Ownership: Expanded Trespasser
Via Dermal Contact with Soil/Sediment

Intake Equation = $\frac{CS \times EFa \times EDa \times CF \times ABS \times AF \times SAa}{BWa \times ATa}$ + $\frac{CS \times EFc \times EDc \times CF \times ABS \times AF \times SAc}{BWc \times ATc}$

SA	Surface area of exposed skin (adult)	5750 cm^2/day
SA	Surface area of exposed skin (child)	4200 cm^2/day
AF	Soil to skin adherence factor	1 mg/cm^2
ABS	chemicals specific absorbtion factor (see table below)	csv
CF	Conversion factor	1E–06 kg/mg
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure duration (adult)	32 Year
EDc	Exposure duration (child)	12 Year
BWa	Body weight (adult)	70 kg
BWc	Body weight (child)	43 kg
AT	Average time for carcinogens	25550 days
ATa	Average time for non–carcinogens (adult)	11680 days
ATc	Average time for non–carcinogens (child)	4380 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	ABS	Concentrati	Units	Compound	ABS	Concentrati	Units
antimony	1.0E–02	NA	mg/kg	NA	NA	NA	mg/kg
arsenic	1.0E–03	2.9E+00	mg/kg	NA	NA	NA	mg/kg
beryllium	1.0E–02	2.2E–01	mg/kg	NA	NA	NA	mg/kg
uranium–total	1.0E–02	5.1E+01	mg/kg	NA	NA	NA	mg/kg
benzo(a)pyrene	3.0E–01	NA	mg/kg	NA	NA	NA	mg/kg
carbazole	3.0E–01	NA	mg/kg	NA	NA	NA	mg/kg
aroclor–1254	6.0E–02	1.1E–02	mg/kg	NA	NA	NA	mg/kg
aroclor–1260	6.0E–02	NA	mg/kg	NA	NA	NA	mg/kg
dieldrin	3.0E–01	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg				

References

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Table C.III-389 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Expanded Trespasser
Via Dermal Contact with Soil/Sediment

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.0E-05	NA
arsenic	1.1E-07	2.9E-04	4.0E-04
beryllium	8.3E-08	5.0E-03	1.7E-05
uranium-total	2.0E-05	1.5E-04	1.3E-01
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	2.4E-08	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.5E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.3E-01

Compound	ILCR Calculation CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	2.7E-08	1.9E+00	5.1E-08
beryllium	2.0E-08	4.3E+00	8.5E-08
uranium-total	4.7E-06	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.2E-02	NA
aroclor-1254	5.8E-09	1.0E+01	6.0E-08
aroclor-1260	NA	1.0E+01	NA
dieldrin	NA	1.8E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		2.0E-07

Table C.III–390
Summary of Intake Quantitation (chemicals) Alternative 2
South Field Area with Federal Ownership: Expanded Trespasser
Via Inhalation of Particulates

Intake Equation = $\frac{CS \times EFa \times EDa \times IR \times ETa}{BWa \times ATa}$ + $\frac{CS \times EFc \times EDc \times IR \times ETc}{BWc \times ATc}$

IR	Inhalation rate of gases	0.83 m^3/hour
ETa	Exposure time (adult)	1 hour/day
ETc	Exposure time (child)	2 hour/day
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure duration (adult)	32 Year
EDc	Exposure duration (child)	12 Year
BWa	Body weight (adult)	70 kg
BWc	Body weight (child)	43 kg
AT	Average time for carcinogens	25550 days
ATa	Average time for non–carcinogens (adult)	11680 days
ATc	Average time for non–carcinogens (child)	4380 days
CS	Concentration of chemicals in particulate as modeled	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/m^3	NA	NA	mg/m^3
arsenic	6.1E–08	mg/m^3	NA	NA	mg/m^3
beryllium	4.6E–09	mg/m^3	NA	NA	mg/m^3
uranium–total	1.1E–06	mg/m^3	NA	NA	mg/m^3
benzo(a)pyrene	NA	mg/m^3	NA	NA	mg/m^3
carbazole	NA	mg/m^3	NA	NA	mg/m^3
aroclor–1254	2.3E–10	mg/m^3	NA	NA	mg/m^3
aroclor–1260	NA	mg/m^3	NA	NA	mg/m^3
dieldrin	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3			

References

Table C.III-390 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Expanded Trespasser
Via Inhalation of Particulates

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	NA	NA
arsenic	7.9E-10	NA	NA
beryllium	5.9E-11	NA	NA
uranium-total	1.4E-08	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	3.0E-12	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		NA

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	1.6E-10	1.5E+01	2.4E-09
beryllium	1.2E-11	8.4E+00	1.0E-10
uranium-total	2.7E-09	NA	NA
benzo(a)pyrene	NA	6.1E+00	NA
carbazole	NA	NA	NA
aroclor-1254	6.0E-13	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		2.5E-09

001078

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Table C.III–391
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
South Field Area with Federal Ownership: Expanded Trespasser
Via Inhalation of Gases and Particulates

Intake Equation = CA X EFa X EDa X IR X ETa + CA X EFc EDc X IR X ETc

IR	Inhalation rate of gases	0.83 m^3/hour
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure duration	32 Year
EDc	Exposure duration	12 Year
ETa	Exposure time (adult)	1 hour/day
ETc	Exposure time (child)	2 hour/day
CA	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	2.8E−06	pCi/m^3	U_{234}	9.1E−05	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	1.5E−05	pCi/m^3
Ra_{226+8d}	3.7E−06	pCi/m^3	U_{238+2d}	9.5E−05	pCi/m^3
Ra_{228+1d}	1.2E−06	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	1.6E+00	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	2.3E−05	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	5.1E−06	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	1.7E−05	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E−11	NA
Np_{237+1d}	9.2E−03	2.9E−08	2.7E−10
Pu_{238}	NA	3.9E−08	NA
Ra_{226+8d}	1.2E−02	7.0E−09	8.3E−11
Ra_{228+1d}	3.8E−03	6.9E−10	2.6E−12
Rn_{222+4d}	5.0E+03	7.7E−12	3.9E−08
Sr_{90+1d}	7.5E−02	6.2E−11	4.6E−12
Tc_{99}	1.6E−02	8.3E−12	1.4E−13
Th_{228+7d}	NA	7.8E−08	NA
Th_{230}	5.4E−02	2.9E−08	1.6E−09
$Th_{232+10d}$	NA	1.1E−07	NA
U_{234}	3.0E−01	2.6E−08	7.7E−09
U_{235+1d}	4.7E−02	2.5E−08	1.2E−09
U_{238+2d}	3.1E−01	2.4E−08	7.4E−09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 5.7E−08

001079

Table C.III−392
Summary of Risk Quantitation (radionuclides) Alternative 2
South Field Area with Federal Ownership: Expanded Trespasser
Via External Radiation

Exposure Equation = $[CR \times EFa \times EDa \times ET_{oa} \times (1-SH_o)] + [CR \times EFc \times EDc \times ET_{oc} \times (1-SH_o)]$

EFa	Fraction of year spent exposured (adult)	0.11 (unitless)
EFc	Fraction of year spent exposured (child)	0.3 (unitless)
EDa	Exposure duration (adult)	32 Year
EDc	Exposure duration (child)	12 Year
ET_{oa}	Fraction of day spent outdoors (adult)	0.04 (unitless)
ET_{oc}	Fraction of day spent outdoors (child)	0.08 (unitless)
SH_o	Shield factor outdoors	NA (unitless)
CR	Radionuclide specific concentrations	(see table below)

Cs_{137+1d}	NA	pCi/g	$Th_{232+10d}$	NA	pCi/g
Np_{237+1d}	2.0E−01	pCi/g	U_{234}	4.2E+00	pCi/g
Pu_{238}	NA	pCi/g	U_{235+1d}	6.7E−01	pCi/g
Ra_{226+8d}	2.1E−01	pCi/g	U_{238+2d}	4.6E+00	pCi/g
Ra_{228+1d}	6.5E−02	pCi/g	NA	NA	pCi/g
Rn_{222+4d}	NA	pCi/g	NA	NA	pCi/g
Sr_{90+1d}	1.1E+00	pCi/g	NA	NA	pCi/g
Tc_{99}	2.3E−01	pCi/g	NA	NA	pCi/g
Th_{228+7d}	NA	pCi/g	NA	NA	pCi/g
Th_{230}	9.5E−01	pCi/g	NA	NA	pCi/g

Radionuclides	CDI (year pCi/g)	CSF $(g/pCi-year)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.0E−06	NA
Np_{237+1d}	8.4E−02	4.3E−07	3.6E−08
Pu_{238}	NA	2.8E−11	NA
Ra_{226+8d}	8.8E−02	6.0E−06	5.3E−07
Ra_{228+1d}	2.8E−02	2.9E−06	8.1E−08
Rn_{222+4d}	NA	5.9E−06	NA
Sr_{90+1d}	4.9E−01	NA	NA
Tc_{99}	1.0E−01	6.0E−13	6.0E−14
Th_{228+7d}	NA	5.6E−06	NA
Th_{230}	4.1E−01	5.4E−11	2.2E−11
$Th_{232+10d}$	NA	8.5E−06	NA
U_{234}	1.8E+00	3.0E−11	5.4E−11
U_{235+1d}	2.9E−01	2.4E−07	6.9E−08
U_{238+2d}	2.0E+00	5.1E−08	1.0E−07
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 8.2E−07

001080

Table C.III–393
Summary of Intake Quantitation (chemicals) Alternative 2
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium–total	1.48E–03	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
aroclor–1254	NA	mg/l	NA	NA	mg/l
aroclor–1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

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Table C.III-393 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off-Property Farmer (Adult)
Via Drinking Water Ingestion

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	4.05E-05	3.00E-03	1.35E-02
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.35E-02

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	4.05E-05	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

5860

Table C.III–394
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	4.5E−01	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	2.4E−02	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	5.0E−01	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	NA	2.2E−10	NA
Pu_{238}	NA	2.2E−10	NA
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	NA	3.6E−11	NA
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	NA	1.3E−11	NA
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	2.2E+04	1.6E−11	3.5E−07
U_{235+1d}	1.2E+03	1.6E−11	1.9E−08
U_{238+2d}	2.4E+04	2.0E−11	4.9E−07
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		8.6E−07

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Table C.III–395
Summary of Intake Quantitation (chemicals) Alternative 2
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2–day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
SA	Skin surface area available for contact	23000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
arsenic	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
beryllium	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
uranium–total	3.70E–10	mg/cm^2–day	NA	NA	mg/cm^2–day
benzo(a)pyrene	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
carbazole	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1254	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1260	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
dieldrin	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day

References

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Table C.III−395 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off−Property Farmer (Adult)
Via Dermal Contact while Bathing

Compound	HQ Calculation CDI (mg/kg−day)	RfD (mg/kg−day)	HQ (unitless)
antimony	NA	6.00E−05	NA
arsenic	NA	2.85E−04	NA
beryllium	NA	5.00E−03	NA
uranium−total	1.17E−07	1.50E−04	7.77E−04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor−1254	NA	NA	NA
aroclor−1260	NA	NA	NA
dieldrin	NA	4.50E−05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		7.77E−04

Compound	ILCR Calculation CDI (mg/kg−day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium−total	1.17E−07	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E−02	NA
aroclor−1254	NA	1.03E+01	NA
aroclor−1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

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Table C.III–396
Summary of Intake Quantitation (chemicals) Alternative 2
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Inhalation of Particulates

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/m^3	NA	NA	mg/m^3
arsenic	2.8E–09	mg/m^3	NA	NA	mg/m^3
beryllium	2.1E–10	mg/m^3	NA	NA	mg/m^3
uranium–total	5.2E–08	mg/m^3	NA	NA	mg/m^3
benzo(a)pyrene	NA	mg/m^3	NA	NA	mg/m^3
carbazole	NA	mg/m^3	NA	NA	mg/m^3
aroclor–1254	1.1E–11	mg/m^3	NA	NA	mg/m^3
aroclor–1260	NA	mg/m^3	NA	NA	mg/m^3
dieldrin	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3			

References

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Table C.III−396 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off−Property Farmer (Adult)
Via Inhalation of Particulates

	HQ Calculation		
Compound	CDI (mg/kg−day)	RfD (mg/kg−day)	HQ (unitless)
antimony	NA	NA	NA
arsenic	7.8E−10	NA	NA
beryllium	5.8E−11	NA	NA
uranium−total	1.4E−08	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor−1254	2.9E−12	NA	NA
aroclor−1260	NA	NA	NA
dieldrin	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	Hazard Quotient Sum =		NA

	ILCR Calculation		
Compound	CDI (mg/kg−day)	CSF (mg/kg−day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	7.8E−10	1.5E+01	1.2E−08
beryllium	5.8E−11	8.4E+00	4.9E−10
uranium−total	1.4E−08	NA	NA
benzo(a)pyrene	NA	6.1E+00	NA
carbazole	NA	NA	NA
aroclor−1254	2.9E−12	NA	NA
aroclor−1260	NA	NA	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		1.2E−08

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Table C.III–397
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	1.8E−07	pCi/m^3	U_{234}	4.2E−06	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	6.7E−07	pCi/m^3
Ra_{226+8d}	1.9E−07	pCi/m^3	U_{238+2d}	4.6E−06	pCi/m^3
Ra_{228+1d}	6.1E−08	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	8.0E−02	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	1.1E−06	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	2.3E−07	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	8.6E−07	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E−11	NA
Np_{237+1d}	8.6E−02	2.9E−08	2.5E−09
Pu_{238}	NA	3.9E−08	NA
Ra_{226+8d}	9.3E−02	7.0E−09	6.5E−10
Ra_{228+1d}	3.0E−02	6.9E−10	2.1E−11
Rn_{222+4d}	3.9E+04	7.7E−12	3.0E−07
Sr_{90+1d}	5.5E−01	6.2E−11	3.4E−11
Tc_{99}	1.1E−01	8.3E−12	9.5E−13
Th_{228+7d}	NA	7.8E−08	NA
Th_{230}	4.2E−01	2.9E−08	1.2E−08
$Th_{232+10d}$	NA	1.1E−07	NA
U_{234}	2.1E+00	2.6E−08	5.4E−08
U_{235+1d}	3.3E−01	2.5E−08	8.2E−09
U_{238+2d}	2.2E+00	2.4E−08	5.4E−08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 4.3E−07

Table C.III–398
Summary of Intake Quantitation (chemicals) Alternative 2
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	2.0E–06	mg/kg	NA	NA	mg/kg
beryllium	3.3E–08	mg/kg	NA	NA	mg/kg
uranium–total	1.6E–05	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	5.9E–08	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-398 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Meat Products

Compound	HQ Calculation CDI (mg/kg-day)	 RfD (mg/kg-day)	 HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	2.1E-09	3.0E-04	7.0E-06
beryllium	3.5E-11	5.0E-03	6.9E-09
uranium-total	1.6E-08	3.0E-03	5.4E-06
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	6.1E-11	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.2E-05

Compound	ILCR Calculation CDI (mg/kg-day)	 CSF $(mg/kg-day)^{-1}$	 ILCR (unitless)
antimony	NA	NA	NA
arsenic	2.1E-09	1.8E+00	3.7E-09
beryllium	3.5E-11	4.3E+00	1.5E-10
uranium-total	1.6E-08	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	6.1E-11	7.7E+00	4.7E-10
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		4.3E-09

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Table C.III–399
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NANA	pCi/kg	$Th_{232+10d}$	NANA	pCi/kg
Np_{237+1d}	7.4E–07	pCi/kg	U_{234}	4.6E–03	pCi/kg
Pu_{238}	NANA	pCi/kg	U_{235+1d}	2.5E–04	pCi/kg
Ra_{226+8d}	6.2E–06	pCi/kg	U_{238+2d}	5.0E–03	pCi/kg
Ra_{228+1d}	1.2E–06	pCi/kg	NANA	NANA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NANA	NANA	pCi/kg
Sr_{90+1d}	9.9E–05	pCi/kg	NANA	NANA	pCi/kg
Tc_{99}	2.8E–04	pCi/kg	NANA	NANA	pCi/kg
Th_{228+7d}	NANA	pCi/kg	NANA	NANA	pCi/kg
Th_{230}	4.7E–07	pCi/kg	NANA	NANA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	1.4E–03	2.2E–10	3.0E–13
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	1.1E–02	7.8E–10	9.0E–12
Ra_{228+1d}	2.2E–03	1.0E–10	2.2E–13
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	1.8E–01	3.6E–11	6.6E–12
Tc_{99}	5.2E–01	1.3E–12	6.8E–13
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	8.7E–04	1.3E–11	1.1E–14
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	8.5E+00	1.6E–11	1.4E–10
U_{235+1d}	4.6E–01	1.6E–11	7.4E–12
U_{238+2d}	9.3E+00	2.0E–11	1.9E–10
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA

ILCR Summation = 3.5E–10

Table C.III–400
Summary of Intake Quantitation (chemicals) Alternative 2
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NANA	mg/kg	NA	NANA	mg/kg
arsenic	6.0E–08	mg/kg	NA	NANA	mg/kg
beryllium	3.0E–11	mg/kg	NA	NANA	mg/kg
uranium–total	5.6E–05	mg/kg	NA	NANA	mg/kg
benzo(a)pyrene	NANA	mg/kg	NA	NANA	mg/kg
carbazole	NANA	mg/kg	NA	NANA	mg/kg
aroclor–1254	1.9E–08	mg/kg	NA	NANA	mg/kg
aroclor–1260	NANA	mg/kg	NA	NANA	mg/kg
dieldrin	NANA	mg/kg	NA	NANA	mg/kg
NANA	NANA	mg/kg	NA	NANA	mg/kg
NANA	NANA	mg/kg	NA	NANA	mg/kg
NANA	NANA	mg/kg	NA	NANA	mg/kg
NANA	NANA	mg/kg	NA	NANA	mg/kg
NANA	NANA	mg/kg	NA	NANA	mg/kg
NANA	NANA	mg/kg	NA	NANA	mg/kg
NANA	NANA	mg/kg			

References

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Table C.III-400 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Dairy Products

Compound	HQ Calculation		
	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	2.5E-10	3.0E-04	8.3E-07
beryllium	1.2E-13	5.0E-03	2.5E-11
uranium-total	2.3E-07	3.0E-03	7.6E-05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	7.6E-11	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
	HQ Summation =		7.7E-05

Compound	ILCR Calculation		
	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	2.5E-10	1.8E+00	4.3E-10
beryllium	1.2E-13	4.3E+00	5.3E-13
uranium-total	2.3E-07	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	7.6E-11	7.7E+00	5.9E-10
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
	ILCR Summation =		1.0E-09

001093

Table C.III-401
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
South Field Area with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NANA	pCi/kg	$Th_{232+10d}$	NANA	pCi/kg
Np_{237+1d}	6.7E-08	pCi/kg	U_{234}	1.6E-02	pCi/kg
Pu_{238}	NANA	pCi/kg	U_{235+1d}	8.9E-04	pCi/kg
Ra_{226+8d}	1.1E-05	pCi/kg	U_{238+2d}	1.8E-02	pCi/kg
Ra_{228+1d}	2.1E-06	pCi/kg	NANA	NANA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NANA	NANA	pCi/kg
Sr_{90+1d}	5.0E-04	pCi/kg	NANA	NANA	pCi/kg
Tc_{99}	3.3E-04	pCi/kg	NANA	NANA	pCi/kg
Th_{228+7d}	NANA	pCi/kg	NANA	NANA	pCi/kg
Th_{230}	3.9E-07	pCi/kg	NANA	NANA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	5.0E-04	2.2E-10	1.1E-13
Pu_{238}	NA	2.2E-10	NA
Ra_{226+8d}	8.2E-02	7.8E-10	6.4E-11
Ra_{228+1d}	1.6E-02	1.0E-10	1.6E-12
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	3.6E+00	3.6E-11	1.3E-10
Tc_{99}	2.4E+00	1.3E-12	3.2E-12
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	2.9E-03	1.3E-11	3.7E-14
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	1.2E+02	1.6E-11	1.9E-09
U_{235+1d}	6.6E+00	1.6E-11	1.1E-10
U_{238+2d}	1.3E+02	2.0E-11	2.6E-09
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
	ILCR Summation	=	4.9E-09

001094

Table C.III–402
Summary of Intake Quantitation (chemicals) Alternative 2
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NANA	mg/kg	NA	NANA	mg/kg
arsenic	9.6E–06	mg/kg	NA	NANA	mg/kg
beryllium	3.6E–07	mg/kg	NA	NANA	mg/kg
uranium–total	7.3E–03	mg/kg	NA	NANA	mg/kg
benzo(a)pyrene	NANA	mg/kg	NA	NANA	mg/kg
carbazole	NANA	mg/kg	NA	NANA	mg/kg
aroclor–1254	2.2E–08	mg/kg	NA	NANA	mg/kg
aroclor–1260	NANA	mg/kg	NA	NANA	mg/kg
dieldrin	NANA	mg/kg	NA	NANA	mg/kg
NANA	NANA	mg/kg	NA	NANA	mg/kg
NANA	NANA	mg/kg	NA	NANA	mg/kg
NANA	NANA	mg/kg	NA	NANA	mg/kg
NANA	NANA	mg/kg	NA	NANA	mg/kg
NANA	NANA	mg/kg	NA	NANA	mg/kg
NANA	NANA	mg/kg	NA	NANA	mg/kg
NANA	NANA	mg/kg			

References

Table C.III–402 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Compound	HQ Calculation CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	4.0E–04	NA
arsenic	1.6E–08	3.0E–04	5.3E–05
beryllium	6.0E–10	5.0E–03	1.2E–07
uranium–total	1.2E–05	3.0E–03	4.1E–03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	3.7E–11	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	5.0E–05	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
HQ Summation =			4.1E–03

Compound	ILCR Calculation CDI (mg/kg–day)	CSF (mg/kg–day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	1.6E–08	1.8E+00	2.8E–08
beryllium	6.0E–10	4.3E+00	2.6E–09
uranium–total	1.2E–05	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E–02	NA
aroclor–1254	3.7E–11	7.7E+00	2.9E–10
aroclor–1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
NANANA		NA	NA
ILCR Summation =			3.1E–08

Table C.III–403
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NANA	pCi/kg	$Th_{232+10d}$	NANA	pCi/kg
Np_{237+1d}	1.7E–04	pCi/kg	U_{234}	2.2E+00	pCi/kg
Pu_{238}	NANA	pCi/kg	U_{235+1d}	1.2E–01	pCi/kg
Ra_{226+8d}	2.8E–04	pCi/kg	U_{238+2d}	2.4E+00	pCi/kg
Ra_{228+1d}	6.1E–05	pCi/kg	NANA	NANA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NANA	NANA	pCi/kg
Sr_{90+1d}	3.2E–03	pCi/kg	NANA	NANA	pCi/kg
Tc_{99}	3.6E–04	pCi/kg	NANA	NANA	pCi/kg
Th_{228+7d}	NANA	pCi/kg	NANA	NANA	pCi/kg
Th_{230}	9.6E–04	pCi/kg	NANA	NANA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	5.2E–01	2.2E–10	1.1E–10
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	8.2E–01	7.8E–10	6.4E–10
Ra_{228+1d}	1.8E–01	1.0E–10	1.8E–11
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	9.6E+00	3.6E–11	3.4E–10
Tc_{99}	1.1E+00	1.3E–12	1.4E–12
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	2.9E+00	1.3E–11	3.7E–11
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	6.6E+03	1.6E–11	1.1E–07
U_{235+1d}	3.5E+02	1.6E–11	5.6E–09
U_{238+2d}	7.3E+03	2.0E–11	1.5E–07
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
NANA	NA	NA	NA
		ILCR Summation =	2.6E–07

Table C.III-404
Summary of Intake Quantitation (chemicals) Alternative 2
South Field Area with Federal Ownership: Off-Property Farmer (Child)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium-total	1.48E-03	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
aroclor-1254	NA	mg/l	NA	NA	mg/l
aroclor-1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

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Table C.III-404 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off-Property Farmer (Child)
Via Drinking Water Ingestion

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	9.46E-05	3.00E-03	3.15E-02
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		3.15E-02

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	8.11E-06	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001099

Table C.III–405
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
South Field Area with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	4.5E–01	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	2.4E–02	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	5.0E–01	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	9.5E+02	1.6E–11	1.5E–08
U_{235+1d}	5.0E+01	1.6E–11	8.1E–10
U_{238+2d}	1.0E+03	2.0E–11	2.1E–08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
		ILCR Summation =	3.7E–08

Table C.III–406
Summary of Intake Quantitation (chemicals) Alternative 2
South Field Area with Federal Ownership: Off–Property Farmer (Child)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2–day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
SA	Skin surface area available for contact	8000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
arsenic	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
beryllium	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
uranium–total	3.70E–10	mg/cm^2–day	NA	NA	mg/cm^2–day
benzo(a)pyrene	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
carbazole	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1254	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1260	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
dieldrin	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day			

References

Table C.III-406 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off-Property Farmer (Child)
Via Dermal Contact while Bathing

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	1.89E-07	1.50E-04	1.26E-03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.26E-03

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	1.62E-08	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001102

Table C.III–407
Summary of Intake Quantitation (chemicals) Alternative 2
South Field Area with Federal Ownership: Off–Property Farmer (Child)
Via Inhalation of Particulates

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Inhalation rate of gases (RAGS, 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/m^3	NA	NA	mg/m^3
arsenic	2.8E–09	mg/m^3	NA	NA	mg/m^3
beryllium	2.1E–10	mg/m^3	NA	NA	mg/m^3
uranium–total	5.2E–08	mg/m^3	NA	NA	mg/m^3
benzo(a)pyrene	NA	mg/m^3	NA	NA	mg/m^3
carbazole	NA	mg/m^3	NA	NA	mg/m^3
aroclor–1254	1.1E–11	mg/m^3	NA	NA	mg/m^3
aroclor–1260	NA	mg/m^3	NA	NA	mg/m^3
dieldrin	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3			

References

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Table C.III-407 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off-Property Farmer (Child)
Via Inhalation of Particulates

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	NA	NA
arsenic	2.2E-09	NA	NA
beryllium	1.6E-10	NA	NA
uranium-total	4.0E-08	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	8.1E-12	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	Hazard Quotient Sum =		NA

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	1.9E-10	1.5E+01	2.8E-09
beryllium	1.4E-11	8.4E+00	1.2E-10
uranium-total	3.4E-09	NA	NA
benzo(a)pyrene	NA	6.1E+00	NA
carbazole	NA	NA	NA
aroclor-1254	7.0E-13	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		2.9E-09

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Table C.III–408
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
South Field Area with Federal Ownership: Off–Property Farmer (Child)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	1.8E–07	pCi/m^3	U_{234}	4.2E–06	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	6.7E–07	pCi/m^3
Ra_{226+8d}	1.9E–07	pCi/m^3	U_{238+2d}	4.6E–06	pCi/m^3
Ra_{228+1d}	6.1E–08	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	8.0E–02	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	1.1E–06	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	2.3E–07	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	8.6E–07	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	4.4E–03	2.9E–08	1.3E–10
Pu_{238}	NA	3.9E–08	NA
Ra_{226+8d}	4.8E–03	7.0E–09	3.4E–11
Ra_{228+1d}	1.5E–03	6.9E–10	1.1E–12
Rn_{222+4d}	2.0E+03	7.7E–12	1.6E–08
Sr_{90+1d}	2.8E–02	6.2E–11	1.7E–12
Tc_{99}	5.9E–03	8.3E–12	4.9E–14
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	2.2E–02	2.9E–08	6.3E–10
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	1.1E–01	2.6E–08	2.8E–09
U_{235+1d}	1.7E–02	2.5E–08	4.2E–10
U_{238+2d}	1.1E–01	2.4E–08	2.8E–09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.2E–08

Table C.III–409
Summary of Intake Quantitation (chemicals) Alternative 2
South Field Area with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	2.0E–06	mg/kg	NA	NA	mg/kg
beryllium	3.3E–08	mg/kg	NA	NA	mg/kg
uranium–total	1.6E–05	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	5.9E–08	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III-409 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Meat Products

Compound	HQ Calculation CDI (mg/kg-day)	HQ Calculation RfD (mg/kg-day)	HQ Calculation HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	3.8E-09	3.0E-04	1.3E-05
beryllium	6.2E-11	5.0E-03	1.2E-08
uranium-total	2.9E-08	3.0E-03	9.7E-06
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	1.1E-10	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.2E-05

Compound	ILCR Calculation CDI (mg/kg-day)	ILCR Calculation CSF $(mg/kg-day)^{-1}$	ILCR Calculation ILCR (unitless)
antimony	NA	NA	NA
arsenic	3.2E-10	1.8E+00	5.6E-10
beryllium	5.3E-12	4.3E+00	2.3E-11
uranium-total	2.5E-09	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	9.4E-12	7.7E+00	7.2E-11
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		6.6E-10

Table C.III–410
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
South Field Area with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	7.4E–07	pCi/kg	U_{234}	4.6E–03	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	2.5E–04	pCi/kg
Ra_{226+8d}	6.2E–06	pCi/kg	U_{238+2d}	5.0E–03	pCi/kg
Ra_{228+1d}	1.2E–06	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	9.9E–05	pCi/kg	NA	NA	pCi/kg
Tc_{99}	2.8E–04	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	4.7E–07	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	4.6E–05	2.2E–10	1.0E–14
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	3.8E–04	7.8E–10	3.0E–13
Ra_{228+1d}	7.2E–05	1.0E–10	7.2E–15
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	6.1E–03	3.6E–11	2.2E–13
Tc_{99}	1.7E–02	1.3E–12	2.2E–14
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	2.9E–05	1.3E–11	3.7E–16
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	2.8E–01	1.6E–11	4.5E–12
U_{235+1d}	1.5E–02	1.6E–11	2.5E–13
U_{238+2d}	3.1E–01	2.0E–11	6.2E–12
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.1E–11

Table C.III–411
Summary of Intake Quantitation (chemicals) Alternative 2
South Field Area with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	6.0E–08	mg/kg	NA	NA	mg/kg
beryllium	3.0E–11	mg/kg	NA	NA	mg/kg
uranium–total	5.6E–05	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	1.9E–08	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg

References

Table C.III-411 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Dairy Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	2.6E-09	3.0E-04	8.7E-06
beryllium	1.3E-12	5.0E-03	2.6E-10
uranium-total	2.4E-06	3.0E-03	8.0E-04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	8.0E-10	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		8.1E-04

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	2.2E-10	1.8E+00	3.9E-10
beryllium	1.1E-13	4.3E+00	4.8E-13
uranium-total	2.1E-07	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	6.9E-11	7.7E+00	5.3E-10
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		9.2E-10

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Table C.III–412
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
South Field Area with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	6.7E–08	pCi/kg	U_{234}	1.6E–02	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	8.9E–04	pCi/kg
Ra_{226+8d}	1.1E–05	pCi/kg	U_{238+2d}	1.8E–02	pCi/kg
Ra_{228+1d}	2.1E–06	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	5.0E–04	pCi/kg	NA	NA	pCi/kg
Tc_{99}	3.3E–04	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	3.9E–07	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	9.6E–05	2.2E–10	2.1E–14
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	1.6E–02	7.8E–10	1.2E–11
Ra_{228+1d}	3.0E–03	1.0E–10	3.0E–13
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	7.0E–01	3.6E–11	2.5E–11
Tc_{99}	4.7E–01	1.3E–12	6.1E–13
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	5.5E–04	1.3E–11	7.2E–15
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	2.3E+01	1.6E–11	3.7E–10
U_{235+1d}	1.3E+00	1.6E–11	2.0E–11
U_{238+2d}	2.6E+01	2.0E–11	5.1E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 9.4E–10

Table C.III-413
Summary of Intake Quantitation (chemicals) Alternative 2
South Field Area with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	9.6E-06	mg/kg	NA	NA	mg/kg
beryllium	3.6E-07	mg/kg	NA	NA	mg/kg
uranium-total	7.3E-03	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor-1254	2.2E-08	mg/kg	NA	NA	mg/kg
aroclor-1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III-413 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	6.1E-08	3.0E-04	2.0E-04
beryllium	2.3E-09	5.0E-03	4.6E-07
uranium-total	4.7E-05	3.0E-03	1.6E-02
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	1.4E-10	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.6E-02

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	5.2E-09	1.8E+00	9.2E-09
beryllium	2.0E-10	4.3E+00	8.4E-10
uranium-total	4.0E-06	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	1.2E-11	7.7E+00	9.4E-11
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		1.0E-08

Table C.III–414
Summary of Intake and Risk Quantitation (radionuclides) Alternative 2
South Field Area with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	1.7E–04	pCi/kg	U_{234}	2.2E+00	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.2E–01	pCi/kg
Ra_{226+8d}	2.8E–04	pCi/kg	U_{238+2d}	2.4E+00	pCi/kg
Ra_{228+1d}	6.1E–05	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	3.2E–03	pCi/kg	NA	NA	pCi/kg
Tc_{99}	3.6E–04	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	9.6E–04	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	3.7E–02	2.2E–10	8.0E–12
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	5.8E–02	7.8E–10	4.5E–11
Ra_{228+1d}	1.3E–02	1.0E–10	1.3E–12
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	6.7E–01	3.6E–11	2.4E–11
Tc_{99}	7.6E–02	1.3E–12	9.9E–14
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	2.0E–01	1.3E–11	2.6E–12
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	4.6E+02	1.6E–11	7.4E–09
U_{235+1d}	2.5E+01	1.6E–11	4.0E–10
U_{238+2d}	5.1E+02	2.0E–11	1.0E–08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
		ILCR Summation =	1.8E–08

001114

Table C.III–415
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Federal Ownership: Expanded Trespasser
Via Incidental Ingestion of Soil/Sediment

Intake Equation

$$= \frac{CS \times EFa \times EDa \times CF \times IRa}{BWa \times ATa} + \frac{CS \times EFc \times EDc \times CF \times IRc}{BWc \times ATc}$$

IRa	Ingestion rate of soil (adult)	12.5 mg/day
IRc	Ingestion rate of soil (child)	12.5 mg/day
CF	Conversion factor	1.00E–06 kg/mg
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure duration (adult)	32 Year
EDc	Exposure duration (child)	12 Year
BWa	Body weight (adult)	70 kg
BWc	Body weight (child)	43 kg
AT	Average time for carcinogens	25550 days
ATa	Average time for non–carcinogens (adult)	11680 days
ATc	Average time for non–carcinogens (child)	4380 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	2.6E+00	mg/kg	NA	NA	mg/kg
beryllium	2.4E–01	mg/kg	NA	NA	mg/kg
uranium–total	4.3E+00	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	4.4E–01	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	1.1E–01	mg/kg	NA	NA	mg/kg
aroclor–1260	9.3E–03	mg/kg	NA	NA	mg/kg
dieldrin	2.4E–03	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

00113

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Table C.III–415 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Expanded Trespasser
Via Incidental Ingestion of Soil/Sediment

	HQ Calculation		
Compound	CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	4.0E–04	NA
arsenic	2.8E–07	3.0E–04	9.2E–04
beryllium	2.6E–08	5.0E–03	5.2E–06
uranium–total	4.6E–07	3.0E–03	1.5E–04
benzo(a)pyrene	4.7E–08	NA	NA
carbazole	NA	NA	NA
aroclor–1254	1.2E–08	NA	NA
aroclor–1260	1.0E–09	NA	NA
dieldrin	2.6E–10	5.0E–05	5.1E–06
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	HQ Summation =		1.1E–03

	ILCR Calculation		
Compound	CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	6.2E–08	1.8E+00	1.1E–07
beryllium	5.9E–09	4.3E+00	2.5E–08
uranium–total	1.0E–07	NA	NA
benzo(a)pyrene	1.1E–08	7.3E+00	7.7E–08
carbazole	NA	2.0E–02	NA
aroclor–1254	2.7E–09	7.7E+00	2.1E–08
aroclor–1260	2.2E–10	7.7E+00	1.7E–09
dieldrin	5.8E–11	1.6E+01	9.2E–10
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	ILCR Summation =		2.3E–07

Table C.III–416
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
South Field Area with Federal Ownership: Expanded Trespasser
Via Incidental Ingestion of Soil/Sediment

Intake Equation = CS X EFa X EDa X FI X IRa + CS X EFc X EDc X FI X IRc

IRa	Ingestion rate of soil (adult)	12.5 mg/day
IRc	Ingestion rate of soil (child)	12.5 mg/day
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure Duration	32 Year
EDc	Exposure Duration	12 Year
FI	Fractional Intake	1 (unitless)
CS	Concentration of radionuclides in soil	(see table below)

Cs_{137+1d}	NA	pCi/mg	$Th_{232+10d}$	3.4E–05	pCi/mg
Np_{237+1d}	1.9E–04	pCi/mg	U_{234}	1.4E–03	pCi/mg
Pu_{238}	NA	pCi/mg	U_{235+1d}	1.3E–03	pCi/mg
Ra_{226+8d}	1.7E–04	pCi/mg	U_{238+2d}	9.5E–04	pCi/mg
Ra_{228+1d}	2.2E–04	pCi/mg	NA	NA	pCi/mg
Rn_{222+4d}	NA	pCi/mg	NA	NA	pCi/mg
Sr_{90+1d}	1.3E–03	pCi/mg	NA	NA	pCi/mg
Tc_{99}	4.0E–04	pCi/mg	NA	NA	pCi/mg
Th_{228+7d}	9.1E–05	pCi/mg	NA	NA	pCi/mg
Th_{230}	3.6E–03	pCi/mg	NA	NA	pCi/mg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	6.1E+00	2.2E–10	1.3E–09
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	5.5E+00	7.8E–10	4.3E–09
Ra_{228+1d}	7.3E+00	1.0E–10	7.3E–10
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	4.1E+01	3.6E–11	1.5E–09
Tc_{99}	1.3E+01	1.3E–12	1.7E–11
Th_{228+7d}	2.9E+00	5.5E–11	1.6E–10
Th_{230}	1.2E+02	1.3E–11	1.5E–09
$Th_{232+10d}$	1.1E+00	1.7E–10	1.9E–10
U_{234}	4.7E+01	1.6E–11	7.5E–10
U_{235+1d}	4.2E+01	1.6E–11	6.7E–10
U_{238+2d}	3.1E+01	2.0E–11	6.2E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.2E–08

001117

Table C.III–417
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Federal Ownership: Expanded Trespasser
Via Dermal Contact with Soil/Sediment

Intake Equation = $\frac{CS \times EFa \times EDa \times CF \times ABS \times AF \times SAa}{BWa \times ATa}$ + $\frac{CS \times EFc \times EDc \times CF \times ABS \times AF \times SAc}{BWc \times ATc}$

SA	Surface area of exposed skin (adult)	5750 cm^2/day
SA	Surface area of exposed skin (child)	4200 cm^2/day
AF	Soil to skin adherence factor	1 mg/cm^2
ABS	chemicals specific absorbtion factor (see table below)	csv
CF	Conversion factor	1E–06 kg/mg
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure duration (adult)	32 Year
EDc	Exposure duration (child)	12 Year
BWa	Body weight (adult)	70 kg
BWc	Body weight (child)	43 kg
AT	Average time for carcinogens	25550 days
ATa	Average time for non–carcinogens (adult)	11680 days
ATc	Average time for non–carcinogens (child)	4380 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	ABS	Concentrati	Units	Compound	ABS	Concentrati	Units
antimony	1.0E–02	NA	mg/kg	NA	NA	NA	mg/kg
arsenic	1.0E–03	2.6E+00	mg/kg	NA	NA	NA	mg/kg
beryllium	1.0E–02	2.4E–01	mg/kg	NA	NA	NA	mg/kg
uranium–total	1.0E–02	4.3E+00	mg/kg	NA	NA	NA	mg/kg
benzo(a)pyrene	3.0E–01	4.4E–01	mg/kg	NA	NA	NA	mg/kg
carbazole	3.0E–01	NA	mg/kg	NA	NA	NA	mg/kg
aroclor–1254	6.0E–02	1.1E–01	mg/kg	NA	NA	NA	mg/kg
aroclor–1260	6.0E–02	9.3E–03	mg/kg	NA	NA	NA	mg/kg
dieldrin	3.0E–01	2.4E–03	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg				

References

001118

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Table C.III-417 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Expanded Trespasser
Via Dermal Contact with Soil/Sediment

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.0E-05	NA
arsenic	9.9E-08	2.9E-04	3.5E-04
beryllium	9.4E-08	5.0E-03	1.9E-05
uranium-total	1.6E-06	1.5E-04	1.1E-02
benzo(a)pyrene	5.1E-06	NA	NA
carbazole	NA	NA	NA
aroclor-1254	2.6E-07	NA	NA
aroclor-1260	2.1E-08	NA	NA
dieldrin	2.8E-08	4.5E-05	6.2E-04
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.2E-02

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	2.4E-08	1.9E+00	4.5E-08
beryllium	2.2E-08	4.3E+00	9.6E-08
uranium-total	3.9E-07	NA	NA
benzo(a)pyrene	1.2E-06	NA	NA
carbazole	NA	2.2E-02	NA
aroclor-1254	6.2E-08	1.0E+01	6.4E-07
aroclor-1260	5.1E-09	1.0E+01	5.2E-08
dieldrin	6.6E-09	1.8E+01	1.2E-07
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		9.5E-07

001119

Table C.III–418
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Federal Ownership: Expanded Trespasser
Via Inhalation of Gases and Particulates

Intake Equation = $\frac{CS \times EFa \times EDa \times IR \times ETa}{BWa \times ATa}$ + $\frac{CS \times EFc \times EDc \times IR \times ETc}{BWc \times ATc}$

IR	Inhalation rate of gases	0.83 m^3/hour
ETa	Exposure time (adult)	1 hour/day
ETc	Exposure time (child)	2 hour/day
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure duration (adult)	32 Year
EDc	Exposure duration (child)	12 Year
BWa	Body weight (adult)	70 kg
BWc	Body weight (child)	43 kg
AT	Average time for carcinogens	25550 days
ATa	Average time for non–carcinogens (adult)	11680 days
ATc	Average time for non–carcinogens (child)	4380 days
CS	Concentration of chemicals in particulate as modeled	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/m^3	NA	NA	mg/m^3
arsenic	8.2E–08	mg/m^3	NA	NA	mg/m^3
beryllium	6.3E–09	mg/m^3	NA	NA	mg/m^3
uranium–total	7.0E–08	mg/m^3	NA	NA	mg/m^3
benzo(a)pyrene	1.3E–08	mg/m^3	NA	NA	mg/m^3
carbazole	NA	mg/m^3	NA	NA	mg/m^3
aroclor–1254	3.3E–09	mg/m^3	NA	NA	mg/m^3
aroclor–1260	2.8E–10	mg/m^3	NA	NA	mg/m^3
dieldrin	7.2E–11	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3			

References

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Table C.III-418 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Expanded Trespasser
Via Inhalation of Gases and Particulates

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	NA	NA
arsenic	1.1E-09	NA	NA
beryllium	8.2E-11	NA	NA
uranium-total	9.1E-10	NA	NA
benzo(a)pyrene	1.7E-10	NA	NA
carbazole	NA	NA	NA
aroclor-1254	4.2E-11	NA	NA
aroclor-1260	3.6E-12	NA	NA
dieldrin	9.3E-13	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		NA

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	2.1E-10	1.5E+01	3.2E-09
beryllium	1.6E-11	8.4E+00	1.4E-10
uranium-total	1.8E-10	NA	NA
benzo(a)pyrene	3.4E-11	6.1E+00	2.1E-10
carbazole	NA	NA	NA
aroclor-1254	8.4E-12	NA	NA
aroclor-1260	7.3E-13	NA	NA
dieldrin	1.9E-13	1.6E+01	3.0E-12
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		3.5E-09

001121

Table C.III-419
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
South Field Area with Federal Ownership: Expanded Trespasser
Via Inhalation of Gases and Particulates

Intake Equation = CA X EFa X EDa X IR X ETa + CA X EFc EDc X IR X ETc

IR	Inhalation rate of gases	0.83 m^3/hour
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure duration	32 Year
EDc	Exposure duration	12 Year
ETa	Exposure time (adult)	1 hour/day
ETc	Exposure time (child)	2 hour/day
CA	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	1.0E−06	pCi/m^3
Np_{237+1d}	3.6E−06	pCi/m^3	U_{234}	3.1E−05	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	2.9E−05	pCi/m^3
Ra_{226+8d}	3.7E−06	pCi/m^3	U_{238+2d}	2.0E−05	pCi/m^3
Ra_{228+1d}	5.9E−06	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	1.7E+00	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	3.0E−05	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	8.7E−06	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	2.7E−06	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	9.3E−05	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E−11	NA
Np_{237+1d}	1.2E−02	2.9E−08	3.4E−10
Pu_{238}	NA	3.9E−08	NA
Ra_{226+8d}	1.2E−02	7.0E−09	8.4E−11
Ra_{228+1d}	1.9E−02	6.9E−10	1.3E−11
Rn_{222+4d}	5.5E+03	7.7E−12	4.2E−08
Sr_{90+1d}	9.7E−02	6.2E−11	6.0E−12
Tc_{99}	2.8E−02	8.3E−12	2.3E−13
Th_{228+7d}	8.9E−03	7.8E−08	6.9E−10
Th_{230}	3.0E−01	2.9E−08	8.8E−09
$Th_{232+10d}$	3.4E−03	1.1E−07	3.7E−10
U_{234}	1.0E−01	2.6E−08	2.6E−09
U_{235+1d}	9.5E−02	2.5E−08	2.4E−09
U_{238+2d}	6.4E−02	2.4E−08	1.5E−09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 5.9E−08

001122

5860

Table C.III–420
Summary of Risk Quantitation (radionuclides) Alternative 3
South Field Area with Federal Ownership: Expanded Trespasser
Via External Radiation

Exposure Equation = $[CR \times EFa \times EDa \times ET_{oa} \times (1-SH_o)] + [CR \times EFc \times EDc \times ET_{oc} \times (1-SH_o)]$

EFa	Fraction of year spent exposured (adult)	0.11 (unitless)
EFc	Fraction of year spent exposured (child)	0.3 (unitless)
EDa	Exposure duration (adult)	32 Year
EDc	Exposure duration (child)	12 Year
ET_{oa}	Fraction of day spent outdoors (adult)	0.04 (unitless)
ET_{oc}	Fraction of day spent outdoors (child)	0.08 (unitless)
SH_o	Shield factor outdoors	NA (unitless)
CR	Radionuclide specific concentrations	(see table below)

Cs_{137+1d}	NA	pCi/g	$Th_{232+10d}$	3.4E–02	pCi/g
Np_{237+1d}	1.9E–01	pCi/g	U_{234}	1.4E+00	pCi/g
Pu_{238}	NA	pCi/g	U_{235+1d}	1.3E+00	pCi/g
Ra_{226+8d}	1.7E–01	pCi/g	U_{238+2d}	9.5E–01	pCi/g
Ra_{228+1d}	2.2E–01	pCi/g	NA	NA	pCi/g
Rn_{222+4d}	NA	pCi/g	NA	NA	pCi/g
Sr_{90+1d}	1.3E+00	pCi/g	NA	NA	pCi/g
Tc_{99}	4.0E–01	pCi/g	NA	NA	pCi/g
Th_{228+7d}	9.1E–02	pCi/g	NA	NA	pCi/g
Th_{230}	3.6E+00	pCi/g	NA	NA	pCi/g

Radionuclides	CDI (year pCi/g)	CSF $(g/pCi-year)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.0E–06	NA
Np_{237+1d}	8.1E–02	4.3E–07	3.5E–08
Pu_{238}	NA	2.8E–11	NA
Ra_{226+8d}	7.2E–02	6.0E–06	4.3E–07
Ra_{228+1d}	9.6E–02	2.9E–06	2.8E–07
Rn_{222+4d}	NA	5.9E–06	NA
Sr_{90+1d}	5.4E–01	NA	NA
Tc_{99}	1.7E–01	6.0E–13	1.0E–13
Th_{228+7d}	3.9E–02	5.6E–06	2.2E–07
Th_{230}	1.6E+00	5.4E–11	8.4E–11
$Th_{232+10d}$	1.5E–02	8.5E–06	1.3E–07
U_{234}	6.2E–01	3.0E–11	1.9E–11
U_{235+1d}	5.5E–01	2.4E–07	1.3E–07
U_{238+2d}	4.1E–01	5.1E–08	2.1E–08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		1.2E–06

001123

Table C.III–421
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium–total	2.16E–03	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
aroclor–1254	NA	mg/l	NA	NA	mg/l
aroclor–1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

Table C.III-421 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off-Property Farmer (Adult)
Via Drinking Water Ingestion

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	5.92E-05	3.00E-03	1.97E-02
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
HQ Summation =			1.97E-02

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	5.92E-05	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
ILCR Summation =			NA

Table C.III-422
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
South Field Area with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	6.6E-01	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	3.5E-02	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	7.2E-01	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	NA	2.2E-10	NA
Pu_{238}	NA	2.2E-10	NA
Ra_{226+8d}	NA	7.8E-10	NA
Ra_{228+1d}	NA	1.0E-10	NA
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	NA	3.6E-11	NA
Tc_{99}	NA	1.3E-12	NA
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	NA	1.3E-11	NA
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	3.2E+04	1.6E-11	5.1E-07
U_{235+1d}	1.7E+03	1.6E-11	2.7E-08
U_{238+2d}	3.5E+04	2.0E-11	7.1E-07
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.2E-06

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Table C.III–423
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2–day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
SA	Skin surface area available for contact	23000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
arsenic	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
beryllium	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
uranium–total	5.40E–10	mg/cm^2–day	NA	NA	mg/cm^2–day
benzo(a)pyrene	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
carbazole	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1254	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1260	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
dieldrin	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day

References

001127

Table C.III−423 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off−Property Farmer (Adult)
Via Dermal Contact while Bathing

Compound	HQ Calculation CDI (mg/kg−day)	RfD (mg/kg−day)	HQ (unitless)
antimony	NA	6.00E−05	NA
arsenic	NA	2.85E−04	NA
beryllium	NA	5.00E−03	NA
uranium−total	1.70E−07	1.50E−04	1.13E−03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor−1254	NA	NA	NA
aroclor−1260	NA	NA	NA
dieldrin	NA	4.50E−05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.13E−03

Compound	ILCR Calculation CDI (mg/kg−day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium−total	1.70E−07	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E−02	NA
aroclor−1254	NA	1.03E+01	NA
aroclor−1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

Table C.III–424
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Inhalation of Particulates

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/m^3	NA	NA	mg/m^3
arsenic	4.3E–09	mg/m^3	NA	NA	mg/m^3
beryllium	3.2E–10	mg/m^3	NA	NA	mg/m^3
uranium–total	5.7E–09	mg/m^3	NA	NA	mg/m^3
benzo(a)pyrene	4.8E–10	mg/m^3	NA	NA	mg/m^3
carbazole	NA	mg/m^3	NA	NA	mg/m^3
aroclor–1254	1.2E–10	mg/m^3	NA	NA	mg/m^3
aroclor–1260	1.0E–11	mg/m^3	NA	NA	mg/m^3
dieldrin	2.6E–12	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3

References

Table C.III-424 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off-Property Farmer (Adult)
Via Inhalation of Particulates

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	NA	NA
arsenic	1.2E-09	NA	NA
beryllium	8.8E-11	NA	NA
uranium-total	1.6E-09	NA	NA
benzo(a)pyrene	1.3E-10	NA	NA
carbazole	NA	NA	NA
aroclor-1254	3.4E-11	NA	NA
aroclor-1260	2.8E-12	NA	NA
dieldrin	7.0E-13	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	Hazard Quotient Sum =		NA

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	1.2E-09	1.5E+01	1.8E-08
beryllium	8.8E-11	8.4E+00	7.4E-10
uranium-total	1.6E-09	NA	NA
benzo(a)pyrene	1.3E-10	6.1E+00	8.0E-10
carbazole	NA	NA	NA
aroclor-1254	3.4E-11	NA	NA
aroclor-1260	2.8E-12	NA	NA
dieldrin	7.0E-13	1.6E+01	1.1E-11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		1.9E-08

Table C.III–425
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	3.7E–08	pCi/m^3
Np_{237+1d}	2.5E–07	pCi/m^3	U_{234}	1.7E–06	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	1.4E–06	pCi/m^3
Ra_{226+8d}	1.9E–07	pCi/m^3	U_{238+2d}	1.1E–06	pCi/m^3
Ra_{228+1d}	2.4E–07	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	8.7E–02	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	1.6E–06	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	4.4E–07	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	9.8E–08	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	3.9E–06	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	1.2E–01	2.9E–08	3.6E–09
Pu_{238}	NA	3.9E–08	NA
Ra_{226+8d}	9.3E–02	7.0E–09	6.5E–10
Ra_{228+1d}	1.2E–01	6.9E–10	8.2E–11
Rn_{222+4d}	4.3E+04	7.7E–12	3.3E–07
Sr_{90+1d}	7.9E–01	6.2E–11	4.9E–11
Tc_{99}	2.2E–01	8.3E–12	1.8E–12
Th_{228+7d}	4.8E–02	7.8E–08	3.8E–09
Th_{230}	1.9E+00	2.9E–08	5.5E–08
$Th_{232+10d}$	1.8E–02	1.1E–07	2.0E–09
U_{234}	8.1E–01	2.6E–08	2.1E–08
U_{235+1d}	7.1E–01	2.5E–08	1.8E–08
U_{238+2d}	5.3E–01	2.4E–08	1.3E–08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 4.5E–07

Table C.III-426
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	3.0E-06	mg/kg	NA	NA	mg/kg
beryllium	5.0E-08	mg/kg	NA	NA	mg/kg
uranium-total	2.2E-05	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	1.9E-06	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor-1254	6.8E-07	mg/kg	NA	NA	mg/kg
aroclor-1260	9.9E-07	mg/kg	NA	NA	mg/kg
dieldrin	1.7E-10	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg

References

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Table C.III-426 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Meat Products

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	3.1E-09	3.0E-04	1.0E-05
beryllium	5.2E-11	5.0E-03	1.0E-08
uranium-total	2.3E-08	3.0E-03	7.5E-06
benzo(a)pyrene	2.0E-09	NA	NA
carbazole	NA	NA	NA
aroclor-1254	7.1E-10	NA	NA
aroclor-1260	1.0E-09	NA	NA
dieldrin	1.8E-13	5.0E-05	3.6E-09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.8E-05

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	3.1E-09	1.8E+00	5.5E-09
beryllium	5.2E-11	4.3E+00	2.3E-10
uranium-total	2.3E-08	NA	NA
benzo(a)pyrene	2.0E-09	7.3E+00	1.4E-08
carbazole	NA	2.0E-02	NA
aroclor-1254	7.1E-10	7.7E+00	5.4E-09
aroclor-1260	1.0E-09	7.7E+00	7.9E-09
dieldrin	1.8E-13	1.6E+01	2.9E-12
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		3.3E-08

001133

Table C.III–427
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	2.0E–08	pCi/kg
Np_{237+1d}	1.1E–06	pCi/kg	U_{234}	6.6E–03	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	3.7E–04	pCi/kg
Ra_{226+8d}	6.2E–06	pCi/kg	U_{238+2d}	7.2E–03	pCi/kg
Ra_{228+1d}	4.7E–06	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	1.4E–04	pCi/kg	NA	NA	pCi/kg
Tc_{99}	5.3E–04	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	4.3E–08	pCi/kg	NA	NA	pCi/kg
Th_{230}	2.1E–06	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	2.0E–03	2.2E–10	4.3E–13
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	1.1E–02	7.8E–10	8.9E–12
Ra_{228+1d}	8.7E–03	1.0E–10	8.7E–13
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	2.7E–01	3.6E–11	9.6E–12
Tc_{99}	9.9E–01	1.3E–12	1.3E–12
Th_{228+7d}	8.1E–05	5.5E–11	4.4E–15
Th_{230}	3.9E–03	1.3E–11	5.1E–14
$Th_{232+10d}$	3.7E–05	1.7E–10	6.3E–15
U_{234}	1.2E+01	1.6E–11	2.0E–10
U_{235+1d}	6.9E–01	1.6E–11	1.1E–11
U_{238+2d}	1.3E+01	2.0E–11	2.7E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
		ILCR Summation =	5.0E–10

001134

Table C.III–428
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	9.0E–08	mg/kg	NA	NA	mg/kg
beryllium	4.5E–11	mg/kg	NA	NA	mg/kg
uranium–total	7.8E–05	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	6.0E–07	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	2.2E–07	mg/kg	NA	NA	mg/kg
aroclor–1260	3.1E–07	mg/kg	NA	NA	mg/kg
dieldrin	5.6E–11	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-428 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Dairy Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	3.7E-10	3.0E-04	1.2E-06
beryllium	1.9E-13	5.0E-03	3.7E-11
uranium-total	3.2E-07	3.0E-03	1.1E-04
benzo(a)pyrene	2.5E-09	NA	NA
carbazole	NA	NA	NA
aroclor-1254	8.8E-10	NA	NA
aroclor-1260	1.3E-09	NA	NA
dieldrin	2.3E-13	5.0E-05	4.6E-09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.1E-04

Compound	ILCR Calculation CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	3.7E-10	1.8E+00	6.5E-10
beryllium	1.9E-13	4.3E+00	8.0E-13
uranium-total	3.2E-07	NA	NA
benzo(a)pyrene	2.5E-09	7.3E+00	1.8E-08
carbazole	NA	2.0E-02	NA
aroclor-1254	8.8E-10	7.7E+00	6.8E-09
aroclor-1260	1.3E-09	7.7E+00	9.9E-09
dieldrin	2.3E-13	1.6E+01	3.7E-12
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		3.5E-08

Table C.III–429
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	1.7E–08	pCi/kg
Np_{237+1d}	9.6E–08	pCi/kg	U_{234}	2.4E–02	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.3E–03	pCi/kg
Ra_{226+8d}	1.1E–05	pCi/kg	U_{238+2d}	2.6E–02	pCi/kg
Ra_{228+1d}	8.5E–06	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	7.2E–04	pCi/kg	NA	NA	pCi/kg
Tc_{99}	6.3E–04	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	3.7E–08	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.8E–06	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	7.1E–04	2.2E–10	1.6E–13
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	8.1E–02	7.8E–10	6.3E–11
Ra_{228+1d}	6.2E–02	1.0E–10	6.2E–12
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	5.3E+00	3.6E–11	1.9E–10
Tc_{99}	4.6E+00	1.3E–12	6.0E–12
Th_{228+7d}	2.7E–04	5.5E–11	1.5E–14
Th_{230}	1.3E–02	1.3E–11	1.7E–13
$Th_{232+10d}$	1.2E–04	1.7E–10	2.1E–14
U_{234}	1.7E+02	1.6E–11	2.8E–09
U_{235+1d}	9.7E+00	1.6E–11	1.6E–10
U_{238+2d}	1.9E+02	2.0E–11	3.8E–09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
		ILCR Summation =	7.0E–09

001137

Table C.III–430
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	1.4E–05	mg/kg	NA	NA	mg/kg
beryllium	5.4E–07	mg/kg	NA	NA	mg/kg
uranium–total	1.1E–02	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	7.7E–07	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	2.6E–07	mg/kg	NA	NA	mg/kg
aroclor–1260	2.7E–08	mg/kg	NA	NA	mg/kg
dieldrin	2.5E–09	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

001138

Table C.III–430 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

	HQ Calculation		
Compound	CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	4.0E–04	NA
arsenic	2.4E–08	3.0E–04	8.0E–05
beryllium	9.0E–10	5.0E–03	1.8E–07
uranium–total	1.8E–05	3.0E–03	5.9E–03
benzo(a)pyrene	1.3E–09	NA	NA
carbazole	NA	NA	NA
aroclor–1254	4.3E–10	NA	NA
aroclor–1260	4.6E–11	NA	NA
dieldrin	4.2E–12	5.0E–05	8.4E–08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		6.0E–03

	ILCR Calculation		
Compound	CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	2.4E–08	1.8E+00	4.2E–08
beryllium	9.0E–10	4.3E+00	3.9E–09
uranium–total	1.8E–05	NA	NA
benzo(a)pyrene	1.3E–09	7.3E+00	9.4E–09
carbazole	NA	2.0E–02	NA
aroclor–1254	4.3E–10	7.7E+00	3.3E–09
aroclor–1260	4.6E–11	7.7E+00	3.5E–10
dieldrin	4.2E–12	1.6E+01	6.7E–11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		5.9E–08

0 0 8 2

Table C.III–431
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	4.1E–05	pCi/kg
Np_{237+1d}	2.5E–04	pCi/kg	U_{234}	3.2E+00	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.7E–01	pCi/kg
Ra_{226+8d}	2.7E–04	pCi/kg	U_{238+2d}	3.5E+00	pCi/kg
Ra_{228+1d}	2.4E–04	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	4.6E–03	pCi/kg	NA	NA	pCi/kg
Tc_{99}	6.9E–04	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	9.6E–05	pCi/kg	NA	NA	pCi/kg
Th_{230}	4.3E–03	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	7.4E–01	2.2E–10	1.6E–10
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	8.2E–01	7.8E–10	6.4E–10
Ra_{228+1d}	7.3E–01	1.0E–10	7.3E–11
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	1.4E+01	3.6E–11	5.0E–10
Tc_{99}	2.0E+00	1.3E–12	2.7E–12
Th_{228+7d}	2.9E–01	5.5E–11	1.6E–11
Th_{230}	1.3E+01	1.3E–11	1.7E–10
$Th_{232+10d}$	1.2E–01	1.7E–10	2.1E–11
U_{234}	9.6E+03	1.6E–11	1.5E–07
U_{235+1d}	5.2E+02	1.6E–11	8.3E–09
U_{238+2d}	1.1E+04	2.0E–11	2.1E–07
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 3.7E–07

Table C.III–432
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Federal Ownership: Off–Property Farmer (Child)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium–total	2.16E–03	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
aroclor–1254	NA	mg/l	NA	NA	mg/l
aroclor–1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

Table C.III–432 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off–Property Farmer (Child)
Via Drinking Water Ingestion

Compound	HQ Calculation CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	4.00E–04	NA
arsenic	NA	3.00E–04	NA
beryllium	NA	5.00E–03	NA
uranium–total	1.38E–04	3.00E–03	4.60E–02
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	5.00E–05	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	HQ Summation =		4.60E–02

Compound	ILCR Calculation CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium–total	1.18E–05	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E–02	NA
aroclor–1254	NA	7.70E+00	NA
aroclor–1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	ILCR Summation =		NA

001142

Table C.III–433
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
South Field Area with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	6.6E–01	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	3.5E–02	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	7.2E–01	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.4E+03	1.6E–11	2.2E–08
U_{235+1d}	7.4E+01	1.6E–11	1.2E–09
U_{238+2d}	1.5E+03	2.0E–11	3.0E–08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
		ILCR Summation =	5.3E–08

Table C.III–434
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Federal Ownership: Off–Property Farmer (Child)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2–day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
SA	Skin surface area available for contact	8000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
arsenic	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
beryllium	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
uranium–total	5.40E–10	mg/cm^2–day	NA	NA	mg/cm^2–day
benzo(a)pyrene	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
carbazole	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1254	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1260	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
dieldrin	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day			

References

00144

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Table C.III-434 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off-Property Farmer (Child)
Via Dermal Contact while Bathing

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	2.76E-07	1.50E-04	1.84E-03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.84E-03

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	2.37E-08	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001145

Table C.III-435
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Federal Ownership: Off-Property Farmer (Child)
Via Inhalation of Particulates

Intake Equation

$$= \frac{CS \times EF \times ED \times IR}{BW \times AT}$$

IR	Inhalation rate of gases (RAGS, 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units
antimony	NA	mg/m^3
arsenic	4.3E-09	mg/m^3
beryllium	3.2E-10	mg/m^3
uranium-total	5.7E-09	mg/m^3
benzo(a)pyrene	4.8E-10	mg/m^3
carbazole	NA	mg/m^3
aroclor-1254	1.2E-10	mg/m^3
aroclor-1260	1.0E-11	mg/m^3
dieldrin	2.6E-12	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3

Compound	Concentration	Units
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3
NA	NA	mg/m^3

References

00116

Table C.III-435 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off-Property Farmer (Child)
Via Inhalation of Particulates

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	NA	NA
arsenic	3.3E-09	NA	NA
beryllium	2.5E-10	NA	NA
uranium-total	4.4E-09	NA	NA
benzo(a)pyrene	3.7E-10	NA	NA
carbazole	NA	NA	NA
aroclor-1254	9.4E-11	NA	NA
aroclor-1260	7.7E-12	NA	NA
dieldrin	2.0E-12	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	Hazard Quotient Sum =		NA

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	2.8E-10	1.5E+01	4.2E-09
beryllium	2.1E-11	8.4E+00	1.8E-10
uranium-total	3.8E-10	NA	NA
benzo(a)pyrene	3.1E-11	6.1E+00	1.9E-10
carbazole	NA	NA	NA
aroclor-1254	8.1E-12	NA	NA
aroclor-1260	6.6E-13	NA	NA
dieldrin	1.7E-13	1.6E+01	2.7E-12
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	ILCR Summation =		4.6E-09

Table C.III–436
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
South Field Area with Federal Ownership: Off–Property Farmer (Child)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	3.7E–08	pCi/m^3
Np_{237+1d}	2.5E–07	pCi/m^3	U_{234}	1.7E–06	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	1.4E–06	pCi/m^3
Ra_{226+8d}	1.9E–07	pCi/m^3	U_{238+2d}	1.1E–06	pCi/m^3
Ra_{228+1d}	2.4E–07	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	8.7E–02	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	1.6E–06	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	4.4E–07	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	9.8E–08	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	3.9E–06	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	6.3E–03	2.9E–08	1.8E–10
Pu_{238}	NA	3.9E–08	NA
Ra_{226+8d}	4.8E–03	7.0E–09	3.3E–11
Ra_{228+1d}	6.1E–03	6.9E–10	4.2E–12
Rn_{222+4d}	2.2E+03	7.7E–12	1.7E–08
Sr_{90+1d}	4.1E–02	6.2E–11	2.5E–12
Tc_{99}	1.1E–02	8.3E–12	9.3E–14
Th_{228+7d}	2.5E–03	7.8E–08	1.9E–10
Th_{230}	9.8E–02	2.9E–08	2.8E–09
$Th_{232+10d}$	9.4E–04	1.1E–07	1.0E–10
U_{234}	4.2E–02	2.6E–08	1.1E–09
U_{235+1d}	3.6E–02	2.5E–08	9.1E–10
U_{238+2d}	2.7E–02	2.4E–08	6.5E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.3E–08

001148

Table C.III–437
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	3.0E–06	mg/kg	NA	NA	mg/kg
beryllium	5.0E–08	mg/kg	NA	NA	mg/kg
uranium–total	2.2E–05	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	1.2E–06	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	6.8E–07	mg/kg	NA	NA	mg/kg
aroclor–1260	9.9E–07	mg/kg	NA	NA	mg/kg
dieldrin	1.7E–10	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

001149

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Table C.III-437 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Meat Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	5.6E-09	3.0E-04	1.9E-05
beryllium	9.4E-11	5.0E-03	1.9E-08
uranium-total	4.1E-08	3.0E-03	1.4E-05
benzo(a)pyrene	2.2E-09	NA	NA
carbazole	NA	NA	NA
aroclor-1254	1.3E-09	NA	NA
aroclor-1260	1.8E-09	NA	NA
dieldrin	3.3E-13	5.0E-05	6.5E-09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		3.2E-05

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	4.8E-10	1.8E+00	8.5E-10
beryllium	8.1E-12	4.3E+00	3.5E-11
uranium-total	3.5E-09	NA	NA
benzo(a)pyrene	1.9E-10	7.3E+00	1.4E-09
carbazole	NA	2.0E-02	NA
aroclor-1254	1.1E-10	7.7E+00	8.4E-10
aroclor-1260	1.6E-10	7.7E+00	1.2E-09
dieldrin	2.8E-14	1.6E+01	4.5E-13
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		4.3E-09

001150

Table C.III–438
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
South Field Area with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	2.0E–08	pCi/kg
Np_{237+1d}	1.1E–06	pCi/kg	U_{234}	6.6E–03	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	3.7E–04	pCi/kg
Ra_{226+8d}	6.2E–06	pCi/kg	U_{238+2d}	7.2E–03	pCi/kg
Ra_{228+1d}	4.7E–06	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	1.4E–04	pCi/kg	NA	NA	pCi/kg
Tc_{99}	5.3E–04	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	4.3E–08	pCi/kg	NA	NA	pCi/kg
Th_{230}	2.1E–06	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	6.5E–05	2.2E–10	1.4E–14
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	3.8E–04	7.8E–10	2.9E–13
Ra_{228+1d}	2.9E–04	1.0E–10	2.9E–14
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	8.8E–03	3.6E–11	3.2E–13
Tc_{99}	3.3E–02	1.3E–12	4.3E–14
Th_{228+7d}	2.7E–06	5.5E–11	1.5E–16
Th_{230}	1.3E–04	1.3E–11	1.7E–15
$Th_{232+10d}$	1.2E–06	1.7E–10	2.1E–16
U_{234}	4.0E–01	1.6E–11	6.5E–12
U_{235+1d}	2.3E–02	1.6E–11	3.7E–13
U_{238+2d}	4.4E–01	2.0E–11	8.9E–12
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		1.6E–11

001151

Table C.III–439
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	9.0E–08	mg/kg	NA	NA	mg/kg
beryllium	4.5E–11	mg/kg	NA	NA	mg/kg
uranium–total	7.8E–05	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	3.7E–07	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	2.2E–07	mg/kg	NA	NA	mg/kg
aroclor–1260	3.1E–07	mg/kg	NA	NA	mg/kg
dieldrin	5.6E–11	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

001152

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Table C.III-439 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Dairy Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	3.9E-09	3.0E-04	1.3E-05
beryllium	2.0E-12	5.0E-03	3.9E-10
uranium-total	3.4E-06	3.0E-03	1.1E-03
benzo(a)pyrene	1.6E-08	NA	NA
carbazole	NA	NA	NA
aroclor-1254	9.3E-09	NA	NA
aroclor-1260	1.3E-08	NA	NA
dieldrin	2.4E-12	5.0E-05	4.8E-08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.1E-03

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	3.3E-10	1.8E+00	5.9E-10
beryllium	1.7E-13	4.3E+00	7.2E-13
uranium-total	2.9E-07	NA	NA
benzo(a)pyrene	1.4E-09	7.3E+00	1.0E-08
carbazole	NA	2.0E-02	NA
aroclor-1254	8.0E-10	7.7E+00	6.1E-09
aroclor-1260	1.2E-09	7.7E+00	8.9E-09
dieldrin	2.1E-13	1.6E+01	3.3E-12
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		2.6E-08

001153

Table C.III–440
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
South Field Area with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	1.7E–08	pCi/kg
Np_{237+1d}	9.6E–08	pCi/kg	U_{234}	2.4E–02	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.3E–03	pCi/kg
Ra_{226+8d}	1.1E–05	pCi/kg	U_{238+2d}	2.6E–02	pCi/kg
Ra_{228+1d}	8.5E–06	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	7.2E–04	pCi/kg	NA	NA	pCi/kg
Tc_{99}	6.3E–04	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	3.7E–08	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.8E–06	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	1.4E–04	2.2E–10	3.0E–14
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	1.6E–02	7.8E–10	1.2E–11
Ra_{228+1d}	1.2E–02	1.0E–10	1.2E–12
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	1.0E+00	3.6E–11	3.7E–11
Tc_{99}	8.9E–01	1.3E–12	1.2E–12
Th_{228+7d}	5.2E–05	5.5E–11	2.9E–15
Th_{230}	2.5E–03	1.3E–11	3.2E–14
$Th_{232+10d}$	2.4E–05	1.7E–10	4.0E–15
U_{234}	3.4E+01	1.6E–11	5.4E–10
U_{235+1d}	1.9E+00	1.6E–11	3.0E–11
U_{238+2d}	3.7E+01	2.0E–11	7.4E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.4E–09

001154

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Table C.III–441
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	1.4E–05	mg/kg	NA	NA	mg/kg
beryllium	5.4E–07	mg/kg	NA	NA	mg/kg
uranium–total	1.1E–02	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	4.8E–07	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	2.6E–07	mg/kg	NA	NA	mg/kg
aroclor–1260	2.7E–08	mg/kg	NA	NA	mg/kg
dieldrin	2.5E–09	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III-441 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	9.2E-08	3.0E-04	3.1E-04
beryllium	3.4E-09	5.0E-03	6.9E-07
uranium-total	6.8E-05	3.0E-03	2.3E-02
benzo(a)pyrene	3.1E-09	NA	NA
carbazole	NA	NA	NA
aroclor-1254	1.6E-09	NA	NA
aroclor-1260	1.8E-10	NA	NA
dieldrin	1.6E-11	5.0E-05	3.2E-07
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.3E-02

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	7.9E-09	1.8E+00	1.4E-08
beryllium	3.0E-10	4.3E+00	1.3E-09
uranium-total	5.8E-06	NA	NA
benzo(a)pyrene	2.6E-10	7.3E+00	1.9E-09
carbazole	NA	2.0E-02	NA
aroclor-1254	1.4E-10	7.7E+00	1.1E-09
aroclor-1260	1.5E-11	7.7E+00	1.2E-10
dieldrin	1.4E-12	1.6E+01	2.2E-11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		1.8E-08

001156

Table C.III–442
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
South Field Area with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	4.1E–05	pCi/kg
Np_{237+1d}	2.5E–04	pCi/kg	U_{234}	3.2E+00	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.7E–01	pCi/kg
Ra_{226+8d}	2.7E–04	pCi/kg	U_{238+2d}	3.5E+00	pCi/kg
Ra_{228+1d}	2.4E–04	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	4.6E–03	pCi/kg	NA	NA	pCi/kg
Tc_{99}	6.9E–04	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	9.6E–05	pCi/kg	NA	NA	pCi/kg
Th_{230}	4.3E–03	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	5.2E–02	2.2E–10	1.1E–11
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	5.8E–02	7.8E–10	4.5E–11
Ra_{228+1d}	5.1E–02	1.0E–10	5.1E–12
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	9.7E–01	3.6E–11	3.5E–11
Tc_{99}	1.4E–01	1.3E–12	1.9E–13
Th_{228+7d}	2.0E–02	5.5E–11	1.1E–12
Th_{230}	9.0E–01	1.3E–11	1.2E–11
$Th_{232+10d}$	8.6E–03	1.7E–10	1.5E–12
U_{234}	6.7E+02	1.6E–11	1.1E–08
U_{235+1d}	3.6E+01	1.6E–11	5.8E–10
U_{238+2d}	7.4E+02	2.0E–11	1.5E–08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.6E–08

Table C.III-443
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Private Ownership: Off-Property Farmer (Adult)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium-total	1.03E-04	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
aroclor-1254	NA	mg/l	NA	NA	mg/l
aroclor-1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

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Table C.III-443 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: Off-Property Farmer (Adult)
Via Drinking Water Ingestion

Compound	HQ Calculation		
	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	2.82E-06	3.00E-03	9.41E-04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		9.41E-04

Compound	ILCR Calculation		
	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	2.82E-06	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

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Table C.III–444
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
South Field Area with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	3.1E–02	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	2.0E–03	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	3.4E–02	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.5E+03	1.6E–11	2.4E–08
U_{235+1d}	9.8E+01	1.6E–11	1.6E–09
U_{238+2d}	1.7E+03	2.0E–11	3.3E–08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 5.9E–08

Table C.III–445
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Private Ownership: Off–Property Farmer (Adult)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2–day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
SA	Skin surface area available for contact	23000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
arsenic	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
beryllium	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
uranium–total	2.58E–11	mg/cm^2–day	NA	NA	mg/cm^2–day
benzo(a)pyrene	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
carbazole	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1254	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1260	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
dieldrin	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day

References

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Table C.III-445 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: Off-Property Farmer (Adult)
Via Dermal Contact while Bathing

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	8.11E-09	1.50E-04	5.41E-05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
HQ Summation =			5.41E-05

Compound	ILCR Calculation CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	8.11E-09	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
ILCR Summation =			NA

5860

Table C.III–446
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
South Field Area with Private Ownership: Off–Property Farmer (Adult)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	3.3E–07	pCi/m^3	U_{234}	1.0E–06	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	8.8E–07	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	2.2E–07	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	2.8E–06	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	1.6E–01	2.9E–08	4.6E–09
Pu_{238}	NA	3.9E–08	NA
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	NA	7.7E–12	NA
Sr_{90+1d}	1.1E–01	6.2E–11	6.6E–12
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	1.4E+00	2.9E–08	3.9E–08
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	4.9E–01	2.6E–08	1.3E–08
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	4.3E–01	2.4E–08	1.0E–08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
		ILCR Summation =	6.7E–08

Table C.III–447
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	1.3E–06	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg

References

Table C.III–447 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Meat Products

Compound	HQ Calculation		
	CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	4.0E–04	NA
arsenic	NA	3.0E–04	NA
beryllium	NA	5.0E–03	NA
uranium–total	1.3E–09	3.0E–03	4.4E–07
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	5.0E–05	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
HQ Summation =			4.4E–07

Compound	ILCR Calculation		
	CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium–total	1.3E–09	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E–02	NA
aroclor–1254	NA	7.7E+00	NA
aroclor–1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
ILCR Summation =			NA

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Table C.III–448
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
South Field Area with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	1.4E−06	pCi/kg	U_{234}	3.3E−04	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	2.0E−05	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	3.5E−04	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	1.9E−05	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.5E−06	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	2.6E−03	2.2E−10	5.6E−13
Pu_{238}	NA	2.2E−10	NA
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	3.6E−02	3.6E−11	1.3E−12
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	2.8E−03	1.3E−11	3.6E−14
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	6.0E−01	1.6E−11	9.7E−12
U_{235+1d}	3.7E−02	1.6E−11	5.9E−13
U_{238+2d}	6.6E−01	2.0E−11	1.3E−11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	2.5E−11

Table C.III–449
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	4.4E–06	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-449 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: Off-Property Farmer (Adult)
Via Ingestion of Dairy Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.8E-08	3.0E-03	6.0E-06
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		6.0E-06

Compound	ILCR Calculation CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.8E-08	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

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Table C.III–450
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
South Field Area with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	1.3E–07	pCi/kg	U_{234}	1.2E–03	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	7.2E–05	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	1.3E–03	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	9.6E–05	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.2E–06	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	9.2E–04	2.2E–10	2.0E–13
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	7.1E–01	3.6E–11	2.5E–11
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	9.1E–03	1.3E–11	1.2E–13
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	8.5E+00	1.6E–11	1.4E–10
U_{235+1d}	5.3E–01	1.6E–11	8.5E–12
U_{238+2d}	9.3E+00	2.0E–11	1.9E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	3.6E–10

Table C.III-451
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Private Ownership: Off-Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium-total	5.2E-04	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor-1254	NA	mg/kg	NA	NA	mg/kg
aroclor-1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III-451 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: Off-Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	8.7E-07	3.0E-03	2.9E-04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.9E-04

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	8.7E-07	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

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Table C.III–452
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
South Field Area with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	3.2E–04	pCi/kg	U_{234}	1.5E–01	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	9.8E–03	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	1.7E–01	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	6.2E–04	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	3.1E–03	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	9.7E–01	2.2E–10	2.1E–10
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	1.9E+00	3.6E–11	6.7E–11
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	9.1E+00	1.3E–11	1.2E–10
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	4.6E+02	1.6E–11	7.3E–09
U_{235+1d}	2.9E+01	1.6E–11	4.7E–10
U_{238+2d}	5.0E+02	2.0E–11	1.0E–08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.8E–08

Table C.III–453
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Private Ownership: Off–Property Farmer (Child)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium–total	1.03E–04	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
aroclor–1254	NA	mg/l	NA	NA	mg/l
aroclor–1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

Table C.III-453 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: Off-Property Farmer (Child)
Via Drinking Water Ingestion

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	6.58E-06	3.00E-03	2.19E-03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.19E-03

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	5.64E-07	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001174

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Table C.III–454
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
South Field Area with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	3.1E–02	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	2.0E–03	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	3.4E–02	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	6.5E+01	1.6E–11	1.0E–09
U_{235+1d}	4.2E+00	1.6E–11	6.7E–11
U_{238+2d}	7.1E+01	2.0E–11	1.4E–09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.5E–09

001175

Table C.III–455
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Private Ownership: Off–Property Farmer (Child)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2–day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
SA	Skin surface area available for contact	8000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
arsenic	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
beryllium	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
uranium–total	2.58E–11	mg/cm^2–day	NA	NA	mg/cm^2–day
benzo(a)pyrene	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
carbazole	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1254	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1260	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
dieldrin	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day			

References

5860

Table C.III-455 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: Off-Property Farmer (Child)
Via Dermal Contact while Bathing

Compound	HQ Calculation		
	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	1.32E-08	1.50E-04	8.78E-05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		8.78E-05

Compound	ILCR Calculation		
	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	1.13E-09	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001177

Table C.III–456
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
South Field Area with Private Ownership: Off–Property Farmer (Child)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	3.3E–07	pCi/m^3	U_{234}	1.0E–06	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	8.8E–07	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	2.2E–07	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	2.8E–06	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	8.2E–03	2.9E–08	2.4E–10
Pu_{238}	NA	3.9E–08	NA
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	NA	7.7E–12	NA
Sr_{90+1d}	5.5E–03	6.2E–11	3.4E–13
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	7.0E–02	2.9E–08	2.0E–09
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	2.5E–02	2.6E–08	6.6E–10
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	2.2E–02	2.4E–08	5.3E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 3.4E–09

Table C.III–457
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	1.3E–06	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg

References

Table C.III-457 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Meat Products

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	2.4E-09	3.0E-03	7.8E-07
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		7.8E-07

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	2.0E-10	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001180

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Table C.III–458
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
South Field Area with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	1.4E–06	pCi/kg	U_{234}	3.3E–04	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	2.0E–05	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	3.5E–04	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	1.9E–05	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.5E–06	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	8.5E–05	2.2E–10	1.9E–14
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	1.2E–03	3.6E–11	4.2E–14
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	9.2E–05	1.3E–11	1.2E–15
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	2.0E–02	1.6E–11	3.2E–13
U_{235+1d}	1.2E–03	1.6E–11	2.0E–14
U_{238+2d}	2.2E–02	2.0E–11	4.3E–13
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 8.4E–13

001181

Table C.III–459
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	4.4E–06	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg

References

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Table C.III–459 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Dairy Products

	HQ Calculation		
Compound	CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	4.0E–04	NA
arsenic	NA	3.0E–04	NA
beryllium	NA	5.0E–03	NA
uranium–total	1.9E–07	3.0E–03	6.3E–05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	5.0E–05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		6.3E–05

	ILCR Calculation		
Compound	CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium–total	1.6E–08	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E–02	NA
aroclor–1254	NA	7.7E+00	NA
aroclor–1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001183

0 8 8 2

Table C.III–460
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
South Field Area with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	1.3E–07	pCi/kg	U_{234}	1.2E–03	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	7.2E–05	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	1.3E–03	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	9.6E–05	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.2E–06	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	1.8E–04	2.2E–10	3.9E–14
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	1.4E–01	3.6E–11	4.9E–12
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	1.8E–03	1.3E–11	2.3E–14
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.6E+00	1.6E–11	2.6E–11
U_{235+1d}	1.0E–01	1.6E–11	1.6E–12
U_{238+2d}	1.8E+00	2.0E–11	3.6E–11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		6.9E–11

Table C.III–461
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	5.2E–04	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-461 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	3.3E-06	3.0E-03	1.1E-03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.1E-03

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	2.8E-07	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001186

Table C.III–462
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
South Field Area with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	3.2E–04	pCi/kg	U_{234}	1.5E–01	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	9.8E–03	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	1.7E–01	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	6.2E–04	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	3.1E–03	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	6.8E–02	2.2E–10	1.5E–11
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	1.3E–01	3.6E–11	4.7E–12
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	6.4E–01	1.3E–11	8.3E–12
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	3.2E+01	1.6E–11	5.1E–10
U_{235+1d}	2.1E+00	1.6E–11	3.3E–11
U_{238+2d}	3.5E+01	2.0E–11	7.0E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		1.3E–09

Table C.III–463
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Incidental Ingestion of Soil

Intake Equation = $\frac{CS \times EF \times ED \times CF \times IR}{BW \times AT}$

IRs	Ingestion rate of soil (RAGS, 1989)	180 mg/day
CF	Conversion factor	1.0E–06 kg/mg
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	7.9E–01	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

001168

Table C.III-463 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Incidental Ingestion of Soil

Compound	HQ Calculation CDI (mg/kg-day)	HQ Calculation RfD (mg/kg-day)	HQ Calculation HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	2.0E-06	3.0E-03	6.5E-04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	HQ Summation =		6.5E-04

Compound	ILCR Calculation CDI (mg/kg-day)	ILCR Calculation CSF $(mg/kg-day)^{-1}$	ILCR Calculation ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	2.0E-06	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	ILCR Summation =		NA

001189

Table C.III–464
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
South Field Area with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Incidental Ingestion of Soil

Intake Equation = CS X EF X EDn X FI X IR

IRs	Ingestion rate of soil (RAGS, 1989)	180 mg/day
EF	Exposure frequency	350 days/year
EDn	Exposure Duration	70 Year
FI	Fractional Intake	1 (unitless)
CS	Concentration of radionuclides in soil	

Cs_{137+1d}	NA	pCi/mg	$Th_{232+10d}$	NA	pCi/mg
Np_{237+1d}	1.55E–05	pCi/mg	U_{234}	3.06E–05	pCi/mg
Pu_{238}	NA	pCi/mg	U_{235+1d}	NA	pCi/mg
Ra_{226+8d}	NA	pCi/mg	U_{238+2d}	2.70E–05	pCi/mg
Ra_{228+1d}	NA	pCi/mg	NA	NA	pCi/mg
Rn_{222+4d}	NA	pCi/mg	NA	NA	pCi/mg
Sr_{90+1d}	1.28E–05	pCi/mg	NA	NA	pCi/mg
Tc_{99}	NA	pCi/mg	NA	NA	pCi/mg
Th_{228+7d}	NA	pCi/mg	NA	NA	pCi/mg
Th_{230}	1.19E–04	pCi/mg	NA	NA	pCi/mg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.80E–11	NA
Np_{237+1d}	6.84E+01	2.20E–10	1.50E–08
Pu_{238}	NA	2.20E–10	NA
Ra_{226+8d}	NA	7.80E–10	NA
Ra_{228+1d}	NA	1.00E–10	NA
Rn_{222+4d}	NA	1.70E–12	NA
Sr_{90+1d}	5.64E+01	3.60E–11	2.03E–09
Tc_{99}	NA	1.30E–12	NA
Th_{228+7d}	NA	5.50E–11	NA
Th_{230}	5.24E+02	1.30E–11	6.81E–09
$Th_{232+10d}$	NA	1.70E–10	NA
U_{234}	1.35E+02	1.60E–11	2.16E–09
U_{235+1d}	NA	1.60E–11	NA
U_{238+2d}	1.19E+02	2.00E–11	2.38E–09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.84E–08

Table C.III–465
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Dermal Contact with Soil

Intake Equation = $\frac{CS \times EF \times ED \times CF \times ABS \times AF \times SA}{BW \times AT}$

SA	Surface area of exposed skin (50th percentile, hands only)	5750 cm^2/day
AF	Soil to skin adherence factor (RAGS, 1989)	1 mg/cm^2
ABS	chemicals specific absorbtion factor (see table below)	csv
CF	Conversion factor	1E–06 kg/mg
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in soil	

Chemical Concentrations

Compound	ABS	Concentrati	Units	Compound		Concentrati	Units
antimony	1.00E–02	NA	mg/kg	NA	NA	NA	mg/kg
arsenic	1.00E–03	NA	mg/kg	NA	NA	NA	mg/kg
beryllium	1.00E–02	NA	mg/kg	NA	NA	NA	mg/kg
uranium–total	1.00E–02	7.94E–01	mg/kg	NA	NA	NA	mg/kg
benzo(a)pyrene	3.00E–01	NA	mg/kg	NA	NA	NA	mg/kg
carbazole	3.00E–01	NA	mg/kg	NA	NA	NA	mg/kg
aroclor–1254	6.00E–02	NA	mg/kg	NA	NA	NA	mg/kg
aroclor–1260	6.00E–02	NA	mg/kg	NA	NA	NA	mg/kg
dieldrin	3.00E–01	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg				

References

Table C.III−465 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: On−Property RME Resident Farmer (Adult)
Via Dermal Contact with Soil

Compound	HQ Calculation CDI (mg/kg−day)	RfD (mg/kg−day)	HQ (unitless)
antimony	NA	6.00E−05	NA
arsenic	NA	2.85E−04	NA
beryllium	NA	5.00E−03	NA
uranium−total	6.26E−07	1.50E−04	4.17E−03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor−1254	NA	NA	NA
aroclor−1260	NA	NA	NA
dieldrin	NA	4.50E−05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		4.17E−03

Compound	ILCR Calculation CDI (mg/kg−day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium−total	6.26E−07	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E−02	NA
aroclor−1254	NA	1.03E+01	NA
aroclor−1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001192

Table C.III–466
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium–total	6.06E–04	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
aroclor–1254	NA	mg/l	NA	NA	mg/l
aroclor–1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

0086

Table C.III-466 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Drinking Water Ingestion

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	1.66E-05	3.00E-03	5.53E-03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	HQ Summation =		5.53E-03

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	1.66E-05	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	NANA	NA	NA
	ILCR Summation =		NA

001194

5860

Table C.III–467
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
South Field Area with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	1.8E–01	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	1.0E–02	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	2.0E–01	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	9.0E+03	1.6E–11	1.4E–07
U_{235+1d}	4.9E+02	1.6E–11	7.8E–09
U_{238+2d}	9.9E+03	2.0E–11	2.0E–07
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
		ILCR Summation =	3.5E–07

Table C.III–468(a)
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2–day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
SA	Skin surface area available for contact	23000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
arsenic	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
beryllium	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
uranium–total	1.52E–10	mg/cm^2–day	NA	NA	mg/cm^2–day
benzo(a)pyrene	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
carbazole	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1254	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1260	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
dieldrin	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day

References

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Table C.III-468(a) (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Dermal Contact while Bathing

Compound	HQ Calculation: CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	4.77E-08	1.50E-04	3.18E-04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		3.18E-04

Compound	ILCR Calculation: CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	4.77E-08	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001197

Table C.III−468(b)
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
South Field Area with Federal Ownership: On−Property RME Resident Farmer (Adult)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	4.3E−06	pCi/m^3	U_{234}	1.3E−05	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	1.1E−05	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	3.1E−06	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	6.6E−05	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E−11	NA
Np_{237+1d}	2.1E+00	2.9E−08	6.1E−08
Pu_{238}	NA	3.9E−08	NA
Ra_{226+8d}	NA	7.0E−09	NA
Ra_{228+1d}	NA	6.9E−10	NA
Rn_{222+4d}	NA	7.7E−12	NA
Sr_{90+1d}	1.5E+00	6.2E−11	9.4E−11
Tc_{99}	NA	8.3E−12	NA
Th_{228+7d}	NA	7.8E−08	NA
Th_{230}	3.2E+01	2.9E−08	9.4E−07
$Th_{232+10d}$	NA	1.1E−07	NA
U_{234}	6.4E+00	2.6E−08	1.7E−07
U_{235+1d}	NA	2.5E−08	NA
U_{238+2d}	5.6E+00	2.4E−08	1.3E−07
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.3E−06

001198

Table C.III-469
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium-total	1.6E-04	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor-1254	NA	mg/kg	NA	NA	mg/kg
aroclor-1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-469 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Ingestion of Meat Products

Compound	HQ Calculation CDI (mg/kg-day)	HQ Calculation RfD (mg/kg-day)	HQ Calculation HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.6E-07	3.0E-03	5.4E-05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		5.4E-05

Compound	ILCR Calculation CDI (mg/kg-day)	ILCR Calculation CSF $(mg/kg-day)^{-1}$	ILCR Calculation ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.6E-07	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001200

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Table C.III−470
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
South Field Area with Federal Ownership: On−Property RME Resident Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	8.7E−04	pCi/kg	U_{234}	7.7E−03	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.0E−04	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	7.2E−03	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	4.8E−01	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	4.2E−04	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	1.6E+00	2.2E−10	3.6E−10
Pu_{238}	NA	2.2E−10	NA
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	8.9E+02	3.6E−11	3.2E−08
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	7.8E−01	1.3E−11	1.0E−11
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	1.4E+01	1.6E−11	2.3E−10
U_{235+1d}	1.9E−01	1.6E−11	3.0E−12
U_{238+2d}	1.3E+01	2.0E−11	2.7E−10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 3.3E−08

001201

Table C.III–471
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	4.7E–04	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg

References

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Table C.III-471 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Ingestion of Dairy Products

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.9E-06	3.0E-03	6.5E-04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		6.5E-04

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.9E-06	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

Table C.III–472
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
South Field Area with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	7.9E–05	pCi/kg	U_{234}	2.4E–02	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	3.6E–04	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.3E–02	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	2.4E+00	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	3.5E–04	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	5.8E–01	2.2E–10	1.3E–10
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	1.8E+04	3.6E–11	6.4E–07
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	2.6E+00	1.3E–11	3.4E–11
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.8E+02	1.6E–11	2.8E–09
U_{235+1d}	2.6E+00	1.6E–11	4.2E–11
U_{238+2d}	1.7E+02	2.0E–11	3.3E–09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		6.4E–07

Table C.III–473
Summary of Intake Quantitation (chemicals) Alternative 3
South Field Area with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	1.0E–02	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg

References

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Table C.III-473 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Ingestion of Vegetables and Fruits

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.7E-05	3.0E-03	5.5E-03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		5.5E-03

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.7E-05	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001206

5860

Table C.III–474
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
South Field Area with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	1.6E–01	pCi/kg	U_{234}	1.2E+00	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	4.9E–02	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	1.2E+00	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	3.2E+01	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.9E–01	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	4.8E+02	2.2E–10	1.0E–07
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	9.6E+04	3.6E–11	3.4E–06
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	5.5E+02	1.3E–11	7.2E–09
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	3.5E+03	1.6E–11	5.6E–08
U_{235+1d}	1.5E+02	1.6E–11	2.3E–09
U_{238+2d}	3.7E+03	2.0E–11	7.3E–08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 3.7E–06

001207

Table C.III−475
Summary of Intake and Risk Quantitation (radionuclides) Alternative 3
South Field Area with Federal Ownership: On−Property RME Resident Farmer (Adult)
Via External Radiation

Dose Equivalency Equat = $[DR \times EF \times EDn \times ET_i \times (1-SH_i)] + [DR \times EF \times EDn \times ET_o \times (1-SH_o)]$

EF	Fraction of year spent exposured	0.96 (unitless)
ED	Exposure duration	70 Year
ET_i	Fraction of day spent indoors	0.76 (unitless)
ET_o	Fraction of day spent outdoors	0.24 (unitless)
SH_i	Shield factor indoors	0.5 (unitless)
SH_o	Shield factor outdoors	NA (unitless)
DR	Radionuclide specific dose concentrations	(see table below)

Cs_{137+1d}	NA	pCi/g	$Th_{232+10d}$	NA	pCi/g
Np_{237+1d}	1.55E−02	pCi/g	U_{234}	3.06E−02	pCi/g
Pu_{238}	NA	pCi/g	U_{235+1d}	NA	pCi/g
Ra_{226+8d}	NA	pCi/g	U_{238+2d}	2.70E−02	pCi/g
Ra_{228+1d}	NA	pCi/g	NA	NA	pCi/g
Rn_{222+4d}	NA	pCi/g	NA	NA	pCi/g
Sr_{90+1d}	1.28E−02	pCi/g	NA	NA	pCi/g
Tc_{99}	NA	pCi/g	NA	NA	pCi/g
Th_{228+7d}	NA	pCi/g	NA	NA	pCi/g
Th_{230}	1.19E−01	pCi/g	NA	NA	pCi/g

Radionuclides	CDI (year pCi/g)	CSF $(g/pCi-year)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.0E−06	NA
Np_{237+1d}	6.5E−01	4.3E−07	2.8E−07
Pu_{238}	NA	2.8E−11	NA
Ra_{226+8d}	NA	6.0E−06	NA
Ra_{228+1d}	NA	2.9E−06	NA
Rn_{222+4d}	NA	5.9E−06	NA
Sr_{90+1d}	5.3E−01	NA	NA
Tc_{99}	NA	6.0E−13	NA
Th_{228+7d}	NA	5.6E−06	NA
Th_{230}	4.9E+00	5.4E−11	2.7E−10
$Th_{232+10d}$	NA	8.5E−06	NA
U_{234}	1.3E+00	3.0E−11	3.8E−11
U_{235+1d}	NA	2.4E−07	NA
U_{238+2d}	1.1E+00	5.1E−08	5.7E−08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 3.4E−07

Table C.III–476
Summary of Intake Quantitation (chemicals) Alternatives 3
South Field Area with Private Ownership: On–Property Farmer (Child)
Via Incidental Ingestion of Soil

Intake Equation = $\frac{CS \times EF \times ED \times CF \times IR}{BW \times AT}$

IRs	Ingestion rate of soil (RAGS, 1989)	200 mg/day
CF	Conversion factor	1.0E–06 kg/mg
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	7.9E–01	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

001209

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Table C.III-476 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: On-Property Farmer (Child)
Via Incidental Ingestion of Soil

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.0E-05	3.0E-03	3.4E-03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		3.4E-03

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	8.7E-07	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

Table C.III−477
Summary of Intake and Risk Quantitation (radionuclides) Alternatives 3
South Field Area with Private Ownership: On−Property Farmer (Child)
Via Incidental Ingestion of Soil

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Intake Equation = CS X EF X EDn X FI X IR

IRs	Ingestion rate of soil (RAGS, 1989)	200 mg/day
EF	Exposure frequency	350 days/year
EDn	Exposure Duration	6 Year
FI	Fractional Intake	1 (unitless)
CS	Concentration of radionuclides in soil	

Cs_{137+1d}	NA	pCi/mg	$Th_{232+10d}$	NA	pCi/mg
Np_{237+1d}	1.55E−05	pCi/mg	U_{234}	3.06E−05	pCi/mg
Pu_{238}	NA	pCi/mg	U_{235+1d}	NA	pCi/mg
Ra_{226+8d}	NA	pCi/mg	U_{238+2d}	2.70E−05	pCi/mg
Ra_{228+1d}	NA	pCi/mg	NA	NA	pCi/mg
Rn_{222+4d}	NA	pCi/mg	NA	NA	pCi/mg
Sr_{90+1d}	1.28E−05	pCi/mg	NA	NA	pCi/mg
Tc_{99}	NA	pCi/mg	NA	NA	pCi/mg
Th_{228+7d}	NA	pCi/mg	NA	NA	pCi/mg
Th_{230}	1.19E−04	pCi/mg	NA	NA	pCi/mg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.80E−11	NA
Np_{237+1d}	6.51E+00	2.20E−10	1.43E−09
Pu_{238}	NA	2.20E−10	NA
Ra_{226+8d}	NA	7.80E−10	NA
Ra_{228+1d}	NA	1.00E−10	NA
Rn_{222+4d}	NA	1.70E−12	NA
Sr_{90+1d}	5.38E+00	3.60E−11	1.94E−10
Tc_{99}	NA	1.30E−12	NA
Th_{228+7d}	NA	5.50E−11	NA
Th_{230}	4.99E+01	1.30E−11	6.49E−10
$Th_{232+10d}$	NA	1.70E−10	NA
U_{234}	1.29E+01	1.60E−11	2.06E−10
U_{235+1d}	NA	1.60E−11	NA
U_{238+2d}	1.13E+01	2.00E−11	2.27E−10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.71E−09

001211

Table C.III–478
Summary of Intake Quantitation (chemicals) Alternatives 3
South Field Area with Private Ownership: On–Property Farmer (Child)
Via Dermal Contact with Soil

Intake Equation = $\frac{CS \times EF \times ED \times CF \times ABS \times AF \times SA}{BW \times AT}$

SA	Surface area of exposed skin (50th percentile, hands only)	2000 cm^2/day
AF	Soil to skin adherence factor (RAGS, 1989)	1 mg/cm^2
ABS	chemicals specific absorbtion factor (see table below)	csv
CF	Conversion factor	1E–06 kg/mg
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in soil	

Chemical Concentrations

Compound	ABS	Concentrati	Units	Compound		Concentrati	Units
antimony	1.00E–02	NA	mg/kg	NA	NA	NA	mg/kg
arsenic	1.00E–03	NA	mg/kg	NA	NA	NA	mg/kg
beryllium	1.00E–02	NA	mg/kg	NA	NA	NA	mg/kg
uranium–total	1.00E–02	7.94E–01	mg/kg	NA	NA	NA	mg/kg
benzo(a)pyrene	3.00E–01	NA	mg/kg	NA	NA	NA	mg/kg
carbazole	3.00E–01	NA	mg/kg	NA	NA	NA	mg/kg
aroclor–1254	6.00E–02	NA	mg/kg	NA	NA	NA	mg/kg
aroclor–1260	6.00E–02	NA	mg/kg	NA	NA	NA	mg/kg
dieldrin	3.00E–01	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg				

References

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Table C.III-478 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: On-Property Farmer (Child)
Via Dermal Contact with Soil

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	1.02E-06	1.50E-04	6.77E-03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		6.77E-03

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	8.70E-08	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001213

Table C.III–479
Summary of Intake Quantitation (chemicals) Alternatives 3
South Field Area with Private Ownership: On–Property Farmer (Child)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium–total	6.06E–04	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
aroclor–1254	NA	mg/l	NA	NA	mg/l
aroclor–1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

Table C.III-479 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: On-Property Farmer (Child)
Via Drinking Water Ingestion

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	3.87E-05	3.00E-03	1.29E-02
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.29E-02

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	3.32E-06	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

Table C.III–480
Summary of Intake and Risk Quantitation (radionuclides) Alternatives 3
South Field Area with Private Ownership: On–Property Farmer (Child)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	1.8E–01	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	1.0E–02	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	2.0E–01	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	3.9E+02	1.6E–11	6.2E–09
U_{235+1d}	2.1E+01	1.6E–11	3.4E–10
U_{238+2d}	4.2E+02	2.0E–11	8.5E–09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
		ILCR Summation =	1.5E–08

Table C.III–481
Summary of Intake Quantitation (chemicals) Alternatives 3
South Field Area with Private Ownership: On–Property Farmer (Child)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2–day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
SA	Skin surface area available for contact	8000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
arsenic	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
beryllium	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
uranium–total	1.52E–10	mg/cm^2–day	NA	NA	mg/cm^2–day
benzo(a)pyrene	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
carbazole	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1254	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1260	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
dieldrin	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day			

References

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Table C.III-481 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: On-Property Farmer (Child)
Via Dermal Contact while Bathing

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	7.75E-08	1.50E-04	5.17E-04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		5.17E-04

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	6.64E-09	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001218

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Table C.III–482
Summary of Intake and Risk Quantitation (radionuclides) Alternatives 3
South Field Area with Private Ownership: On–Property Farmer (Child)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	4.3E–06	pCi/m^3	U_{234}	1.3E–05	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	1.1E–05	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	3.1E–06	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	6.6E–05	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	1.1E–01	2.9E–08	3.1E–09
Pu_{238}	NA	3.9E–08	NA
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	NA	7.7E–12	NA
Sr_{90+1d}	7.8E–02	6.2E–11	4.8E–12
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	1.7E+00	2.9E–08	4.8E–08
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	3.3E–01	2.6E–08	8.5E–09
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	2.9E–01	2.4E–08	6.9E–09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		6.7E–08

Table C.III–483
Summary of Intake Quantitation (chemicals) Alternatives 3
South Field Area with Private Ownership: On–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	1.6E–04	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III−483 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: On−Property Farmer (Child)
Via Ingestion of Meat Products

Compound	HQ Calculation		
	CDI (mg/kg−day)	RfD (mg/kg−day)	HQ (unitless)
antimony	NA	4.0E−04	NA
arsenic	NA	3.0E−04	NA
beryllium	NA	5.0E−03	NA
uranium−total	2.9E−07	3.0E−03	9.8E−05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor−1254	NA	NA	NA
aroclor−1260	NA	NA	NA
dieldrin	NA	5.0E−05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		9.8E−05

Compound	ILCR Calculation		
	CDI (mg/kg−day)	CSF (mg/kg−day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium−total	2.5E−08	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E−02	NA
aroclor−1254	NA	7.7E+00	NA
aroclor−1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

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Table C.III–484
Summary of Intake and Risk Quantitation (radionuclides) Alternatives 3
South Field Area with Private Ownership: On–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	8.7E–04	pCi/kg	U_{234}	7.7E–03	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.0E–04	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	7.2E–03	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	4.8E–01	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	4.2E–04	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	5.3E–02	2.2E–10	1.2E–11
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	3.0E+01	3.6E–11	1.1E–09
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	2.6E–02	1.3E–11	3.4E–13
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	4.7E–01	1.6E–11	7.6E–12
U_{235+1d}	6.1E–03	1.6E–11	9.8E–14
U_{238+2d}	4.4E–01	2.0E–11	8.8E–12
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.1E–09

Table C.III–485
Summary of Intake Quantitation (chemicals) Alternatives 3
South Field Area with Private Ownership: On–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	4.7E–04	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III−485 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: On−Property Farmer (Child)
Via Ingestion of Dairy Products

	HQ Calculation		
Compound	CDI (mg/kg−day)	RfD (mg/kg−day)	HQ (unitless)
antimony	NA	4.0E−04	NA
arsenic	NA	3.0E−04	NA
beryllium	NA	5.0E−03	NA
uranium−total	2.0E−05	3.0E−03	6.8E−03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor−1254	NA	NA	NA
aroclor−1260	NA	NA	NA
dieldrin	NA	5.0E−05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		6.8E−03

	ILCR Calculation		
Compound	CDI (mg/kg−day)	CSF (mg/kg−day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium−total	1.8E−06	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E−02	NA
aroclor−1254	NA	7.7E+00	NA
aroclor−1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

5860

Table C.III–486
Summary of Intake and Risk Quantitation (radionuclides) Alternatives 3
South Field Area with Private Ownership: On–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	7.9E–05	pCi/kg	U_{234}	2.4E–02	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	3.6E–04	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.3E–02	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	2.4E+00	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	3.5E–04	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	1.1E–01	2.2E–10	2.5E–11
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	3.4E+03	3.6E–11	1.2E–07
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	5.0E–01	1.3E–11	6.5E–12
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	3.4E+01	1.6E–11	5.5E–10
U_{235+1d}	5.1E–01	1.6E–11	8.2E–12
U_{238+2d}	3.2E+01	2.0E–11	6.5E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.2E–07

001225

Table C.III–487
Summary of Intake Quantitation (chemicals) Alternatives 3
South Field Area with Private Ownership: On–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	1.0E–02	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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**Table C.III-487 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: On-Property Farmer (Child)
Via Ingestion of Vegetables and Fruits**

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	6.4E-05	3.0E-03	2.1E-02
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.1E-02

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	5.5E-06	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001227

Table C.III–488
Summary of Intake and Risk Quantitation (radionuclides) Alternatives 3
South Field Area with Private Ownership: On–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	1.6E−01	pCi/kg	U_{234}	1.2E+00	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	4.9E−02	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	1.2E+00	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	3.2E+01	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.9E−01	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	3.3E+01	2.2E−10	7.4E−09
Pu_{238}	NA	2.2E−10	NA
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	6.7E+03	3.6E−11	2.4E−07
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	3.9E+01	1.3E−11	5.1E−10
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	2.5E+02	1.6E−11	3.9E−09
U_{235+1d}	1.0E+01	1.6E−11	1.6E−10
U_{238+2d}	2.6E+02	2.0E−11	5.2E−09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
		ILCR Summation =	2.6E−07

001228

5860

Table C.III–489
Summary of Intake and Risk Quantitation (radionuclides) Alternatives 3
South Field Area with Private Ownership: On–Property Farmer (Child)
Via External Radiation

Dose Equivalency Equat = $[DR \times EF \times EDn \times ET_i \times (1-SH_i)] + [DR \times EF \times EDn \times ET_o \times (1-SH_o)]$

EF	Fraction of year spent exposured	0.96 (unitless)
ED	Exposure duration	6 Year
ET_i	Fraction of day spent indoors	0.92 (unitless)
ET_o	Fraction of day spent outdoors	0.08 (unitless)
SH_i	Shield factor indoors	0.5 (unitless)
SH_o	Shield factor outdoors	NA (unitless)
DR	Radionuclide specific dose concentrations	(see table below)

Cs_{137+1d}	NA	pCi/g	$Th_{232+10d}$	NA	pCi/g
Np_{237+1d}	1.55E–02	pCi/g	U_{234}	3.06E–02	pCi/g
Pu_{238}	NA	pCi/g	U_{235+1d}	NA	pCi/g
Ra_{226+8d}	NA	pCi/g	U_{238+2d}	2.70E–02	pCi/g
Ra_{228+1d}	NA	pCi/g	NA	NA	pCi/g
Rn_{222+4d}	NA	pCi/g	NA	NA	pCi/g
Sr_{90+1d}	1.28E–02	pCi/g	NA	NA	pCi/g
Tc_{99}	NA	pCi/g	NA	NA	pCi/g
Th_{228+7d}	NA	pCi/g	NA	NA	pCi/g
Th_{230}	1.19E–01	pCi/g	NA	NA	pCi/g

Radionuclides	CDI (year pCi/g)	CSF $(g/pCi-year)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.0E–06	NA
Np_{237+1d}	4.8E–02	4.3E–07	2.1E–08
Pu_{238}	NA	2.8E–11	NA
Ra_{226+8d}	NA	6.0E–06	NA
Ra_{228+1d}	NA	2.9E–06	NA
Rn_{222+4d}	NA	5.9E–06	NA
Sr_{90+1d}	4.0E–02	NA	NA
Tc_{99}	NA	6.0E–13	NA
Th_{228+7d}	NA	5.6E–06	NA
Th_{230}	3.7E–01	5.4E–11	2.0E–11
$Th_{232+10d}$	NA	8.5E–06	NA
U_{234}	9.5E–02	3.0E–11	2.9E–12
U_{235+1d}	NA	2.4E–07	NA
U_{238+2d}	8.4E–02	5.1E–08	4.3E–09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		2.5E–08

001229

Table C.III–490
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Federal Ownership: Expanded Trespasser
Via Incidental Ingestion of Soil/Sediment

Intake Equation

$$= \frac{CS \times EFa \times EDa \times CF \times IRa}{BWa \times ATa} + \frac{CS \times EFc \times EDc \times CF \times IRc}{BWc \times ATc}$$

IRa	Ingestion rate of soil (adult)	12.5 mg/day
IRc	Ingestion rate of soil (child)	12.5 mg/day
CF	Conversion factor	1.00E–06 kg/mg
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure duration (adult)	32 Year
EDc	Exposure duration (child)	12 Year
BWa	Body weight (adult)	70 kg
BWc	Body weight (child)	43 kg
AT	Average time for carcinogens	25550 days
ATa	Average time for non–carcinogens (adult)	11680 days
ATc	Average time for non–carcinogens (child)	4380 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	2.6E+00	mg/kg	NA	NA	mg/kg
beryllium	2.4E–01	mg/kg	NA	NA	mg/kg
uranium–total	4.3E+00	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	4.4E–01	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	1.1E–01	mg/kg	NA	NA	mg/kg
aroclor–1260	9.3E–03	mg/kg	NA	NA	mg/kg
dieldrin	2.4E–03	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

001230

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Table C.III-490 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Expanded Trespasser
Via Incidental Ingestion of Soil/Sediment

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	2.8E-07	3.0E-04	9.2E-04
beryllium	2.6E-08	5.0E-03	5.2E-06
uranium-total	4.6E-07	3.0E-03	1.5E-04
benzo(a)pyrene	4.7E-08	NA	NA
carbazole	NA	NA	NA
aroclor-1254	1.2E-08	NA	NA
aroclor-1260	1.0E-09	NA	NA
dieldrin	2.6E-10	5.0E-05	5.1E-06
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.1E-03

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	6.2E-08	1.8E+00	1.1E-07
beryllium	5.9E-09	4.3E+00	2.5E-08
uranium-total	1.0E-07	NA	NA
benzo(a)pyrene	1.1E-08	7.3E+00	7.7E-08
carbazole	NA	2.0E-02	NA
aroclor-1254	2.7E-09	7.7E+00	2.1E-08
aroclor-1260	2.2E-10	7.7E+00	1.7E-09
dieldrin	5.8E-11	1.6E+01	9.2E-10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		2.3E-07

001231

0886

Table C.III–491
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Federal Ownership: Expanded Trespasser
Via Incidental Ingestion of Soil/Sediment

Intake Equation = CS X EFa X EDa X FI X IRa + CS X EFc X EDc X FI X IRc

IRa	Ingestion rate of soil (adult)	12.5 mg/day
IRc	Ingestion rate of soil (child)	12.5 mg/day
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure Duration	32 Year
EDc	Exposure Duration	12 Year
FI	Fractional Intake	1 (unitless)
CS	Concentration of radionuclides in soil	(see table below)

Cs_{137+1d}	NA	pCi/mg	$Th_{232+10d}$	3.4E−05	pCi/mg
Np_{237+1d}	1.9E−04	pCi/mg	U_{234}	1.4E−03	pCi/mg
Pu_{238}	NA	pCi/mg	U_{235+1d}	1.3E−03	pCi/mg
Ra_{226+8d}	1.7E−04	pCi/mg	U_{238+2d}	9.5E−04	pCi/mg
Ra_{228+1d}	2.2E−04	pCi/mg	NA	NA	pCi/mg
Rn_{222+4d}	NA	pCi/mg	NA	NA	pCi/mg
Sr_{90+1d}	1.3E−03	pCi/mg	NA	NA	pCi/mg
Tc_{99}	4.0E−04	pCi/mg	NA	NA	pCi/mg
Th_{228+7d}	9.1E−05	pCi/mg	NA	NA	pCi/mg
Th_{230}	3.6E−03	pCi/mg	NA	NA	pCi/mg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	6.1E+00	2.2E−10	1.3E−09
Pu_{238}	NA	2.2E−10	NA
Ra_{226+8d}	5.5E+00	7.8E−10	4.3E−09
Ra_{228+1d}	7.3E+00	1.0E−10	7.3E−10
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	4.1E+01	3.6E−11	1.5E−09
Tc_{99}	1.3E+01	1.3E−12	1.7E−11
Th_{228+7d}	2.9E+00	5.5E−11	1.6E−10
Th_{230}	1.2E+02	1.3E−11	1.5E−09
$Th_{232+10d}$	1.1E+00	1.7E−10	1.9E−10
U_{234}	4.7E+01	1.6E−11	7.5E−10
U_{235+1d}	4.2E+01	1.6E−11	6.7E−10
U_{238+2d}	3.1E+01	2.0E−11	6.2E−10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.2E−08

001232

Table C.III–492
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Federal Ownership: Expanded Trespasser
Via Dermal Contact with Soil/Sediment

Intake Equation = $\frac{CS \times EFa \times EDa \times CF \times ABS \times AF \times SAa}{BWa \times ATa}$ + $\frac{CS \times EFc \times EDc \times CF \times ABS \times AF \times SAc}{BWc \times ATc}$

SA	Surface area of exposed skin (adult)	5750 cm^2/day
SA	Surface area of exposed skin (child)	4200 cm^2/day
AF	Soil to skin adherence factor	1 mg/cm^2
ABS	chemicals specific absorbtion factor (see table below)	csv
CF	Conversion factor	1E–06 kg/mg
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure duration (adult)	32 Year
EDc	Exposure duration (child)	12 Year
BWa	Body weight (adult)	70 kg
BWc	Body weight (child)	43 kg
AT	Average time for carcinogens	25550 days
ATa	Average time for non–carcinogens (adult)	11680 days
ATc	Average time for non–carcinogens (child)	4380 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	ABS	Concentrati	Units	Compound	ABS	Concentrati	Units
antimony	1.0E–02	NA	mg/kg	NA	NA	NA	mg/kg
arsenic	1.0E–03	2.6E+00	mg/kg	NA	NA	NA	mg/kg
beryllium	1.0E–02	2.4E–01	mg/kg	NA	NA	NA	mg/kg
uranium–total	1.0E–02	4.3E+00	mg/kg	NA	NA	NA	mg/kg
benzo(a)pyrene	3.0E–01	4.4E–01	mg/kg	NA	NA	NA	mg/kg
carbazole	3.0E–01	NA	mg/kg	NA	NA	NA	mg/kg
aroclor–1254	6.0E–02	1.1E–01	mg/kg	NA	NA	NA	mg/kg
aroclor–1260	6.0E–02	9.3E–03	mg/kg	NA	NA	NA	mg/kg
dieldrin	3.0E–01	2.4E–03	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg				

References

001233

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Table C.III-492 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Expanded Trespasser
Via Dermal Contact with Soil/Sediment

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.0E-05	NA
arsenic	9.9E-08	2.9E-04	3.5E-04
beryllium	9.4E-08	5.0E-03	1.9E-05
uranium-total	1.6E-06	1.5E-04	1.1E-02
benzo(a)pyrene	5.1E-06	NA	NA
carbazole	NA	NA	NA
aroclor-1254	2.6E-07	NA	NA
aroclor-1260	2.1E-08	NA	NA
dieldrin	2.8E-08	4.5E-05	6.2E-04
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.2E-02

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	2.4E-08	1.9E+00	4.5E-08
beryllium	2.2E-08	4.3E+00	9.6E-08
uranium-total	3.9E-07	NA	NA
benzo(a)pyrene	1.2E-06	NA	NA
carbazole	NA	2.2E-02	NA
aroclor-1254	6.2E-08	1.0E+01	6.4E-07
aroclor-1260	5.1E-09	1.0E+01	5.2E-08
dieldrin	6.6E-09	1.8E+01	1.2E-07
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		9.5E-07

Table C.III–493
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Federal Ownership: Expanded Trespasser
Via Inhalation of Gases and Particulates

Intake Equation $= \frac{CS \times EFa \times EDa \times IR \times ETa}{BWa \times ATa} + \frac{CS \times EFc \times EDc \times IR \times ETc}{BWc \times ATc}$

IR	Inhalation rate of gases	0.83 m^3/hour
ETa	Exposure time (adult)	1 hour/day
ETc	Exposure time (child)	2 hour/day
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure duration (adult)	32 Year
EDc	Exposure duration (child)	12 Year
BWa	Body weight (adult)	70 kg
BWc	Body weight (child)	43 kg
AT	Average time for carcinogens	25550 days
ATa	Average time for non–carcinogens (adult)	11680 days
ATc	Average time for non–carcinogens (child)	4380 days
CS	Concentration of chemicals in particulate as modeled	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/m^3	NA	NA	mg/m^3
arsenic	8.2E–08	mg/m^3	NA	NA	mg/m^3
beryllium	6.3E–09	mg/m^3	NA	NA	mg/m^3
uranium–total	7.0E–08	mg/m^3	NA	NA	mg/m^3
benzo(a)pyrene	1.3E–08	mg/m^3	NA	NA	mg/m^3
carbazole	NA	mg/m^3	NA	NA	mg/m^3
aroclor–1254	3.3E–09	mg/m^3	NA	NA	mg/m^3
aroclor–1260	2.8E–10	mg/m^3	NA	NA	mg/m^3
dieldrin	7.2E–11	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3

References

001235

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Table C.III-493 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Expanded Trespasser
Via Inhalation of Gases and Particulates

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	NA	NA
arsenic	1.1E-09	NA	NA
beryllium	8.2E-11	NA	NA
uranium-total	9.1E-10	NA	NA
benzo(a)pyrene	1.7E-10	NA	NA
carbazole	NA	NA	NA
aroclor-1254	4.2E-11	NA	NA
aroclor-1260	3.6E-12	NA	NA
dieldrin	9.3E-13	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
HQ Summation =			NA

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	2.1E-10	1.5E+01	3.2E-09
beryllium	1.6E-11	8.4E+00	1.4E-10
uranium-total	1.8E-10	NA	NA
benzo(a)pyrene	3.4E-11	6.1E+00	2.1E-10
carbazole	NA	NA	NA
aroclor-1254	8.4E-12	NA	NA
aroclor-1260	7.3E-13	NA	NA
dieldrin	1.9E-13	1.6E+01	3.0E-12
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
ILCR Summation =			3.5E-09

Table C.III–494
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Federal Ownership: Expanded Trespasser
Via Inhalation of Gases and Particulates

Intake Equation = CA X EFa X EDa X IR X ETa + CA X EFc EDc X IR X ETc

IR	Inhalation rate of gases	0.83 m^3/hour
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure duration	32 Year
EDc	Exposure duration	12 Year
ETa	Exposure time (adult)	1 hour/day
ETc	Exposure time (child)	2 hour/day
CA	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	1.0E–06	pCi/m^3
Np_{237+1d}	3.6E–06	pCi/m^3	U_{234}	3.1E–05	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	2.9E–05	pCi/m^3
Ra_{226+8d}	3.7E–06	pCi/m^3	U_{238+2d}	2.0E–05	pCi/m^3
Ra_{228+1d}	5.9E–06	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	1.7E+00	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	3.0E–05	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	8.7E–06	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	2.7E–06	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	9.3E–05	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	1.2E–02	2.9E–08	3.4E–10
Pu_{238}	NA	3.9E–08	NA
Ra_{226+8d}	1.2E–02	7.0E–09	8.4E–11
Ra_{228+1d}	1.9E–02	6.9E–10	1.3E–11
Rn_{222+4d}	5.5E+03	7.7E–12	4.2E–08
Sr_{90+1d}	9.7E–02	6.2E–11	6.0E–12
Tc_{99}	2.8E–02	8.3E–12	2.3E–13
Th_{228+7d}	8.9E–03	7.8E–08	6.9E–10
Th_{230}	3.0E–01	2.9E–08	8.8E–09
$Th_{232+10d}$	3.4E–03	1.1E–07	3.7E–10
U_{234}	1.0E–01	2.6E–08	2.6E–09
U_{235+1d}	9.5E–02	2.5E–08	2.4E–09
U_{238+2d}	6.4E–02	2.4E–08	1.5E–09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 5.9E–08

Table C.III−495
Summary of Risk Quantitation (radionuclides) Alternative 6
South Field Area with Federal Ownership: Expanded Trespasser
Via External Radiation

Exposure Equation = $[CR \times EFa \times EDa \times ET_{oa} \times (1-SH_o)]+[CR \times EFc \times EDc \times ET_{oc} \times (1-SH_o)]$

EFa	Fraction of year spent exposured (adult)	0.11 (unitless)
EFc	Fraction of year spent exposured (child)	0.3 (unitless)
EDa	Exposure duration (adult)	32 Year
EDc	Exposure duration (child)	12 Year
ET_{oa}	Fraction of day spent outdoors (adult)	0.04 (unitless)
ET_{oc}	Fraction of day spent outdoors (child)	0.08 (unitless)
SH_o	Shield factor outdoors	NA (unitless)
CR	Radionuclide specific concentrations	(see table below)

Cs_{137+1d}	NA	pCi/g	$Th_{232+10d}$	3.4E−02	pCi/g
Np_{237+1d}	1.9E−01	pCi/g	U_{234}	1.4E+00	pCi/g
Pu_{238}	NA	pCi/g	U_{235+1d}	1.3E+00	pCi/g
Ra_{226+8d}	1.7E−01	pCi/g	U_{238+2d}	9.5E−01	pCi/g
Ra_{228+1d}	2.2E−01	pCi/g	NA	NA	pCi/g
Rn_{222+4d}	NA	pCi/g	NA	NA	pCi/g
Sr_{90+1d}	1.3E+00	pCi/g	NA	NA	pCi/g
Tc_{99}	4.0E−01	pCi/g	NA	NA	pCi/g
Th_{228+7d}	9.1E−02	pCi/g	NA	NA	pCi/g
Th_{230}	3.6E+00	pCi/g	NA	NA	pCi/g

Radionuclides	CDI (year pCi/g)	CSF $(g/pCi-year)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.0E−06	NA
Np_{237+1d}	8.1E−02	4.3E−07	3.5E−08
Pu_{238}	NA	2.8E−11	NA
Ra_{226+8d}	7.2E−02	6.0E−06	4.3E−07
Ra_{228+1d}	9.6E−02	2.9E−06	2.8E−07
Rn_{222+4d}	NA	5.9E−06	NA
Sr_{90+1d}	5.4E−01	NA	NA
Tc_{99}	1.7E−01	6.0E−13	1.0E−13
Th_{228+7d}	3.9E−02	5.6E−06	2.2E−07
Th_{230}	1.6E+00	5.4E−11	8.4E−11
$Th_{232+10d}$	1.5E−02	8.5E−06	1.3E−07
U_{234}	6.2E−01	3.0E−11	1.9E−11
U_{235+1d}	5.5E−01	2.4E−07	1.3E−07
U_{238+2d}	4.1E−01	5.1E−08	2.1E−08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
		ILCR Summation =	1.2E−06

Table C.III–496
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium–total	2.16E–03	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
aroclor–1254	NA	mg/l	NA	NA	mg/l
aroclor–1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

Table C.III-496 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off-Property Farmer (Adult)
Via Drinking Water Ingestion

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	5.92E-05	3.00E-03	1.97E-02
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.97E-02

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	5.92E-05	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001240

5860

Table C.III–497
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	6.6E–01	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	3.5E–02	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	7.2E–01	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	3.2E+04	1.6E–11	5.1E–07
U_{235+1d}	1.7E+03	1.6E–11	2.7E–08
U_{238+2d}	3.5E+04	2.0E–11	7.1E–07
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.2E–06

001241

Table C.III–498
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2–day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
SA	Skin surface area available for contact	23000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
arsenic	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
beryllium	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
uranium–total	5.40E–10	mg/cm^2–day	NA	NA	mg/cm^2–day
benzo(a)pyrene	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
carbazole	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1254	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1260	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
dieldrin	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day			

References

001242

Table C.III–498 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Dermal Contact while Bathing

Compound	HQ Calculation CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	6.00E–05	NA
arsenic	NA	2.85E–04	NA
beryllium	NA	5.00E–03	NA
uranium–total	1.70E–07	1.50E–04	1.13E–03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	4.50E–05	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
HQ Summation =			1.13E–03

Compound	ILCR Calculation CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium–total	1.70E–07	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E–02	NA
aroclor–1254	NA	1.03E+01	NA
aroclor–1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
ILCR Summation =			NA

Table C.III–499
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Inhalation of Particulates

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/m^3	NA	NA	mg/m^3
arsenic	4.3E–09	mg/m^3	NA	NA	mg/m^3
beryllium	3.2E–10	mg/m^3	NA	NA	mg/m^3
uranium–total	5.7E–09	mg/m^3	NA	NA	mg/m^3
benzo(a)pyrene	4.8E–10	mg/m^3	NA	NA	mg/m^3
carbazole	NA	mg/m^3	NA	NA	mg/m^3
aroclor–1254	1.2E–10	mg/m^3	NA	NA	mg/m^3
aroclor–1260	1.0E–11	mg/m^3	NA	NA	mg/m^3
dieldrin	2.6E–12	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3

References

001244

Table C.III–499 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Inhalation of Particulates

Compound	HQ Calculation CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	NA	NA
arsenic	1.2E–09	NA	NA
beryllium	8.8E–11	NA	NA
uranium–total	1.6E–09	NA	NA
benzo(a)pyrene	1.3E–10	NA	NA
carbazole	NA	NA	NA
aroclor–1254	3.4E–11	NA	NA
aroclor–1260	2.8E–12	NA	NA
dieldrin	7.0E–13	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
Hazard Quotient Sum =			NA

Compound	ILCR Calculation CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	1.2E–09	1.5E+01	1.8E–08
beryllium	8.8E–11	8.4E+00	7.4E–10
uranium–total	1.6E–09	NA	NA
benzo(a)pyrene	1.3E–10	6.1E+00	8.0E–10
carbazole	NA	NA	NA
aroclor–1254	3.4E–11	NA	NA
aroclor–1260	2.8E–12	NA	NA
dieldrin	7.0E–13	1.6E+01	1.1E–11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
ILCR Summation =			1.9E–08

Table C.III–500
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	3.7E–08	pCi/m^3
Np_{237+1d}	2.5E–07	pCi/m^3	U_{234}	1.7E–06	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	1.4E–06	pCi/m^3
Ra_{226+8d}	1.9E–07	pCi/m^3	U_{238+2d}	1.1E–06	pCi/m^3
Ra_{228+1d}	2.4E–07	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	8.7E–02	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	1.6E–06	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	4.4E–07	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	9.8E–08	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	3.9E–06	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	1.2E–01	2.9E–08	3.6E–09
Pu_{238}	NA	3.9E–08	NA
Ra_{226+8d}	9.3E–02	7.0E–09	6.5E–10
Ra_{228+1d}	1.2E–01	6.9E–10	8.2E–11
Rn_{222+4d}	4.3E+04	7.7E–12	3.3E–07
Sr_{90+1d}	7.9E–01	6.2E–11	4.9E–11
Tc_{99}	2.2E–01	8.3E–12	1.8E–12
Th_{228+7d}	4.8E–02	7.8E–08	3.8E–09
Th_{230}	1.9E+00	2.9E–08	5.5E–08
$Th_{232+10d}$	1.8E–02	1.1E–07	2.0E–09
U_{234}	8.1E–01	2.6E–08	2.1E–08
U_{235+1d}	7.1E–01	2.5E–08	1.8E–08
U_{238+2d}	5.3E–01	2.4E–08	1.3E–08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 4.5E–07

001246

Table C.III–501
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	3.0E–06	mg/kg	NA	NA	mg/kg
beryllium	5.0E–08	mg/kg	NA	NA	mg/kg
uranium–total	2.2E–05	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	1.9E–06	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	6.8E–07	mg/kg	NA	NA	mg/kg
aroclor–1260	9.9E–07	mg/kg	NA	NA	mg/kg
dieldrin	1.7E–10	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-501 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Meat Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	3.1E-09	3.0E-04	1.0E-05
beryllium	5.2E-11	5.0E-03	1.0E-08
uranium-total	2.3E-08	3.0E-03	7.5E-06
benzo(a)pyrene	2.0E-09	NA	NA
carbazole	NA	NA	NA
aroclor-1254	7.1E-10	NA	NA
aroclor-1260	1.0E-09	NA	NA
dieldrin	1.8E-13	5.0E-05	3.6E-09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.8E-05

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	3.1E-09	1.8E+00	5.5E-09
beryllium	5.2E-11	4.3E+00	2.3E-10
uranium-total	2.3E-08	NA	NA
benzo(a)pyrene	2.0E-09	7.3E+00	1.4E-08
carbazole	NA	2.0E-02	NA
aroclor-1254	7.1E-10	7.7E+00	5.4E-09
aroclor-1260	1.0E-09	7.7E+00	7.9E-09
dieldrin	1.8E-13	1.6E+01	2.9E-12
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		3.3E-08

001248

5860

Table C.III–502
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	2.0E–08	pCi/kg
Np_{237+1d}	1.1E–06	pCi/kg	U_{234}	6.6E–03	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	3.7E–04	pCi/kg
Ra_{226+8d}	6.2E–06	pCi/kg	U_{238+2d}	7.2E–03	pCi/kg
Ra_{228+1d}	4.7E–06	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	1.4E–04	pCi/kg	NA	NA	pCi/kg
Tc_{99}	5.3E–04	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	4.3E–08	pCi/kg	NA	NA	pCi/kg
Th_{230}	2.1E–06	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	2.0E–03	2.2E–10	4.3E–13
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	1.1E–02	7.8E–10	8.9E–12
Ra_{228+1d}	8.7E–03	1.0E–10	8.7E–13
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	2.7E–01	3.6E–11	9.6E–12
Tc_{99}	9.9E–01	1.3E–12	1.3E–12
Th_{228+7d}	8.1E–05	5.5E–11	4.4E–15
Th_{230}	3.9E–03	1.3E–11	5.1E–14
$Th_{232+10d}$	3.7E–05	1.7E–10	6.3E–15
U_{234}	1.2E+01	1.6E–11	2.0E–10
U_{235+1d}	6.9E–01	1.6E–11	1.1E–11
U_{238+2d}	1.3E+01	2.0E–11	2.7E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 5.0E–10

001249

Table C.III–503
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	9.0E–08	mg/kg	NA	NA	mg/kg
beryllium	4.5E–11	mg/kg	NA	NA	mg/kg
uranium–total	7.8E–05	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	6.0E–07	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	2.2E–07	mg/kg	NA	NA	mg/kg
aroclor–1260	3.1E–07	mg/kg	NA	NA	mg/kg
dieldrin	5.6E–11	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

001250

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Table C.III-503 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Dairy Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	3.7E-10	3.0E-04	1.2E-06
beryllium	1.9E-13	5.0E-03	3.7E-11
uranium-total	3.2E-07	3.0E-03	1.1E-04
benzo(a)pyrene	2.5E-09	NA	NA
carbazole	NA	NA	NA
aroclor-1254	8.8E-10	NA	NA
aroclor-1260	1.3E-09	NA	NA
dieldrin	2.3E-13	5.0E-05	4.6E-09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.1E-04

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	3.7E-10	1.8E+00	6.5E-10
beryllium	1.9E-13	4.3E+00	8.0E-13
uranium-total	3.2E-07	NA	NA
benzo(a)pyrene	2.5E-09	7.3E+00	1.8E-08
carbazole	NA	2.0E-02	NA
aroclor-1254	8.8E-10	7.7E+00	6.8E-09
aroclor-1260	1.3E-09	7.7E+00	9.9E-09
dieldrin	2.3E-13	1.6E+01	3.7E-12
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		3.5E-08

001251

Table C.III–504
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	1.7E–08	pCi/kg
Np_{237+1d}	9.6E–08	pCi/kg	U_{234}	2.4E–02	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.3E–03	pCi/kg
Ra_{226+8d}	1.1E–05	pCi/kg	U_{238+2d}	2.6E–02	pCi/kg
Ra_{228+1d}	8.5E–06	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	7.2E–04	pCi/kg	NA	NA	pCi/kg
Tc_{99}	6.3E–04	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	3.7E–08	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.8E–06	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	7.1E–04	2.2E–10	1.6E–13
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	8.1E–02	7.8E–10	6.3E–11
Ra_{228+1d}	6.2E–02	1.0E–10	6.2E–12
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	5.3E+00	3.6E–11	1.9E–10
Tc_{99}	4.6E+00	1.3E–12	6.0E–12
Th_{228+7d}	2.7E–04	5.5E–11	1.5E–14
Th_{230}	1.3E–02	1.3E–11	1.7E–13
$Th_{232+10d}$	1.2E–04	1.7E–10	2.1E–14
U_{234}	1.7E+02	1.6E–11	2.8E–09
U_{235+1d}	9.7E+00	1.6E–11	1.6E–10
U_{238+2d}	1.9E+02	2.0E–11	3.8E–09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 7.0E–09

001252

Table C.III–505
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	1.4E–05	mg/kg	NA	NA	mg/kg
beryllium	5.4E–07	mg/kg	NA	NA	mg/kg
uranium–total	1.1E–02	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	7.7E–07	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	2.6E–07	mg/kg	NA	NA	mg/kg
aroclor–1260	2.7E–08	mg/kg	NA	NA	mg/kg
dieldrin	2.5E–09	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

001253

5860

Table C.III-505 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	2.4E-08	3.0E-04	8.0E-05
beryllium	9.0E-10	5.0E-03	1.8E-07
uranium-total	1.8E-05	3.0E-03	5.9E-03
benzo(a)pyrene	1.3E-09	NA	NA
carbazole	NA	NA	NA
aroclor-1254	4.3E-10	NA	NA
aroclor-1260	4.6E-11	NA	NA
dieldrin	4.2E-12	5.0E-05	8.4E-08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		6.0E-03

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	2.4E-08	1.8E+00	4.2E-08
beryllium	9.0E-10	4.3E+00	3.9E-09
uranium-total	1.8E-05	NA	NA
benzo(a)pyrene	1.3E-09	7.3E+00	9.4E-09
carbazole	NA	2.0E-02	NA
aroclor-1254	4.3E-10	7.7E+00	3.3E-09
aroclor-1260	4.6E-11	7.7E+00	3.5E-10
dieldrin	4.2E-12	1.6E+01	6.7E-11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		5.9E-08

001254

5860

Table C.III–506
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	4.1E–05	pCi/kg
Np_{237+1d}	2.5E–04	pCi/kg	U_{234}	3.2E+00	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.7E–01	pCi/kg
Ra_{226+8d}	2.7E–04	pCi/kg	U_{238+2d}	3.5E+00	pCi/kg
Ra_{228+1d}	2.4E–04	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	4.6E–03	pCi/kg	NA	NA	pCi/kg
Tc_{99}	6.9E–04	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	9.6E–05	pCi/kg	NA	NA	pCi/kg
Th_{230}	4.3E–03	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	7.4E–01	2.2E–10	1.6E–10
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	8.2E–01	7.8E–10	6.4E–10
Ra_{228+1d}	7.3E–01	1.0E–10	7.3E–11
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	1.4E+01	3.6E–11	5.0E–10
Tc_{99}	2.0E+00	1.3E–12	2.7E–12
Th_{228+7d}	2.9E–01	5.5E–11	1.6E–11
Th_{230}	1.3E+01	1.3E–11	1.7E–10
$Th_{232+10d}$	1.2E–01	1.7E–10	2.1E–11
U_{234}	9.6E+03	1.6E–11	1.5E–07
U_{235+1d}	5.2E+02	1.6E–11	8.3E–09
U_{238+2d}	1.1E+04	2.0E–11	2.1E–07
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
		ILCR Summation =	3.7E–07

001255

Table C.III–507
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Federal Ownership: Off–Property Farmer (Child)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium–total	2.16E–03	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
aroclor–1254	NA	mg/l	NA	NA	mg/l
aroclor–1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

001256

Table C.III-507 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off-Property Farmer (Child)
Via Drinking Water Ingestion

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	1.38E-04	3.00E-03	4.60E-02
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	HQ Summation =		4.60E-02

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	1.18E-05	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	ILCR Summation =		NA

Table C.III−508
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Federal Ownership: Off−Property Farmer (Child)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	6.6E−01	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	3.5E−02	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	7.2E−01	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	NA	2.2E−10	NA
Pu_{238}	NA	2.2E−10	NA
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	NA	3.6E−11	NA
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	NA	1.3E−11	NA
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	1.4E+03	1.6E−11	2.2E−08
U_{235+1d}	7.4E+01	1.6E−11	1.2E−09
U_{238+2d}	1.5E+03	2.0E−11	3.0E−08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	5.3E−08

001258

Table C.III–509
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Federal Ownership: Off–Property Farmer (Child)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2–day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
SA	Skin surface area available for contact	8000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
arsenic	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
beryllium	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
uranium–total	5.40E–10	mg/cm^2–day	NA	NA	mg/cm^2–day
benzo(a)pyrene	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
carbazole	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1254	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1260	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
dieldrin	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day			

References

Table C.III-509 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off-Property Farmer (Child)
Via Dermal Contact while Bathing

Compound	HQ Calculation: CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	2.76E-07	1.50E-04	1.84E-03
beizo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.84E-03

Compound	ILCR Calculation: CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	2.37E-08	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001260

Table C.III–510
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Federal Ownership: Off–Property Farmer (Child)
Via Inhalation of Particulates

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Inhalation rate of gases (RAGS, 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/m^3	NA	NA	mg/m^3
arsenic	4.3E–09	mg/m^3	NA	NA	mg/m^3
beryllium	3.2E–10	mg/m^3	NA	NA	mg/m^3
uranium–total	5.7E–09	mg/m^3	NA	NA	mg/m^3
benzo(a)pyrene	4.8E–10	mg/m^3	NA	NA	mg/m^3
carbazole	NA	mg/m^3	NA	NA	mg/m^3
aroclor–1254	1.2E–10	mg/m^3	NA	NA	mg/m^3
aroclor–1260	1.0E–11	mg/m^3	NA	NA	mg/m^3
dieldrin	2.6E–12	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3	NA	NA	mg/m^3
NA	NA	mg/m^3			

References

Table C.III-510 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off-Property Farmer (Child)
Via Inhalation of Particulates

Compound	HQ Calculation		
	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	NA	NA
arsenic	3.3E-09	NA	NA
beryllium	2.5E-10	NA	NA
uranium-total	4.4E-09	NA	NA
benzo(a)pyrene	3.7E-10	NA	NA
carbazole	NA	NA	NA
aroclor-1254	9.4E-11	NA	NA
aroclor-1260	7.7E-12	NA	NA
dieldrin	2.0E-12	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
Hazard Quotient Sum =			NA

Compound	ILCR Calculation		
	CDI (mg/kg-day)	CSF $(mg/kg\text{-}day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	2.8E-10	1.5E+01	4.2E-09
beryllium	2.1E-11	8.4E+00	1.8E-10
uranium-total	3.8E-10	NA	NA
benzo(a)pyrene	3.1E-11	6.1E+00	1.9E-10
carbazole	NA	NA	NA
aroclor-1254	8.1E-12	NA	NA
aroclor-1260	6.6E-13	NA	NA
dieldrin	1.7E-13	1.6E+01	2.7E-12
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
ILCR Summation =			4.6E-09

001262

5860

Table C.III–511
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Federal Ownership: Off–Property Farmer (Child)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	3.7E–08	pCi/m^3
Np_{237+1d}	2.5E–07	pCi/m^3	U_{234}	1.7E–06	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	1.4E–06	pCi/m^3
Ra_{226+8d}	1.9E–07	pCi/m^3	U_{238+2d}	1.1E–06	pCi/m^3
Ra_{228+1d}	2.4E–07	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	8.7E–02	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	1.6E–06	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	4.4E–07	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	9.8E–08	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	3.9E–06	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	6.3E–03	2.9E–08	1.8E–10
Pu_{238}	NA	3.9E–08	NA
Ra_{226+8d}	4.8E–03	7.0E–09	3.3E–11
Ra_{228+1d}	6.1E–03	6.9E–10	4.2E–12
Rn_{222+4d}	2.2E+03	7.7E–12	1.7E–08
Sr_{90+1d}	4.1E–02	6.2E–11	2.5E–12
Tc_{99}	1.1E–02	8.3E–12	9.3E–14
Th_{228+7d}	2.5E–03	7.8E–08	1.9E–10
Th_{230}	9.8E–02	2.9E–08	2.8E–09
$Th_{232+10d}$	9.4E–04	1.1E–07	1.0E–10
U_{234}	4.2E–02	2.6E–08	1.1E–09
U_{235+1d}	3.6E–02	2.5E–08	9.1E–10
U_{238+2d}	2.7E–02	2.4E–08	6.5E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.3E–08

001263

Table C.III–512
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	3.0E–06	mg/kg	NA	NA	mg/kg
beryllium	5.0E–08	mg/kg	NA	NA	mg/kg
uranium–total	2.2E–05	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	1.2E–06	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	6.8E–07	mg/kg	NA	NA	mg/kg
aroclor–1260	9.9E–07	mg/kg	NA	NA	mg/kg
dieldrin	1.7E–10	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

001264

Table C.III-512 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Meat Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	5.6E-09	3.0E-04	1.9E-05
beryllium	9.4E-11	5.0E-03	1.9E-08
uranium-total	4.1E-08	3.0E-03	1.4E-05
benzo(a)pyrene	2.2E-09	NA	NA
carbazole	NA	NA	NA
aroclor-1254	1.3E-09	NA	NA
aroclor-1260	1.8E-09	NA	NA
dieldrin	3.3E-13	5.0E-05	6.5E-09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
HQ Summation =			3.2E-05

Compound	ILCR Calculation CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	4.8E-10	1.8E+00	8.5E-10
beryllium	8.1E-12	4.3E+00	3.5E-11
uranium-total	3.5E-09	NA	NA
benzo(a)pyrene	1.9E-10	7.3E+00	1.4E-09
carbazole	NA	2.0E-02	NA
aroclor-1254	1.1E-10	7.7E+00	8.4E-10
aroclor-1260	1.6E-10	7.7E+00	1.2E-09
dieldrin	2.8E-14	1.6E+01	4.5E-13
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
ILCR Summation =			4.3E-09

Table C.III–513
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	2.0E–08	pCi/kg
Np_{237+1d}	1.1E–06	pCi/kg	U_{234}	6.6E–03	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	3.7E–04	pCi/kg
Ra_{226+8d}	6.2E–06	pCi/kg	U_{238+2d}	7.2E–03	pCi/kg
Ra_{228+1d}	4.7E–06	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	1.4E–04	pCi/kg	NA	NA	pCi/kg
Tc_{99}	5.3E–04	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	4.3E–08	pCi/kg	NA	NA	pCi/kg
Th_{230}	2.1E–06	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	6.5E–05	2.2E–10	1.4E–14
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	3.8E–04	7.8E–10	2.9E–13
Ra_{228+1d}	2.9E–04	1.0E–10	2.9E–14
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	8.8E–03	3.6E–11	3.2E–13
Tc_{99}	3.3E–02	1.3E–12	4.3E–14
Th_{228+7d}	2.7E–06	5.5E–11	1.5E–16
Th_{230}	1.3E–04	1.3E–11	1.7E–15
$Th_{232+10d}$	1.2E–06	1.7E–10	2.1E–16
U_{234}	4.0E–01	1.6E–11	6.5E–12
U_{235+1d}	2.3E–02	1.6E–11	3.7E–13
U_{238+2d}	4.4E–01	2.0E–11	8.9E–12
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.6E–11

5860

Table C.III–514
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	9.0E–08	mg/kg	NA	NA	mg/kg
beryllium	4.5E–11	mg/kg	NA	NA	mg/kg
uranium–total	7.8E–05	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	3.7E–07	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	2.2E–07	mg/kg	NA	NA	mg/kg
aroclor–1260	3.1E–07	mg/kg	NA	NA	mg/kg
dieldrin	5.6E–11	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

001267

Table C.III-514 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Dairy Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	3.9E-09	3.0E-04	1.3E-05
beryllium	2.0E-12	5.0E-03	3.9E-10
uranium-total	3.4E-06	3.0E-03	1.1E-03
benzo(a)pyrene	1.6E-08	NA	NA
carbazole	NA	NA	NA
aroclor-1254	9.3E-09	NA	NA
aroclor-1260	1.3E-08	NA	NA
dieldrin	2.4E-12	5.0E-05	4.8E-08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.1E-03

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	3.3E-10	1.8E+00	5.9E-10
beryllium	1.7E-13	4.3E+00	7.2E-13
uranium-total	2.9E-07	NA	NA
benzo(a)pyrene	1.4E-09	7.3E+00	1.0E-08
carbazole	NA	2.0E-02	NA
aroclor-1254	8.0E-10	7.7E+00	6.1E-09
aroclor-1260	1.2E-09	7.7E+00	8.9E-09
dieldrin	2.1E-13	1.6E+01	3.3E-12
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		2.6E-08

001268

Table C.III–515
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	1.7E–08	pCi/kg
Np_{237+1d}	9.6E–08	pCi/kg	U_{234}	2.4E–02	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.3E–03	pCi/kg
Ra_{226+8d}	1.1E–05	pCi/kg	U_{238+2d}	2.6E–02	pCi/kg
Ra_{228+1d}	8.5E–06	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	7.2E–04	pCi/kg	NA	NA	pCi/kg
Tc_{99}	6.3E–04	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	3.7E–08	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.8E–06	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	1.4E–04	2.2E–10	3.0E–14
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	1.6E–02	7.8E–10	1.2E–11
Ra_{228+1d}	1.2E–02	1.0E–10	1.2E–12
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	1.0E+00	3.6E–11	3.7E–11
Tc_{99}	8.9E–01	1.3E–12	1.2E–12
Th_{228+7d}	5.2E–05	5.5E–11	2.9E–15
Th_{230}	2.5E–03	1.3E–11	3.2E–14
$Th_{232+10d}$	2.4E–05	1.7E–10	4.0E–15
U_{234}	3.4E+01	1.6E–11	5.4E–10
U_{235+1d}	1.9E+00	1.6E–11	3.0E–11
U_{238+2d}	3.7E+01	2.0E–11	7.4E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
		ILCR Summation =	1.4E–09

001269

Table C.III–516
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	1.4E–05	mg/kg	NA	NA	mg/kg
beryllium	5.4E–07	mg/kg	NA	NA	mg/kg
uranium–total	1.1E–02	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	4.8E–07	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	2.6E–07	mg/kg	NA	NA	mg/kg
aroclor–1260	2.7E–08	mg/kg	NA	NA	mg/kg
dieldrin	2.5E–09	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III-516 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	9.2E-08	3.0E-04	3.1E-04
beryllium	3.4E-09	5.0E-03	6.9E-07
uranium-total	6.8E-05	3.0E-03	2.3E-02
benzo(a)pyrene	3.1E-09	NA	NA
carbazole	NA	NA	NA
aroclor-1254	1.6E-09	NA	NA
aroclor-1260	1.8E-10	NA	NA
dieldrin	1.6E-11	5.0E-05	3.2E-07
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.3E-02

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	7.9E-09	1.8E+00	1.4E-08
beryllium	3.0E-10	4.3E+00	1.3E-09
uranium-total	5.8E-06	NA	NA
benzo(a)pyrene	2.6E-10	7.3E+00	1.9E-09
carbazole	NA	2.0E-02	NA
aroclor-1254	1.4E-10	7.7E+00	1.1E-09
aroclor-1260	1.5E-11	7.7E+00	1.2E-10
dieldrin	1.4E-12	1.6E+01	2.2E-11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		1.8E-08

001271

Table C.III–517
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	4.1E–05	pCi/kg
Np_{237+1d}	2.5E–04	pCi/kg	U_{234}	3.2E+00	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.7E–01	pCi/kg
Ra_{226+8d}	2.7E–04	pCi/kg	U_{238+2d}	3.5E+00	pCi/kg
Ra_{228+1d}	2.4E–04	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	4.6E–03	pCi/kg	NA	NA	pCi/kg
Tc_{99}	6.9E–04	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	9.6E–05	pCi/kg	NA	NA	pCi/kg
Th_{230}	4.3E–03	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	5.2E–02	2.2E–10	1.1E–11
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	5.8E–02	7.8E–10	4.5E–11
Ra_{228+1d}	5.1E–02	1.0E–10	5.1E–12
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	9.7E–01	3.6E–11	3.5E–11
Tc_{99}	1.4E–01	1.3E–12	1.9E–13
Th_{228+7d}	2.0E–02	5.5E–11	1.1E–12
Th_{230}	9.0E–01	1.3E–11	1.2E–11
$Th_{232+10d}$	8.6E–03	1.7E–10	1.5E–12
U_{234}	6.7E+02	1.6E–11	1.1E–08
U_{235+1d}	3.6E+01	1.6E–11	5.8E–10
U_{238+2d}	7.4E+02	2.0E–11	1.5E–08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.6E–08

5860

Table C.III–518
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Private Ownership: Off–Property Farmer (Adult)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium–total	1.03E–04	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
aroclor–1254	NA	mg/l	NA	NA	mg/l
aroclor–1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

001273

Table C.III-518 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: Off-Property Farmer (Adult)
Via Drinking Water Ingestion

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	2.82E-06	3.00E-03	9.41E-04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		9.41E-04

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	2.82E-06	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

5860

Table C.III–519
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	3.1E–02	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	2.0E–03	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	3.4E–02	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.5E+03	1.6E–11	2.4E–08
U_{235+1d}	9.8E+01	1.6E–11	1.6E–09
U_{238+2d}	1.7E+03	2.0E–11	3.3E–08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 5.9E–08

Table C.III–520
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Private Ownership: Off–Property Farmer (Adult)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2–day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
SA	Skin surface area available for contact	23000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
arsenic	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
beryllium	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
uranium–total	2.58E–11	mg/cm^2–day	NA	NA	mg/cm^2–day
benzo(a)pyrene	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
carbazole	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1254	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1260	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
dieldrin	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day			

References

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Table C.III−520 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: Off−Property Farmer (Adult)
Via Dermal Contact while Bathing

Compound	HQ Calculation CDI (mg/kg−day)	RfD (mg/kg−day)	HQ (unitless)
antimony	NA	6.00E−05	NA
arsenic	NA	2.85E−04	NA
beryllium	NA	5.00E−03	NA
uranium−total	8.11E−09	1.50E−04	5.41E−05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor−1254	NA	NA	NA
aroclor−1260	NA	NA	NA
dieldrin	NA	4.50E−05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		5.41E−05

Compound	ILCR Calculation CDI (mg/kg−day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium−total	8.11E−09	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E−02	NA
aroclor−1254	NA	1.03E+01	NA
aroclor−1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

Table C.III–521
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Private Ownership: Off–Property Farmer (Adult)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	3.3E−07	pCi/m^3	U_{234}	1.0E−06	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	8.8E−07	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	2.2E−07	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	2.8E−06	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E−11	NA
Np_{237+1d}	1.6E−01	2.9E−08	4.6E−09
Pu_{238}	NA	3.9E−08	NA
Ra_{226+8d}	NA	7.0E−09	NA
Ra_{228+1d}	NA	6.9E−10	NA
Rn_{222+4d}	NA	7.7E−12	NA
Sr_{90+1d}	1.1E−01	6.2E−11	6.6E−12
Tc_{99}	NA	8.3E−12	NA
Th_{228+7d}	NA	7.8E−08	NA
Th_{230}	1.4E+00	2.9E−08	3.9E−08
$Th_{232+10d}$	NA	1.1E−07	NA
U_{234}	4.9E−01	2.6E−08	1.3E−08
U_{235+1d}	NA	2.5E−08	NA
U_{238+2d}	4.3E−01	2.4E−08	1.0E−08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	6.7E−08

Table C.III–522
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	1.3E–06	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III-522 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: Off-Property Farmer (Adult)
Via Ingestion of Meat Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.3E-09	3.0E-03	4.4E-07
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		4.4E-07

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.3E-09	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

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Table C.III–523
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	1.4E–06	pCi/kg	U_{234}	3.3E–04	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	2.0E–05	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	3.5E–04	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	1.9E–05	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.5E–06	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	2.6E–03	2.2E–10	5.6E–13
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	3.6E–02	3.6E–11	1.3E–12
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	2.8E–03	1.3E–11	3.6E–14
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	6.0E–01	1.6E–11	9.7E–12
U_{235+1d}	3.7E–02	1.6E–11	5.9E–13
U_{238+2d}	6.6E–01	2.0E–11	1.3E–11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	2.5E–11

Table C.III–524
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	4.4E–06	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III-524 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: Off-Property Farmer (Adult)
Via Ingestion of Dairy Products

Compound	HQ Calculation		
	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.8E-08	3.0E-03	6.0E-06
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		6.0E-06

Compound	ILCR Calculation		
	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.8E-08	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

0282

Table C.III–525
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	1.3E–07	pCi/kg	U_{234}	1.2E–03	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	7.2E–05	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	1.3E–03	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	9.6E–05	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.2E–06	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	9.2E–04	2.2E–10	2.0E–13
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	7.1E–01	3.6E–11	2.5E–11
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	9.1E–03	1.3E–11	1.2E–13
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	8.5E+00	1.6E–11	1.4E–10
U_{235+1d}	5.3E–01	1.6E–11	8.5E–12
U_{238+2d}	9.3E+00	2.0E–11	1.9E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	3.6E–10

Table C.III–526
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	5.2E–04	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-526 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: Off-Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	8.7E-07	3.0E-03	2.9E-04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.9E-04

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	8.7E-07	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

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Table C.III–527
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Private Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	3.2E–04	pCi/kg	U_{234}	1.5E–01	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	9.8E–03	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	1.7E–01	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	6.2E–04	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	3.1E–03	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	9.7E–01	2.2E–10	2.1E–10
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	1.9E+00	3.6E–11	6.7E–11
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	9.1E+00	1.3E–11	1.2E–10
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	4.6E+02	1.6E–11	7.3E–09
U_{235+1d}	2.9E+01	1.6E–11	4.7E–10
U_{238+2d}	5.0E+02	2.0E–11	1.0E–08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	1.8E–08

Table C.III–528
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Private Ownership: Off–Property Farmer (Child)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium–total	1.03E–04	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
aroclor–1254	NA	mg/l	NA	NA	mg/l
aroclor–1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l

References

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Table C.III-528 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: Off-Property Farmer (Child)
Via Drinking Water Ingestion

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	6.58E-06	3.00E-03	2.19E-03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.19E-03

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	5.64E-07	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001289

Table C.III–529
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	3.1E–02	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	2.0E–03	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	3.4E–02	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	6.5E+01	1.6E–11	1.0E–09
U_{235+1d}	4.2E+00	1.6E–11	6.7E–11
U_{238+2d}	7.1E+01	2.0E–11	1.4E–09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.5E–09

Table C.III–530
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Private Ownership: Off–Property Farmer (Child)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2–day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
SA	Skin surface area available for contact	8000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
arsenic	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
beryllium	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
uranium–total	2.58E–11	mg/cm^2–day	NA	NA	mg/cm^2–day
benzo(a)pyrene	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
carbazole	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1254	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1260	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
dieldrin	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day

References

Table C.III-530 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: Off-Property Farmer (Child)
Via Dermal Contact while Bathing

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	1.32E-08	1.50E-04	8.78E-05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	HQ Summation =		8.78E-05

Compound	ILCR Calculation CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	1.13E-09	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	ILCR Summation =		NA

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Table C.III–531
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Private Ownership: Off–Property Farmer (Child)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	3.3E–07	pCi/m^3	U_{234}	1.0E–06	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	8.8E–07	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	2.2E–07	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	2.8E–06	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	8.2E–03	2.9E–08	2.4E–10
Pu_{238}	NA	3.9E–08	NA
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	NA	7.7E–12	NA
Sr_{90+1d}	5.5E–03	6.2E–11	3.4E–13
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	7.0E–02	2.9E–08	2.0E–09
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	2.5E–02	2.6E–08	6.6E–10
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	2.2E–02	2.4E–08	5.3E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
		ILCR Summation =	3.4E–09

001293

Table C.III–532
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	1.3E–06	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III−532 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: Off−Property Farmer (Child)
Via Ingestion of Meat Products

Compound	HQ Calculation CDI (mg/kg−day)	RfD (mg/kg−day)	HQ (unitless)
antimony	NA	4.0E−04	NA
arsenic	NA	3.0E−04	NA
beryllium	NA	5.0E−03	NA
uranium−total	2.4E−09	3.0E−03	7.8E−07
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor−1254	NA	NA	NA
aroclor−1260	NA	NA	NA
dieldrin	NA	5.0E−05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		7.8E−07

Compound	ILCR Calculation CDI (mg/kg−day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium−total	2.0E−10	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E−02	NA
aroclor−1254	NA	7.7E+00	NA
aroclor−1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

0882

Table C.III–533
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	1.4E–06	pCi/kg	U_{234}	3.3E–04	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	2.0E–05	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	3.5E–04	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	1.9E–05	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.5E–06	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	8.5E–05	2.2E–10	1.9E–14
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	1.2E–03	3.6E–11	4.2E–14
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	9.2E–05	1.3E–11	1.2E–15
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	2.0E–02	1.6E–11	3.2E–13
U_{235+1d}	1.2E–03	1.6E–11	2.0E–14
U_{238+2d}	2.2E–02	2.0E–11	4.3E–13
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	8.4E–13

Table C.III–534
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	4.4E–06	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III-534 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Dairy Products

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.9E-07	3.0E-03	6.3E-05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		6.3E-05

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.6E-08	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

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Table C.III-535
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	1.3E-07	pCi/kg	U_{234}	1.2E-03	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	7.2E-05	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	1.3E-03	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	9.6E-05	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.2E-06	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	1.8E-04	2.2E-10	3.9E-14
Pu_{238}	NA	2.2E-10	NA
Ra_{226+8d}	NA	7.8E-10	NA
Ra_{228+1d}	NA	1.0E-10	NA
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	1.4E-01	3.6E-11	4.9E-12
Tc_{99}	NA	1.3E-12	NA
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	1.8E-03	1.3E-11	2.3E-14
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	1.6E+00	1.6E-11	2.6E-11
U_{235+1d}	1.0E-01	1.6E-11	1.6E-12
U_{238+2d}	1.8E+00	2.0E-11	3.6E-11
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	6.9E-11

Table C.III–536
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	5.2E–04	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III-536 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: Off-Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	3.3E-06	3.0E-03	1.1E-03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.1E-03

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	2.8E-07	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001301

0382

Table C.III–537
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Private Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	3.2E–04	pCi/kg	U_{234}	1.5E–01	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	9.8E–03	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	1.7E–01	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	6.2E–04	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	3.1E–03	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	6.8E–02	2.2E–10	1.5E–11
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	1.3E–01	3.6E–11	4.7E–12
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	6.4E–01	1.3E–11	8.3E–12
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	3.2E+01	1.6E–11	5.1E–10
U_{235+1d}	2.1E+00	1.6E–11	3.3E–11
U_{238+2d}	3.5E+01	2.0E–11	7.0E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	1.3E–09

5860

Table C.III–538
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Incidental Ingestion of Soil

Intake Equation = $\frac{CS \times EF \times ED \times CF \times IR}{BW \times AT}$

IRs	Ingestion rate of soil (RAGS, 1989)	180 mg/day
CF	Conversion factor	1.0E–06 kg/mg
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	7.9E–01	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg

References

001303

Table C.III-538 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Incidental Ingestion of Soil

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	2.0E-06	3.0E-03	6.5E-04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		6.5E-04

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	2.0E-06	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001304

Table C.III-539
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Incidental Ingestion of Soil

Intake Equation = CS X EF X EDn X FI X IR

IRs	Ingestion rate of soil (RAGS, 1989)	180 mg/day
EF	Exposure frequency	350 days/year
EDn	Exposure Duration	70 Year
FI	Fractional Intake	1 (unitless)
CS	Concentration of radionuclides in soil	

Cs_{137+1d}	NA	pCi/mg	$Th_{232+10d}$	NA	pCi/mg
Np_{237+1d}	1.55E-05	pCi/mg	U_{234}	3.06E-05	pCi/mg
Pu_{238}	NA	pCi/mg	U_{235+1d}	NA	pCi/mg
Ra_{226+8d}	NA	pCi/mg	U_{238+2d}	2.70E-05	pCi/mg
Ra_{228+1d}	NA	pCi/mg	NA	NA	pCi/mg
Rn_{222+4d}	NA	pCi/mg	NA	NA	pCi/mg
Sr_{90+1d}	1.28E-05	pCi/mg	NA	NA	pCi/mg
Tc_{99}	NA	pCi/mg	NA	NA	pCi/mg
Th_{228+7d}	NA	pCi/mg	NA	NA	pCi/mg
Th_{230}	1.19E-04	pCi/mg	NA	NA	pCi/mg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.80E-11	NA
Np_{237+1d}	6.84E+01	2.20E-10	1.50E-08
Pu_{238}	NA	2.20E-10	NA
Ra_{226+8d}	NA	7.80E-10	NA
Ra_{228+1d}	NA	1.00E-10	NA
Rn_{222+4d}	NA	1.70E-12	NA
Sr_{90+1d}	5.64E+01	3.60E-11	2.03E-09
Tc_{99}	NA	1.30E-12	NA
Th_{228+7d}	NA	5.50E-11	NA
Th_{230}	5.24E+02	1.30E-11	6.81E-09
$Th_{232+10d}$	NA	1.70E-10	NA
U_{234}	1.35E+02	1.60E-11	2.16E-09
U_{235+1d}	NA	1.60E-11	NA
U_{238+2d}	1.19E+02	2.00E-11	2.38E-09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.84E-08

001305

Table C.III–540
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Dermal Contact with Soil

Intake Equation = $\frac{CS \times EF \times ED \times CF \times ABS \times AF \times SA}{BW \times AT}$

SA	Surface area of exposed skin (50th percentile, hands only)	5750 cm^2/day
AF	Soil to skin adherence factor (RAGS, 1989)	1 mg/cm^2
ABS	chemicals specific absorbtion factor (see table below)	csv
CF	Conversion factor	1E–06 kg/mg
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in soil	

Chemical Concentrations

Compound	ABS	Concentrati	Units	Compound		Concentrati	Units
antimony	1.00E–02	NA	mg/kg	NA	NA	NA	mg/kg
arsenic	1.00E–03	NA	mg/kg	NA	NA	NA	mg/kg
beryllium	1.00E–02	NA	mg/kg	NA	NA	NA	mg/kg
uranium–total	1.00E–02	7.94E–01	mg/kg	NA	NA	NA	mg/kg
benzo(a)pyrene	3.00E–01	NA	mg/kg	NA	NA	NA	mg/kg
carbazole	3.00E–01	NA	mg/kg	NA	NA	NA	mg/kg
aroclor–1254	6.00E–02	NA	mg/kg	NA	NA	NA	mg/kg
aroclor–1260	6.00E–02	NA	mg/kg	NA	NA	NA	mg/kg
dieldrin	3.00E–01	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg				

References

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Table C.III-540 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Dermal Contact with Soil

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	6.26E-07	1.50E-04	4.17E-03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		4.17E-03

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	6.26E-07	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001307

Table C.III–541
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium–total	6.06E–04	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
aroclor–1254	NA	mg/l	NA	NA	mg/l
aroclor–1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l

References

001308

Table C.III-541 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Drinking Water Ingestion

Compound	HQ Calculation		
	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	1.66E-05	3.00E-03	5.53E-03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		5.53E-03

Compound	ILCR Calculation		
	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	1.66E-05	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

Table C.III–542
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	1.8E–01	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	1.0E–02	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	2.0E–01	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	9.0E+03	1.6E–11	1.4E–07
U_{235+1d}	4.9E+02	1.6E–11	7.8E–09
U_{238+2d}	9.9E+03	2.0E–11	2.0E–07
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 3.5E–07

Table C.III–543
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2–day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
SA	Skin surface area available for contact	23000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
arsenic	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
beryllium	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
uranium–total	1.52E–10	mg/cm^2–day	NA	NA	mg/cm^2–day
benzo(a)pyrene	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
carbazole	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1254	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1260	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
dieldrin	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day			

References

Table C.III-543 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Dermal Contact while Bathing

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	4.77E-08	1.50E-04	3.18E-04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		3.18E-04

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	4.77E-08	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

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Table C.III–544
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	4.3E–06	pCi/m^3	U_{234}	1.3E–05	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	1.1E–05	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	3.1E–06	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	6.6E–05	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	2.1E+00	2.9E–08	6.1E–08
Pu_{238}	NA	3.9E–08	NA
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	NA	7.7E–12	NA
Sr_{90+1d}	1.5E+00	6.2E–11	9.4E–11
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	3.2E+01	2.9E–08	9.4E–07
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	6.4E+00	2.6E–08	1.7E–07
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	5.6E+00	2.4E–08	1.3E–07
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
		ILCR Summation =	1.3E–06

Table C.III–545
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	1.6E–04	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

001334

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Table C.III-545 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Ingestion of Meat Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.6E-07	3.0E-03	5.4E-05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		5.4E-05

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.6E-07	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001315

Table C.III–546
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	8.7E–04	pCi/kg	U_{234}	7.7E–03	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.0E–04	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	7.2E–03	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	4.8E–01	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	4.2E–04	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	1.6E+00	2.2E–10	3.6E–10
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	8.9E+02	3.6E–11	3.2E–08
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	7.8E–01	1.3E–11	1.0E–11
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.4E+01	1.6E–11	2.3E–10
U_{235+1d}	1.9E–01	1.6E–11	3.0E–12
U_{238+2d}	1.3E+01	2.0E–11	2.7E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 3.3E–08

Table C.III–547
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	4.7E–04	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg

References

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Table C.III-547 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Ingestion of Dairy Products

Compound	HQ Calculation		
	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.9E-06	3.0E-03	6.5E-04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		6.5E-04

Compound	ILCR Calculation		
	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.9E-06	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001318

Table C.III–548
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	7.9E–05	pCi/kg	U_{234}	2.4E–02	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	3.6E–04	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.3E–02	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	2.4E+00	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	3.5E–04	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	5.8E–01	2.2E–10	1.3E–10
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	1.8E+04	3.6E–11	6.4E–07
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	2.6E+00	1.3E–11	3.4E–11
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.8E+02	1.6E–11	2.8E–09
U_{235+1d}	2.6E+00	1.6E–11	4.2E–11
U_{238+2d}	1.7E+02	2.0E–11	3.3E–09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 6.4E–07

Table C.III–549
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	1.0E–02	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

001320

5860

Table C.III-549 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Federal Ownership: On-Property RME Resident Farmer (Adult)
Via Ingestion of Vegetables and Fruits

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.7E-05	3.0E-03	5.5E-03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		5.5E-03

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.7E-05	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001321

Table C.III–550
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	1.6E−01	pCi/kg	U_{234}	1.2E+00	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	4.9E−02	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	1.2E+00	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	3.2E+01	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.9E−01	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	4.8E+02	2.2E−10	1.0E−07
Pu_{238}	NA	2.2E−10	NA
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	9.6E+04	3.6E−11	3.4E−06
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	5.5E+02	1.3E−11	7.2E−09
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	3.5E+03	1.6E−11	5.6E−08
U_{235+1d}	1.5E+02	1.6E−11	2.3E−09
U_{238+2d}	3.7E+03	2.0E−11	7.3E−08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 3.7E−06

001322

5860

Table C.III–551
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Federal Ownership: On–Property RME Resident Farmer (Adult)
Via External Radiation

Dose Equivalency Equat = $[DR \times EF \times EDn \times ET_i \times (1-SH_i)] + [DR \times EF \times EDn \times ET_o \times (1-SH_o)]$

EF	Fraction of year spent exposured	0.96 (unitless)
ED	Exposure duration	70 Year
ET_i	Fraction of day spent indoors	0.76 (unitless)
ET_o	Fraction of day spent outdoors	0.24 (unitless)
SH_i	Shield factor indoors	0.5 (unitless)
SH_o	Shield factor outdoors	NA (unitless)
DR	Radionuclide specific dose concentrations	(see table below)

Cs_{137+1d}	NA	pCi/g	$Th_{232+10d}$	NA	pCi/g
Np_{237+1d}	1.55E–02	pCi/g	U_{234}	3.06E–02	pCi/g
Pu_{238}	NA	pCi/g	U_{235+1d}	NA	pCi/g
Ra_{226+8d}	NA	pCi/g	U_{238+2d}	2.70E–02	pCi/g
Ra_{228+1d}	NA	pCi/g	NA	NA	pCi/g
Rn_{222+4d}	NA	pCi/g	NA	NA	pCi/g
Sr_{90+1d}	1.28E–02	pCi/g	NA	NA	pCi/g
Tc_{99}	NA	pCi/g	NA	NA	pCi/g
Th_{228+7d}	NA	pCi/g	NA	NA	pCi/g
Th_{230}	1.19E–01	pCi/g	NA	NA	pCi/g

Radionuclides	CDI (year pCi/g)	CSF $(g/pCi-year)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.0E–06	NA
Np_{237+1d}	6.5E–01	4.3E–07	2.8E–07
Pu_{238}	NA	2.8E–11	NA
Ra_{226+8d}	NA	6.0E–06	NA
Ra_{228+1d}	NA	2.9E–06	NA
Rn_{222+4d}	NA	5.9E–06	NA
Sr_{90+1d}	5.3E–01	NA	NA
Tc_{99}	NA	6.0E–13	NA
Th_{228+7d}	NA	5.6E–06	NA
Th_{230}	4.9E+00	5.4E–11	2.7E–10
$Th_{232+10d}$	NA	8.5E–06	NA
U_{234}	1.3E+00	3.0E–11	3.8E–11
U_{235+1d}	NA	2.4E–07	NA
U_{238+2d}	1.1E+00	5.1E–08	5.7E–08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	3.4E–07

001323

Table C.III–552
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Private Ownership: On–Property Farmer (Child)
Via Incidental Ingestion of Soil

Intake Equation = $\frac{CS \times EF \times ED \times CF \times IR}{BW \times AT}$

IRs	Ingestion rate of soil (RAGS, 1989)	200 mg/day
CF	Conversion factor	1.0E–06 kg/mg
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in soil	(see table below)

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	7.9E–01	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg

References

001324

Table C.III–552 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: On–Property Farmer (Child)
Via Incidental Ingestion of Soil

	HQ Calculation		
Compound	CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	4.0E–04	NA
arsenic	NA	3.0E–04	NA
beryllium	NA	5.0E–03	NA
uranium–total	1.0E–05	3.0E–03	3.4E–03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	5.0E–05	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	HQ Summation =		3.4E–03

	ILCR Calculation		
Compound	CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium–total	8.7E–07	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E–02	NA
aroclor–1254	NA	7.7E+00	NA
aroclor–1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	ILCR Summation =		NA

Table C.III−553
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Private Ownership: On−Property Farmer (Child)
Via Incidental Ingestion of Soil

Intake Equation = CS X EF X EDn X FI X IR

IRs	Ingestion rate of soil (RAGS, 1989)	200 mg/day
EF	Exposure frequency	350 days/year
EDn	Exposure Duration	6 Year
FI	Fractional Intake	1 (unitless)
CS	Concentration of radionuclides in soil	

Cs_{137+1d}	NA	pCi/mg	$Th_{232+10d}$	NA	pCi/mg
Np_{237+1d}	1.55E−05	pCi/mg	U_{234}	3.06E−05	pCi/mg
Pu_{238}	NA	pCi/mg	U_{235+1d}	NA	pCi/mg
Ra_{226+8d}	NA	pCi/mg	U_{238+2d}	2.70E−05	pCi/mg
Ra_{228+1d}	NA	pCi/mg	NA	NA	pCi/mg
Rn_{222+4d}	NA	pCi/mg	NA	NA	pCi/mg
Sr_{90+1d}	1.28E−05	pCi/mg	NA	NA	pCi/mg
Tc_{99}	NA	pCi/mg	NA	NA	pCi/mg
Th_{228+7d}	NA	pCi/mg	NA	NA	pCi/mg
Th_{230}	1.19E−04	pCi/mg	NA	NA	pCi/mg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.80E−11	NA
Np_{237+1d}	6.51E+00	2.20E−10	1.43E−09
Pu_{238}	NA	2.20E−10	NA
Ra_{226+8d}	NA	7.80E−10	NA
Ra_{228+1d}	NA	1.00E−10	NA
Rn_{222+4d}	NA	1.70E−12	NA
Sr_{90+1d}	5.38E+00	3.60E−11	1.94E−10
Tc_{99}	NA	1.30E−12	NA
Th_{228+7d}	NA	5.50E−11	NA
Th_{230}	4.99E+01	1.30E−11	6.49E−10
$Th_{232+10d}$	NA	1.70E−10	NA
U_{234}	1.29E+01	1.60E−11	2.06E−10
U_{235+1d}	NA	1.60E−11	NA
U_{238+2d}	1.13E+01	2.00E−11	2.27E−10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	2.71E−09

001326

Table C.III-554
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Private Ownership: On-Property Farmer (Child)
Via Dermal Contact with Soil

Intake Equation = $\frac{CS \times EF \times ED \times CF \times ABS \times AF \times SA}{BW \times AT}$

SA	Surface area of exposed skin (50th percentile, hands only)	2000 cm^2/day
AF	Soil to skin adherence factor (RAGS, 1989)	1 mg/cm^2
ABS	chemicals specific absorbtion factor (see table below)	csv
CF	Conversion factor	1E-06 kg/mg
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in soil	

Chemical Concentrations

Compound	ABS	Concentrati	Units	Compound		Concentrati	Units
antimony	1.00E-02	NA	mg/kg	NA	NA	NA	mg/kg
arsenic	1.00E-03	NA	mg/kg	NA	NA	NA	mg/kg
beryllium	1.00E-02	NA	mg/kg	NA	NA	NA	mg/kg
uranium-total	1.00E-02	7.94E-01	mg/kg	NA	NA	NA	mg/kg
benzo(a)pyrene	3.00E-01	NA	mg/kg	NA	NA	NA	mg/kg
carbazole	3.00E-01	NA	mg/kg	NA	NA	NA	mg/kg
aroclor-1254	6.00E-02	NA	mg/kg	NA	NA	NA	mg/kg
aroclor-1260	6.00E-02	NA	mg/kg	NA	NA	NA	mg/kg
dieldrin	3.00E-01	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg
NA	NA	NA	mg/kg	NA	NA	NA	mg/kg

References

Table C.III-554 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: On-Property Farmer (Child)
Via Dermal Contact with Soil

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	1.02E-06	1.50E-04	6.77E-03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		6.77E-03

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	8.70E-08	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

Table C.III–555
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Private Ownership: On–Property Farmer (Child)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium–total	6.06E–04	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
aroclor–1254	NA	mg/l	NA	NA	mg/l
aroclor–1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

Table C.III-555 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: On-Property Farmer (Child)
Via Drinking Water Ingestion

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	3.87E-05	3.00E-03	1.29E-02
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.29E-02

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	3.32E-06	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001330

Table C.III–556
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Private Ownership: On–Property Farmer (Child)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	1.8E–01	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	1.0E–02	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	2.0E–01	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	3.9E+02	1.6E–11	6.2E–09
U_{235+1d}	2.1E+01	1.6E–11	3.4E–10
U_{238+2d}	4.2E+02	2.0E–11	8.5E–09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.5E–08

Table C.III–557
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Private Ownership: On–Property Farmer (Child)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2–day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
SA	Skin surface area available for contact	8000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
arsenic	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
beryllium	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
uranium–total	1.52E–10	mg/cm^2–day	NA	NA	mg/cm^2–day
benzo(a)pyrene	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
carbazole	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1254	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1260	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
dieldrin	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day

References

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Table C.III-557 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: On-Property Farmer (Child)
Via Dermal Contact while Bathing

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	7.75E-08	1.50E-04	5.17E-04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
HQ Summation =			5.17E-04

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	6.64E-09	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
ILCR Summation =			NA

Table C.III–558
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Private Ownership: On–Property Farmer (Child)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	4.3E–06	pCi/m^3	U_{234}	1.3E–05	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	1.1E–05	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	NA	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	3.1E–06	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	6.6E–05	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	1.1E–01	2.9E–08	3.1E–09
Pu_{238}	NA	3.9E–08	NA
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	NA	7.7E–12	NA
Sr_{90+1d}	7.8E–02	6.2E–11	4.8E–12
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	1.7E+00	2.9E–08	4.8E–08
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	3.3E–01	2.6E–08	8.5E–09
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	2.9E–01	2.4E–08	6.9E–09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 6.7E–08

Table C.III–559
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Private Ownership: On–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	1.6E–04	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-559 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: On-Property Farmer (Child)
Via Ingestion of Meat Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	2.9E-07	3.0E-03	9.8E-05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		9.8E-05

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	2.5E-08	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001336

5860

Table C.III–560
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Private Ownership: On–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	8.7E–04	pCi/kg	U_{234}	7.7E–03	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.0E–04	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	7.2E–03	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	4.8E–01	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	4.2E–04	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	5.3E–02	2.2E–10	1.2E–11
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	3.0E+01	3.6E–11	1.1E–09
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	2.6E–02	1.3E–11	3.4E–13
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	4.7E–01	1.6E–11	7.6E–12
U_{235+1d}	6.1E–03	1.6E–11	9.8E–14
U_{238+2d}	4.4E–01	2.0E–11	8.8E–12
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.1E–09

001337

Table C.III–561
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Private Ownership: On–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	4.7E–04	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg

References

001338

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Table C.III-561 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: On-Property Farmer (Child)
Via Ingestion of Dairy Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	2.0E-05	3.0E-03	6.8E-03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		6.8E-03

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.8E-06	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

Table C.III-562
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Private Ownership: On-Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	7.9E-05	pCi/kg	U_{234}	2.4E-02	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	3.6E-04	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.3E-02	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	2.4E+00	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	3.5E-04	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	1.1E-01	2.2E-10	2.5E-11
Pu_{238}	NA	2.2E-10	NA
Ra_{226+8d}	NA	7.8E-10	NA
Ra_{228+1d}	NA	1.0E-10	NA
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	3.4E+03	3.6E-11	1.2E-07
Tc_{99}	NA	1.3E-12	NA
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	5.0E-01	1.3E-11	6.5E-12
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	3.4E+01	1.6E-11	5.5E-10
U_{235+1d}	5.1E-01	1.6E-11	8.2E-12
U_{238+2d}	3.2E+01	2.0E-11	6.5E-10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.2E-07

Table C.III–563
Summary of Intake Quantitation (chemicals) Alternative 6
South Field Area with Private Ownership: On–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	1.0E–02	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-563 (continued)
Summary of Risk Characterization (chemicals)
South Field Area with Private Ownership: On-Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	6.4E-05	3.0E-03	2.1E-02
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.1E-02

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	5.5E-06	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001342

5860

Table C.III-564
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Private Ownership: On-Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	1.6E-01	pCi/kg	U_{234}	1.2E+00	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	4.9E-02	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	1.2E+00	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	3.2E+01	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	1.9E-01	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	3.3E+01	2.2E-10	7.4E-09
Pu_{238}	NA	2.2E-10	NA
Ra_{226+8d}	NA	7.8E-10	NA
Ra_{228+1d}	NA	1.0E-10	NA
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	6.7E+03	3.6E-11	2.4E-07
Tc_{99}	NA	1.3E-12	NA
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	3.9E+01	1.3E-11	5.1E-10
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	2.5E+02	1.6E-11	3.9E-09
U_{235+1d}	1.0E+01	1.6E-11	1.6E-10
U_{238+2d}	2.6E+02	2.0E-11	5.2E-09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	2.6E-07

001343

0482

Table C.III–565
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
South Field Area with Private Ownership: On–Property Farmer (Child)
Via External Radiation

Dose Equivalency Equat = $[DR \times EF \times EDn \times ET_i \times (1-SH_i)] + [DR \times EF \times EDn \times ET_o \times (1-SH_o)]$

EF	Fraction of year spent exposured	0.96 (unitless)
ED	Exposure duration	6 Year
ET_i	Fraction of day spent indoors	0.92 (unitless)
ET_o	Fraction of day spent outdoors	0.08 (unitless)
SH_i	Shield factor indoors	0.5 (unitless)
SH_o	Shield factor outdoors	NA (unitless)
DR	Radionuclide specific dose concentrations	(see table below)

Cs_{137+1d}	NA	pCi/g	$Th_{232+10d}$	NA	pCi/g
Np_{237+1d}	1.55E–02	pCi/g	U_{234}	3.06E–02	pCi/g
Pu_{238}	NA	pCi/g	U_{235+1d}	NA	pCi/g
Ra_{226+8d}	NA	pCi/g	U_{238+2d}	2.70E–02	pCi/g
Ra_{228+1d}	NA	pCi/g	NA	NA	pCi/g
Rn_{222+4d}	NA	pCi/g	NA	NA	pCi/g
Sr_{90+1d}	1.28E–02	pCi/g	NA	NA	pCi/g
Tc_{99}	NA	pCi/g	NA	NA	pCi/g
Th_{228+7d}	NA	pCi/g	NA	NA	pCi/g
Th_{230}	1.19E–01	pCi/g	NA	NA	pCi/g

Radionuclides	CDI (year pCi/g)	CSF $(g/pCi-year)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.0E–06	NA
Np_{237+1d}	4.8E–02	4.3E–07	2.1E–08
Pu_{238}	NA	2.8E–11	NA
Ra_{226+8d}	NA	6.0E–06	NA
Ra_{228+1d}	NA	2.9E–06	NA
Rn_{222+4d}	NA	5.9E–06	NA
Sr_{90+1d}	4.0E–02	NA	NA
Tc_{99}	NA	6.0E–13	NA
Th_{228+7d}	NA	5.6E–06	NA
Th_{230}	3.7E–01	5.4E–11	2.0E–11
$Th_{232+10d}$	NA	8.5E–06	NA
U_{234}	9.5E–02	3.0E–11	2.9E–12
U_{235+1d}	NA	2.4E–07	NA
U_{238+2d}	8.4E–02	5.1E–08	4.3E–09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.5E–08

5860

Table C.III–566
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Disposal Cell with Federal Ownership: Expanded Trespasser
Via Inhalation of Gases and Particulates

Intake Equation = CA X EFa X EDa X IR X ETa + CA X EFc EDc X IR X ETc

IR	Inhalation rate of gases	0.83 m^3/hour
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure duration	32 Year
EDc	Exposure duration	12 Year
ETa	Exposure time (adult)	1 hour/day
ETc	Exposure time (child)	2 hour/day
CA	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	NA	pCi/m^3	U_{234}	NA	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	5.6E−06	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	NA	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E−11	NA
Np_{237+1d}	NA	2.9E−08	NA
Pu_{238}	NA	3.9E−08	NA
Ra_{226+8d}	NA	7.0E−09	NA
Ra_{228+1d}	NA	6.9E−10	NA
Rn_{222+4d}	1.8E−02	7.7E−12	1.4E−13
Sr_{90+1d}	NA	6.2E−11	NA
Tc_{99}	NA	8.3E−12	NA
Th_{228+7d}	NA	7.8E−08	NA
Th_{230}	NA	2.9E−08	NA
$Th_{232+10d}$	NA	1.1E−07	NA
U_{234}	NA	2.6E−08	NA
U_{235+1d}	NA	2.5E−08	NA
U_{238+2d}	NA	2.4E−08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	1.4E−13

001345

Table C.III – 567
Summary of Intake Quantitation (chemicals) Alternative 6
Disposal Cell with Federal Ownership: Off – Property Farmer (Adult)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non – carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non – carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium – total	2.09E – 03	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
aroclor – 1254	NA	mg/l	NA	NA	mg/l
aroclor – 1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l

References

001336

Table C.III-567 (continued)
Summary of Risk Characterization (chemicals)
Disposal Cell with Federal Ownership: Off-Property Farmer (Adult)
Via Drinking Water Ingestion

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	5.71E-05	3.00E-03	1.90E-02
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.90E-02

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	5.71E-05	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

0082

Table C.III–568
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Disposal Cell with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	6.3E−01	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	3.3E−02	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	7.0E−01	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	NA	2.2E−10	NA
Pu_{238}	NA	2.2E−10	NA
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	NA	3.6E−11	NA
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	NA	1.3E−11	NA
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	3.1E+04	1.6E−11	5.0E−07
U_{235+1d}	1.6E+03	1.6E−11	2.6E−08
U_{238+2d}	3.4E+04	2.0E−11	6.8E−07
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
		ILCR Summation =	1.2E−06

001348

Table C.III–569
Summary of Intake Quantitation (chemicals) Alternative 6
Disposal Cell with Federal Ownership: Off–Property Farmer (Adult)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2–day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
SA	Skin surface area available for contact	23000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
arsenic	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
beryllium	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
uranium–total	5.21E–10	mg/cm^2–day	NA	NA	mg/cm^2–day
benzo(a)pyrene	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
carbazole	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1254	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1260	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
dieldrin	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day			

References

001349

Table C.III–569 (continued)
Summary of Risk Characterization (chemicals)
Disposal Cell with Federal Ownership: Off–Property Farmer (Adult)
Via Dermal Contact while Showering

Compound	HQ Calculation CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	6.00E–05	NA
arsenic	NA	2.85E–04	NA
beryllium	NA	5.00E–03	NA
uranium–total	1.64E–07	1.50E–04	1.09E–03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	4.50E–05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.09E–03

Compound	ILCR Calculation CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium–total	1.64E–07	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E–02	NA
aroclor–1254	NA	1.03E+01	NA
aroclor–1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001350

5860

Table C.III–570
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Disposal Cell with Federal Ownership: Off–Property Farmer (Adult)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	NA	pCi/m^3	U_{234}	NA	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	2.0E–06	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	NA	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	NA	2.9E–08	NA
Pu_{238}	NA	3.9E–08	NA
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	9.9E–01	7.7E–12	7.7E–12
Sr_{90+1d}	NA	6.2E–11	NA
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	NA	2.9E–08	NA
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	NA	2.6E–08	NA
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	NA	2.4E–08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	7.7E–12

001351

Table C.III–571a
Summary of Intake Quantitation (chemicals) Alternative 6
Disposal Cell with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	2.1E–05	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

001352

Table C.III-571a (continued)
Summary of Risk Characterization (chemicals)
Disposal Cell with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Meat Products

Compound	HQ Calculation CDI (mg/kg-day)	 RfD (mg/kg-day)	 HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	2.2E-08	3.0E-03	7.2E-06
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	.NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		7.2E-06

Compound	ILCR Calculation CDI (mg/kg-day)	 CSF $(mg/kg-day)^{-1}$	 ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	2.2E-08	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

0882

Table C.III–571b
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Disposal Cell with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	NA	pCi/kg	U_{234}	6.3E–03	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	3.3E–04	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	6.9E–03	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	NA	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.2E+01	1.6E–11	1.9E–10
U_{235+1d}	6.1E–01	1.6E–11	9.8E–12
U_{238+2d}	1.3E+01	2.0E–11	2.6E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 4.6E–10

001354

Table C.III–572
Summary of Intake Quantitation (chemicals) Alternative 6
Disposal Cell with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	7.5E–05	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-572 (continued)
Summary of Risk Characterization (chemicals)
Disposal Cell with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Dairy Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	3.1E-07	3.0E-03	1.0E-04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.0E-04

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	3.1E-07	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001356

5860

Table C.III–573
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Disposal Cell with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	NA	pCi/kg	U_{234}	2.3E–02	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.2E–03	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.5E–02	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	NA	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.7E+02	1.6E–11	2.7E–09
U_{235+1d}	8.7E+00	1.6E–11	1.4E–10
U_{238+2d}	1.8E+02	2.0E–11	3.7E–09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 6.5E–09

001357

Table C.III–574
Summary of Risk Characterization (chemicals)
Disposal Cell with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.122	kg/day
FI	Fraction ingested from contaminated source	1	(Unitless)
EF	Exposure frequency	350	days/year
EDn	Exposure duration for non–carcinogens	70	Year
EDc	Exposure duration for carcinogens	70	Year
BW	Body weight	70	kg
ATc	Average time for carcinogens (lifetime)	25550	days
ATn	Average time for non–carcinogens (EDn x 365)	25550	days
CS	Concentration of chemicals in vegetables		

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	1.0E–02	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

001356

Table C.III-574 (continued)
Summary of Risk Characterization (chemicals)
Disposal Cell with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.7E-05	3.0E-03	5.7E-03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
HQ Summation =			5.7E-03

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.7E-05	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
	NA	NA	NA
ILCR Summation =			NA

0 0 8 3 : 4

Table C.III–575
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Disposal Cell with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	NA	pCi/kg	U_{234}	3.1E+00	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.6E−01	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	3.4E+00	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	NA	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	NA	2.2E−10	NA
Pu_{238}	NA	2.2E−10	NA
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	NA	3.6E−11	NA
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	NA	1.3E−11	NA
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	9.3E+03	1.6E−11	1.5E−07
U_{235+1d}	4.8E+02	1.6E−11	7.7E−09
U_{238+2d}	1.0E+04	2.0E−11	2.0E−07
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
		ILCR Summation =	3.6E−07

Table C.III–576
Summary of Intake Quantitation (chemicals) Alternative 6
Disposal Cell with Federal Ownership: Off–Property Farmer (Child)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium–total	2.09E–03	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
aroclor–1254	NA	mg/l	NA	NA	mg/l
aroclor–1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l

References

001361

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Table C.III-576 (continued)
Summary of Risk Characterization (chemicals)
Disposal Cell with Federal Ownership: Off-Property Farmer (Child)
Via Drinking Water Ingestion

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	1.33E-04	3.00E-03	4.44E-02
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		4.44E-02

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	1.14E-05	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001362

5860

Table C.III–577
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Disposal Cell with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	6.3E–01	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	3.3E–02	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	7.0E–01	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.3E+03	1.6E–11	2.1E–08
U_{235+1d}	6.9E+01	1.6E–11	1.1E–09
U_{238+2d}	1.5E+03	2.0E–11	2.9E–08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	5.2E–08

Table C.III–578
Summary of Intake Quantitation (chemicals) Alternative 6
Disposal Cell with Federal Ownership: Off–Property Farmer (Child)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2–day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
SA	Skin surface area available for contact	8000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
arsenic	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
beryllium	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
uranium–total	5.21E–10	mg/cm^2–day	NA	NA	mg/cm^2–day
benzo(a)pyrene	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
carbazole	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1254	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1260	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
dieldrin	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day

References

001364

Table C.III-578 (continued)
Summary of Risk Characterization (chemicals)
Disposal Cell with Federal Ownership: Off-Property Farmer (Child)
Via Dermal Contact while Bathing

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	2.67E-07	1.50E-04	1.78E-03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
HQ Summation =			1.78E-03

Compound	ILCR Calculation CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	2.28E-08	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
ILCR Summation =			NA

0085

Table C.III–579
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Disposal Cell with Federal Ownership: Off–Property Farmer (Child)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	NA	pCi/m^3	U_{234}	NA	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	2.0E–06	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	NA	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	NA	2.9E–08	NA
Pu_{238}	NA	3.9E–08	NA
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	5.1E–02	7.7E–12	3.9E–13
Sr_{90+1d}	NA	6.2E–11	NA
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	NA	2.9E–08	NA
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	NA	2.6E–08	NA
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	NA	2.4E–08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 3.9E–13

001366

Table C.III–580
Summary of Intake Quantitation (chemicals) Alternative 6
Disposal Cell with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	2.1E–05	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg

References

001367

Table C.III-580 (continued)
Summary of Risk Characterization (chemicals)
Disposal Cell with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Meat Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	3.9E-08	3.0E-03	1.3E-05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.3E-05

Compound	ILCR Calculation CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	3.3E-09	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

Table C.III-581
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Disposal Cell with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	NA	pCi/kg	U_{234}	6.3E-03	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	3.3E-04	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	6.9E-03	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	NA	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	NA	2.2E-10	NA
Pu_{238}	NA	2.2E-10	NA
Ra_{226+8d}	NA	7.8E-10	NA
Ra_{228+1d}	NA	1.0E-10	NA
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	NA	3.6E-11	NA
Tc_{99}	NA	1.3E-12	NA
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	NA	1.3E-11	NA
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	3.9E-01	1.6E-11	6.2E-12
U_{235+1d}	2.0E-02	1.6E-11	3.2E-13
U_{238+2d}	4.3E-01	2.0E-11	8.5E-12
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.5E-11

Table C.III–582
Summary of Intake Quantitation (chemicals) Alternative 6
Disposal Cell with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	7.5E–05	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

001370

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Table C.III-582 (continued)
Summary of Risk Characterization (chemicals)
Disposal Cell with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Dairy Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	3.2E-06	3.0E-03	1.1E-03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.1E-03

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	2.8E-07	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001371

Table C.III–583
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Disposal Cell with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	NA	pCi/kg	U_{234}	2.3E–02	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.2E–03	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.5E–02	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	NA	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	3.2E+01	1.6E–11	5.2E–10
U_{235+1d}	1.7E+00	1.6E–11	2.7E–11
U_{238+2d}	3.5E+01	2.0E–11	7.1E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	1.3E–09

Table C.III–584
Summary of Intake Quantitation (chemicals) Alternative 6
Disposal Cell with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	1.0E–02	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-584 (continued)
Summary of Risk Characterization (chemicals)
Disposal Cell with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Compound	HQ Calculation		
	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	6.5E-05	3.0E-03	2.2E-02
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.2E-02

Compound	ILCR Calculation		
	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	5.6E-06	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

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Table C.III–585
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Disposal Cell with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	NA	pCi/kg	U_{234}	3.1E+00	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.6E–01	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	3.4E+00	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	NA	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	6.5E+02	1.6E–11	1.0E–08
U_{235+1d}	3.4E+01	1.6E–11	5.4E–10
U_{238+2d}	7.1E+02	2.0E–11	1.4E–08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.5E–08

Table C.III–586
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Disposal Cell with Private Ownership: Expanded Trespasser
Via Inhalation of Gases and Particulates

Intake Equation = CA X EFa X EDa X IR X ETa + CA X EFc EDc X IR X ETc

IR	Inhalation rate of gases	0.83 m^3/hour
EFa	Exposure frequency (adult)	40 days/year
EFc	Exposure frequency (child)	110 days/year
EDa	Exposure duration	32 Year
EDc	Exposure duration	12 Year
ETa	Exposure time (adult)	1 hour/day
ETc	Exposure time (child)	2 hour/day
CA	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	NA	pCi/m^3	U_{234}	NA	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	2.9E−06	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	NA	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E−11	NA
Np_{237+1d}	NA	2.9E−08	NA
Pu_{238}	NA	3.9E−08	NA
Ra_{226+8d}	NA	7.0E−09	NA
Ra_{228+1d}	NA	6.9E−10	NA
Rn_{222+4d}	9.4E−03	7.7E−12	7.3E−14
Sr_{90+1d}	NA	6.2E−11	NA
Tc_{99}	NA	8.3E−12	NA
Th_{228+7d}	NA	7.8E−08	NA
Th_{230}	NA	2.9E−08	NA
$Th_{232+10d}$	NA	1.1E−07	NA
U_{234}	NA	2.6E−08	NA
U_{235+1d}	NA	2.5E−08	NA
U_{238+2d}	NA	2.4E−08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 7.3E−14

Table C.III–587
Summary of Intake Quantitation (chemicals) Alternative 6
Disposal cell with Federal Ownership: Off–Property Farmer (Adult)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium–total	2.09E–03	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
aroclor–1254	NA	mg/l	NA	NA	mg/l
aroclor–1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

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Table C.III-587 (continued)
Summary of Risk Characterization (chemicals)
Disposal cell with Federal Ownership: Off-Property Farmer (Adult)
Via Drinking Water Ingestion

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	5.71E-05	3.00E-03	1.90E-02
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.90E-02

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	5.71E-05	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

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Table C.III–588
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Disposal cell with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	2 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	6.3E–01	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	3.3E–02	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	7.0E–01	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	3.1E+04	1.6E–11	5.0E–07
U_{235+1d}	1.6E+03	1.6E–11	2.6E–08
U_{238+2d}	3.4E+04	2.0E–11	6.8E–07
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.2E–06

Table C.III–589
Summary of Intake Quantitation (chemicals) Alternative 6
Disposal cell with Federal Ownership: Off–Property Farmer (Adult)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2–day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
SA	Skin surface area available for contact	23000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
arsenic	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
beryllium	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
uranium–total	5.21E–10	mg/cm^2–day	NA	NA	mg/cm^2–day
benzo(a)pyrene	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
carbazole	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1254	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1260	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
dieldrin	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day

References

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Table C.III–589 (continued)
Summary of Risk Characterization (chemicals)
Disposal cell with Federal Ownership: Off–Property Farmer (Adult)
Via Dermal Contact while Bathing

Compound	HQ Calculation CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	6.00E–05	NA
arsenic	NA	2.85E–04	NA
beryllium	NA	5.00E–03	NA
uranium–total	1.64E–07	1.50E–04	1.09E–03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	4.50E–05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.09E–03

Compound	ILCR Calculation CDI (mg/kg–day)	CSF (mg/kg–day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium–total	1.64E–07	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E–02	NA
aroclor–1254	NA	1.03E+01	NA
aroclor–1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

Table C.III–590
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Disposal cell with Federal Ownership: Off–Property Farmer (Adult)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	20 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	NA	pCi/m^3	U_{234}	NA	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	1.1E–06	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	NA	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E–11	NA
Np_{237+1d}	NA	2.9E–08	NA
Pu_{238}	NA	3.9E–08	NA
Ra_{226+8d}	NA	7.0E–09	NA
Ra_{228+1d}	NA	6.9E–10	NA
Rn_{222+4d}	5.1E–01	7.7E–12	4.0E–12
Sr_{90+1d}	NA	6.2E–11	NA
Tc_{99}	NA	8.3E–12	NA
Th_{228+7d}	NA	7.8E–08	NA
Th_{230}	NA	2.9E–08	NA
$Th_{232+10d}$	NA	1.1E–07	NA
U_{234}	NA	2.6E–08	NA
U_{235+1d}	NA	2.5E–08	NA
U_{238+2d}	NA	2.4E–08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation	=	4.0E–12

Table C.III–591
Summary of Intake Quantitation (chemicals) Alternative 6
Disposal cell with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	2.1E–05	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III−591 (continued)
Summary of Risk Characterization (chemicals)
Disposal cell with Federal Ownership: Off−Property Farmer (Adult)
Via Ingestion of Meat Products

Compound	HQ Calculation CDI (mg/kg−day)	RfD (mg/kg−day)	HQ (unitless)
antimony	NA	4.0E−04	NA
arsenic	NA	3.0E−04	NA
beryllium	NA	5.0E−03	NA
uranium−total	2.2E−08	3.0E−03	7.2E−06
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor−1254	NA	NA	NA
aroclor−1260	NA	NA	NA
dieldrin	NA	5.0E−05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		7.2E−06

Compound	ILCR Calculation CDI (mg/kg−day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium−total	2.2E−08	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E−02	NA
aroclor−1254	NA	7.7E+00	NA
aroclor−1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001384

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Table C.III–592
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Disposal cell with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.101 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cf	Concentration of radionuclides in meat	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	NA	pCi/kg	U_{234}	6.3E–03	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	3.3E–04	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	6.9E–03	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	NA	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.2E+01	1.6E–11	1.9E–10
U_{235+1d}	6.1E–01	1.6E–11	9.8E–12
U_{238+2d}	1.3E+01	2.0E–11	2.6E–10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 4.6E–10

Table C.III–593
Summary of Intake Quantitation (chemicals) Alternative 6
Disposal cell with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	7.5E–05	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

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Table C.III–593 (continued)
Summary of Risk Characterization (chemicals)
Disposal cell with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

Compound	HQ Calculation CDI (mg/kg–day)	RfD (mg/kg–day)	HQ (unitless)
antimony	NA	4.0E–04	NA
arsenic	NA	3.0E–04	NA
beryllium	NA	5.0E–03	NA
uranium–total	3.1E–07	3.0E–03	1.0E–04
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor–1254	NA	NA	NA
aroclor–1260	NA	NA	NA
dieldrin	NA	5.0E–05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.0E–04

Compound	ILCR Calculation CDI (mg/kg–day)	CSF $(mg/kg–day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium–total	3.1E–07	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E–02	NA
aroclor–1254	NA	7.7E+00	NA
aroclor–1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001387

Table C.III–594
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Disposal cell with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.4 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	NA	pCi/kg	U_{234}	2.3E–02	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.2E–03	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.5E–02	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	NA	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.7E+02	1.6E–11	2.7E–09
U_{235+1d}	8.7E+00	1.6E–11	1.4E–10
U_{238+2d}	1.8E+02	2.0E–11	3.7E–09
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 6.5E–09

Table C.III–595
Summary of Risk Characterization (chemicals)
Disposal cell with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	70 Year
EDc	Exposure duration for carcinogens	70 Year
BW	Body weight	70 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	25550 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium–total	1.0E–02	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor–1254	NA	mg/kg	NA	NA	mg/kg
aroclor–1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg

References

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Table C.III-595 (continued)
Summary of Risk Characterization (chemicals)
Disposal cell with Federal Ownership: Off-Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

	HQ Calculation		
Compound	CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	1.7E-05	3.0E-03	5.7E-03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		5.7E-03

	ILCR Calculation		
Compound	CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	1.7E-05	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001330

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Table C.III–596
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Disposal cell with Federal Ownership: Off–Property Farmer (Adult)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.122 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	70 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	NA	pCi/kg	U_{234}	3.1E+00	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.6E–01	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	3.4E+00	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	NA	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	9.3E+03	1.6E–11	1.5E–07
U_{235+1d}	4.8E+02	1.6E–11	7.7E–09
U_{238+2d}	1.0E+04	2.0E–11	2.0E–07
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 3.6E–07

Table C.III-597
Summary of Intake Quantitation (chemicals) Alternative 6
Disposal cell with Federal Ownership: Off-Property Farmer (Child)
Via Drinking Water Ingestion

Intake Equation = $\frac{CS \times EF \times ED \times IR}{BW \times AT}$

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in groundwater	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/l	NA	NA	mg/l
arsenic	NA	mg/l	NA	NA	mg/l
beryllium	NA	mg/l	NA	NA	mg/l
uranium-total	2.09E-03	mg/l	NA	NA	mg/l
benzo(a)pyrene	NA	mg/l	NA	NA	mg/l
carbazole	NA	mg/l	NA	NA	mg/l
aroclor-1254	NA	mg/l	NA	NA	mg/l
aroclor-1260	NA	mg/l	NA	NA	mg/l
dieldrin	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l	NA	NA	mg/l
NA	NA	mg/l			

References

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Table C.III-597 (continued)
Summary of Risk Characterization (chemicals)
Disposal cell with Federal Ownership: Off-Property Farmer (Child)
Via Drinking Water Ingestion

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.00E-04	NA
arsenic	NA	3.00E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	1.33E-04	3.00E-03	4.44E-02
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.00E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		4.44E-02

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA*
arsenic	NA	1.75E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	1.14E-05	NA	NA
benzo(a)pyrene	NA	7.30E+00	NA
carbazole	NA	2.00E-02	NA
aroclor-1254	NA	7.70E+00	NA
aroclor-1260	NA	7.70E+00	NA
dieldrin	NA	1.60E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001393

Table C.III–598
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Disposal cell with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Drinking Water

Intake Equation = Cw X EF X EDn X FI X IR

IR	Ingestion rate of groundwater (RAGS, 1989)	1 l/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
FI	Fractional intake for radionuclides	1 (Unitless)
Cw	Concentration of radionuclides in groundwater	(see table below)

Cs_{137+1d}	NA	pCi/l	$Th_{232+10d}$	NA	pCi/l
Np_{237+1d}	NA	pCi/l	U_{234}	6.3E–01	pCi/l
Pu_{238}	NA	pCi/l	U_{235+1d}	3.3E–02	pCi/l
Ra_{226+8d}	NA	pCi/l	U_{238+2d}	7.0E–01	pCi/l
Ra_{228+1d}	NA	pCi/l	NA	NA	pCi/l
Rn_{222+4d}	NA.	pCi/l	NA	NA	pCi/l
Sr_{90+1d}	NA	pCi/l	NA	NA	pCi/l
Tc_{99}	NA	pCi/l	NA	NA	pCi/l
Th_{228+7d}	NA	pCi/l	NA	NA	pCi/l
Th_{230}	NA	pCi/l	NA	NA	pCi/l

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	1.3E+03	1.6E–11	2.1E–08
U_{235+1d}	6.9E+01	1.6E–11	1.1E–09
U_{238+2d}	1.5E+03	2.0E–11	2.9E–08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 5.2E–08

001394

Table C.III–599
Summary of Intake Quantitation (chemicals) Alternative 6
Disposal cell with Federal Ownership: Off–Property Farmer (Child)
Via Dermal Contact while Bathing

Intake Equation = $\frac{DA \times EF \times ED \times SA}{BW \times AT}$

DA	Dermal absorbed dose	csv mg/cm^2–day
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non–carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non–carcinogens (EDn x 365)	2190 days
SA	Skin surface area available for contact	8000 cm^2

Chemical Concentrations

Compound	DA	Units	Compound	DA	Units
antimony	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
arsenic	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
beryllium	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
uranium–total	5.21E–10	mg/cm^2–day	NA	NA	mg/cm^2–day
benzo(a)pyrene	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
carbazole	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1254	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
aroclor–1260	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
dieldrin	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day
NA	NA	mg/cm^2–day	NA	NA	mg/cm^2–day

References

Table C.III-599 (continued)
Summary of Risk Characterization (chemicals)
Disposal cell with Federal Ownership: Off-Property Farmer (Child)
Via Dermal Contact while Bathing

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	6.00E-05	NA
arsenic	NA	2.85E-04	NA
beryllium	NA	5.00E-03	NA
uranium-total	2.67E-07	1.50E-04	1.78E-03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	4.50E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.78E-03

Compound	ILCR Calculation CDI (mg/kg-day)	CSF (mg/kg-day)$^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.90E+00	NA
beryllium	NA	4.30E+00	NA
uranium-total	2.28E-08	NA	NA
benzo(a)pyrene	NA	NA	NA
carbazole	NA	2.22E-02	NA
aroclor-1254	NA	1.03E+01	NA
aroclor-1260	NA	1.03E+01	NA
dieldrin	NA	1.78E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001396

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Table C.III-600
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Disposal cell with Federal Ownership: Off-Property Farmer (Child)
Via Inhalation of Gases and Particulates

Intake Equation = Ca X EF X EDn X IR

IR	Inhalation rate of gases (RAGS, 1989)	12 m^3/day
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Ca	Concentration of radionuclides in air	(see table below)

Cs_{137+1d}	NA	pCi/m^3	$Th_{232+10d}$	NA	pCi/m^3
Np_{237+1d}	NA	pCi/m^3	U_{234}	NA	pCi/m^3
Pu_{238}	NA	pCi/m^3	U_{235+1d}	NA	pCi/m^3
Ra_{226+8d}	NA	pCi/m^3	U_{238+2d}	NA	pCi/m^3
Ra_{228+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Rn_{222+4d}	1.1E-06	pCi/m^3	NA	NA	pCi/m^3
Sr_{90+1d}	NA	pCi/m^3	NA	NA	pCi/m^3
Tc_{99}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{228+7d}	NA	pCi/m^3	NA	NA	pCi/m^3
Th_{230}	NA	pCi/m^3	NA	NA	pCi/m^3

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	1.9E-11	NA
Np_{237+1d}	NA	2.9E-08	NA
Pu_{238}	NA	3.9E-08	NA
Ra_{226+8d}	NA	7.0E-09	NA
Ra_{228+1d}	NA	6.9E-10	NA
Rn_{222+4d}	2.6E-02	7.7E-12	2.0E-13
Sr_{90+1d}	NA	6.2E-11	NA
Tc_{99}	NA	8.3E-12	NA
Th_{228+7d}	NA	7.8E-08	NA
Th_{230}	NA	2.9E-08	NA
$Th_{232+10d}$	NA	1.1E-07	NA
U_{234}	NA	2.6E-08	NA
U_{235+1d}	NA	2.5E-08	NA
U_{238+2d}	NA	2.4E-08	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.0E-13

001397

Table C.III-601
Summary of Intake Quantitation (chemicals) Alternative 6
Disposal cell with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in meat	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium-total	2.1E-05	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor-1254	NA	mg/kg	NA	NA	mg/kg
aroclor-1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

001398

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Table C.III-601 (continued)
Summary of Risk Characterization (chemicals)
Disposal cell with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Meat Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	3.9E-08	3.0E-03	1.3E-05
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.3E-05

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	3.3E-09	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001399

Table C.III–602
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Disposal cell with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Meat Products

Intake Equation = Cf X EF X EDn X FI X IR

IR	Ingestion rate of meat	0.039 kg/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cf	*Concentration of radionuclides in meat*	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	NA	pCi/kg	U_{234}	6.3E–03	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	3.3E–04	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	6.9E–03	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	NA	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E–11	NA
Np_{237+1d}	NA	2.2E–10	NA
Pu_{238}	NA	2.2E–10	NA
Ra_{226+8d}	NA	7.8E–10	NA
Ra_{228+1d}	NA	1.0E–10	NA
Rn_{222+4d}	NA	1.7E–12	NA
Sr_{90+1d}	NA	3.6E–11	NA
Tc_{99}	NA	1.3E–12	NA
Th_{228+7d}	NA	5.5E–11	NA
Th_{230}	NA	1.3E–11	NA
$Th_{232+10d}$	NA	1.7E–10	NA
U_{234}	3.9E–01	1.6E–11	6.2E–12
U_{235+1d}	2.0E–02	1.6E–11	3.2E–13
U_{238+2d}	4.3E–01	2.0E–11	8.5E–12
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.5E–11

Table C.III-603
Summary of Intake Quantitation (chemicals) Alternative 6
Disposal cell with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in animal products	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium-total	7.5E-05	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor-1254	NA	mg/kg	NA	NA	mg/kg
aroclor-1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

Table C.III-603 (continued)
Summary of Risk Characterization (chemicals)
Disposal cell with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Dairy Products

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	3.2E-06	3.0E-03	1.1E-03
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		1.1E-03

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	2.8E-07	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

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Table C.III-604
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Disposal cell with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Dairy Products

Intake Equation = Cp X EF X EDn X FI X IR

IR	Ingestion rate of dairy products	0.9 l/day
FI	Fraction ingested from contaminated source	0.75 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cp	Concentration of radionuclides in animal products	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	NA	pCi/kg	U_{234}	2.3E-02	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.2E-03	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	2.5E-02	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	NA	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E-11	NA
Np_{237+1d}	NA	2.2E-10	NA
Pu_{238}	NA	2.2E-10	NA
Ra_{226+8d}	NA	7.8E-10	NA
Ra_{228+1d}	NA	1.0E-10	NA
Rn_{222+4d}	NA	1.7E-12	NA
Sr_{90+1d}	NA	3.6E-11	NA
Tc_{99}	NA	1.3E-12	NA
Th_{228+7d}	NA	5.5E-11	NA
Th_{230}	NA	1.3E-11	NA
$Th_{232+10d}$	NA	1.7E-10	NA
U_{234}	3.2E+01	1.6E-11	5.2E-10
U_{235+1d}	1.7E+00	1.6E-11	2.7E-11
U_{238+2d}	3.5E+01	2.0E-11	7.1E-10
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 1.3E-09

001403

Table C.III-605
Summary of Risk Characterization (chemicals) Alternative 6
Disposal cell with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = $\frac{CS \times EF \times ED \times FI \times IR}{BW \times AT}$

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration for non-carcinogens	6 Year
EDc	Exposure duration for carcinogens	6 Year
BW	Body weight	15 kg
ATc	Average time for carcinogens (lifetime)	25550 days
ATn	Average time for non-carcinogens (EDn x 365)	2190 days
CS	Concentration of chemicals in vegetables	

Chemical Concentrations

Compound	Concentration	Units	Compound	Concentration	Units
antimony	NA	mg/kg	NA	NA	mg/kg
arsenic	NA	mg/kg	NA	NA	mg/kg
beryllium	NA	mg/kg	NA	NA	mg/kg
uranium-total	1.0E-02	mg/kg	NA	NA	mg/kg
benzo(a)pyrene	NA	mg/kg	NA	NA	mg/kg
carbazole	NA	mg/kg	NA	NA	mg/kg
aroclor-1254	NA	mg/kg	NA	NA	mg/kg
aroclor-1260	NA	mg/kg	NA	NA	mg/kg
dieldrin	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg	NA	NA	mg/kg
NA	NA	mg/kg			

References

001404

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Table C.III-605 (continued)
Summary of Risk Characterization (chemicals)
Disposal cell with Federal Ownership: Off-Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Compound	HQ Calculation CDI (mg/kg-day)	RfD (mg/kg-day)	HQ (unitless)
antimony	NA	4.0E-04	NA
arsenic	NA	3.0E-04	NA
beryllium	NA	5.0E-03	NA
uranium-total	6.5E-05	3.0E-03	2.2E-02
benzo(a)pyrene	NA	NA	NA
carbazole	NA	NA	NA
aroclor-1254	NA	NA	NA
aroclor-1260	NA	NA	NA
dieldrin	NA	5.0E-05	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	HQ Summation =		2.2E-02

Compound	ILCR Calculation CDI (mg/kg-day)	CSF $(mg/kg-day)^{-1}$	ILCR (unitless)
antimony	NA	NA	NA
arsenic	NA	1.8E+00	NA
beryllium	NA	4.3E+00	NA
uranium-total	5.6E-06	NA	NA
benzo(a)pyrene	NA	7.3E+00	NA
carbazole	NA	2.0E-02	NA
aroclor-1254	NA	7.7E+00	NA
aroclor-1260	NA	7.7E+00	NA
dieldrin	NA	1.6E+01	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
	ILCR Summation =		NA

001405

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Table C.III–606
Summary of Intake and Risk Quantitation (radionuclides) Alternative 6
Disposal cell with Federal Ownership: Off–Property Farmer (Child)
Via Ingestion of Vegetables and Fruits

Intake Equation = Cv X EF X EDn X FI X IR

IR	Ingestion rate of fruits or vegetables	0.1 kg/day
FI	Fraction ingested from contaminated source	1 (Unitless)
EF	Exposure frequency	350 days/year
EDn	Exposure duration	6 Year
Cv	Concentration of radionuclides in vegetables	

Cs_{137+1d}	NA	pCi/kg	$Th_{232+10d}$	NA	pCi/kg
Np_{237+1d}	NA	pCi/kg	U_{234}	3.1E+00	pCi/kg
Pu_{238}	NA	pCi/kg	U_{235+1d}	1.6E−01	pCi/kg
Ra_{226+8d}	NA	pCi/kg	U_{238+2d}	3.4E+00	pCi/kg
Ra_{228+1d}	NA	pCi/kg	NA	NA	pCi/kg
Rn_{222+4d}	ERR	pCi/kg	NA	NA	pCi/kg
Sr_{90+1d}	NA	pCi/kg	NA	NA	pCi/kg
Tc_{99}	NA	pCi/kg	NA	NA	pCi/kg
Th_{228+7d}	NA	pCi/kg	NA	NA	pCi/kg
Th_{230}	NA	pCi/kg	NA	NA	pCi/kg

Radionuclides	CDI (pCi)	CSF $(pCi)^{-1}$	ILCR (unitless)
Cs_{137+1d}	NA	2.8E−11	NA
Np_{237+1d}	NA	2.2E−10	NA
Pu_{238}	NA	2.2E−10	NA
Ra_{226+8d}	NA	7.8E−10	NA
Ra_{228+1d}	NA	1.0E−10	NA
Rn_{222+4d}	NA	1.7E−12	NA
Sr_{90+1d}	NA	3.6E−11	NA
Tc_{99}	NA	1.3E−12	NA
Th_{228+7d}	NA	5.5E−11	NA
Th_{230}	NA	1.3E−11	NA
$Th_{232+10d}$	NA	1.7E−10	NA
U_{234}	6.5E+02	1.6E−11	1.0E−08
U_{235+1d}	3.4E+01	1.6E−11	5.4E−10
U_{238+2d}	7.1E+02	2.0E−11	1.4E−08
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA

ILCR Summation = 2.5E−08

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LIST OF ACRONYMS

ASL	analytical support level
ASTM	American Society for Testing and Materials
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CLP	Contract Laboratory Program
cm	centimeter
cm/sec	centimeters per second
cm^2/sec	square centimeters per second
COC	contaminant of concern
CPC	constituent of potential concern
DI	deionized water
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
E_h	oxidation/reduction potential
FEMP	Fernald Environmental Management Project
ft	foot
FS	feasibility study
GMA	Great Miami Aquifer
ILCR	incremental lifetime cancer risk
in.	inch
IT	International Technology Corporation
ITAS	International Technology Corporation Analytical Services
K_d	partition coefficients
Kg	kilogram
L	liter
m	meter
m^2	square meter
MCL	maximum contaminant level
mg	milligram
mL	milliliter
NWS	National Weather Service
ODAST	One-Dimensional Analytical Solute Transport

LIST OF ACRONYMS
(Continued)

PE	precipitation index
PRG	preliminary remediation goal
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
SCS	Soil Conservation Service
SWIFTLOAD	Sandia Waste Isolation Fate and Transport Loading
TCLP	toxicity characteristic leaching procedure
TFV	threshold friction velocity
TSP	total suspended particulate
μg/g	micrograms per gram
UCL	upper confidence level
USGS	U.S. Geological Survey
USLE	Universal Soil Loss Equation
WAC	waste acceptance criteria

APPENDIX D.1

GROUNDWATER FATE AND TRANSPORT FOR CONTAMINANTS OF CONCERN

D.1.0 GROUNDWATER FATE AND TRANSPORT FOR CONTAMINANTS OF CONCERN

This section summarizes the results of fate and transport modeling that was used to simulate constituent movement from the Operable Unit 2 subunits to potential human receptors from residual soils, in situ containment of waste with cap, and waste deposited in an engineered disposal cell. The fate and transport models provide the only means of predicting potential groundwater concentrations at receptor locations in the future under assumed conditions. Results of the fate and transport modeling are needed to evaluate various alternatives and are used in the risk assessment to evaluate residual risk from Operable Unit 2 waste. Conservative assumptions were used to simulate "worst-case" contaminant migration scenarios. Impacts of deposition of airborne contaminated dust and leaching of sediments were not considered here. Impacts of those mechanisms will be considered under Operable Unit 5 modeling efforts. The models used were as follows:

- The Universal Soil Loss Equation (USLE) model was used to estimate erosion potential in 1,000 years.
- The Hydrological Evaluation of Landfill Performance (HELP) model was used to estimate exfiltration and infiltration rates.
- The One-Dimensional Analytical Solute Transport/Sandia Waste Isolation Fate and Transport Loading (ODAST/SWIFTLOAD) model was used to predict contaminant movement through the vadose zone and prepare input files for the SWIFT III model.
- The SWIFT III model was used to predict contaminant movement through the Great Miami Aquifer

Only a brief description of the methodology used to quantitatively predict concentrations of contaminants is presented here. For a more complete description of the methods and parameters used for the Operable Unit 2 modeling, refer to Appendix A of the Remedial Investigation (RI) Report for Operable Unit 2 (DOE 1994).

D.1.1 SOIL EROSION POTENTIAL

Depths of erosion were calculated to determine the minimum topsoil and vegetative support zone thickness. The USLE model was used to estimate the yearly amount of sediments released from the South Field and Inactive Flyash Pile area annually. Depth of soil erosion was then calculated by dividing the sediment loss by area and the bulk density. Details of the calculations are included in Attachment D.1-II. Table D.1-1 presents the summary of soil erosion depths in 1,000 years for a

TABLE D.1-1

SUMMARY OF SOIL EROSION CALCULATIONS[a]

Area	R (100m-tonne-cm/ Ha-hr)	K (tonnes/Ha/R)	LS	C	P	ρ (gm/cm^3)	Erosion Depth (cm/yr)	Erosion Depth (cm/1,000 yr)	Erosion Depth (in/1,000 yr)
A	303.6	0.55	2.2	0.003	1	1.3	8.48E-03	8.48	3.34
B	303.6	0.55	6	0.003	1	1.3	2.31E-02	23.12	9.10
C	303.6	0.55	3	0.003	1	1.3	1.16E-02	11.56	4.55

[a]See Attachment D.1.II for definitions of parameters.

number of cross-sections shown in Figure D.1-1. For the future slope scenario, soil erosion depths range from 8.4 to 23.1 centimeters (cm) [3.3 to 9.1 inches (in.)] in 1,000 years. Therefore, less than 30.5 cm (12 in.) of topsoil/vegetative cover will erode in 1,000 years, and surface runoff will not carry contaminants.

D.1.2 CONCEPTUAL GROUNDWATER FLOW MODEL

The geology of the FEMP site is dominated by glacial sediments. Well-sorted sand and gravel glacial outwash forms the regional Great Miami Aquifer. Beneath the site, this aquifer is divided by a 0.3 to 6.6 meter (m) [1 to 20 foot (ft)] thick clay interbed at an approximate depth of 37 m (120 ft) (Figure D.1-2). The receptor pathway considered for this modeling is the upper part of the Great Miami Aquifer above the clay interbed. The term glacial overburden has been selected to describe the deposits located stratigraphically above the glaciofluvial material of the Great Miami Aquifer. A sequence of fine-grained till deposits interbedded with sand and gravel glaciofluvial stringers forms the glacial overburden at the site.

The migration of contaminants from sources to the groundwater begins with the infiltration of rainwater (Figure D.1-3). As the water percolates through the waste, contaminants in the waste are dissolved into the water to form a leachate. Fluid and/or leachate entering from the waste areas migrates first through the glacial overburden (if present), then through the unsaturated outwash deposits, and finally into the Great Miami Aquifer. Downward movement of water, driven by the forces resulting from gravitational potential, capillary pressure, and other components of total fluid potential, mobilize the constituents and carry them through the vadose zone.

Based on characteristics of the geology underlying the Operable Unit 2 subunits and the on-site disposal cell, a conceptual model was developed for the pathways between the subunits and potential receptor locations. Five pathways for contaminant migration from the Operable Unit 2 subunits to the Great Miami Aquifer were identified in the RI Report:

- Vadose Zone Pathway: Migration of constituents of potential concern (CPCs) from the waste unit laterally and vertically through the vadose zone to the aquifer was designated as the vadose zone pathway.
- Perched Water Infiltration Pathway: Vertical migration of perched water through the glacial till to the Great Miami Aquifer was designated as the perched water infiltration pathway.

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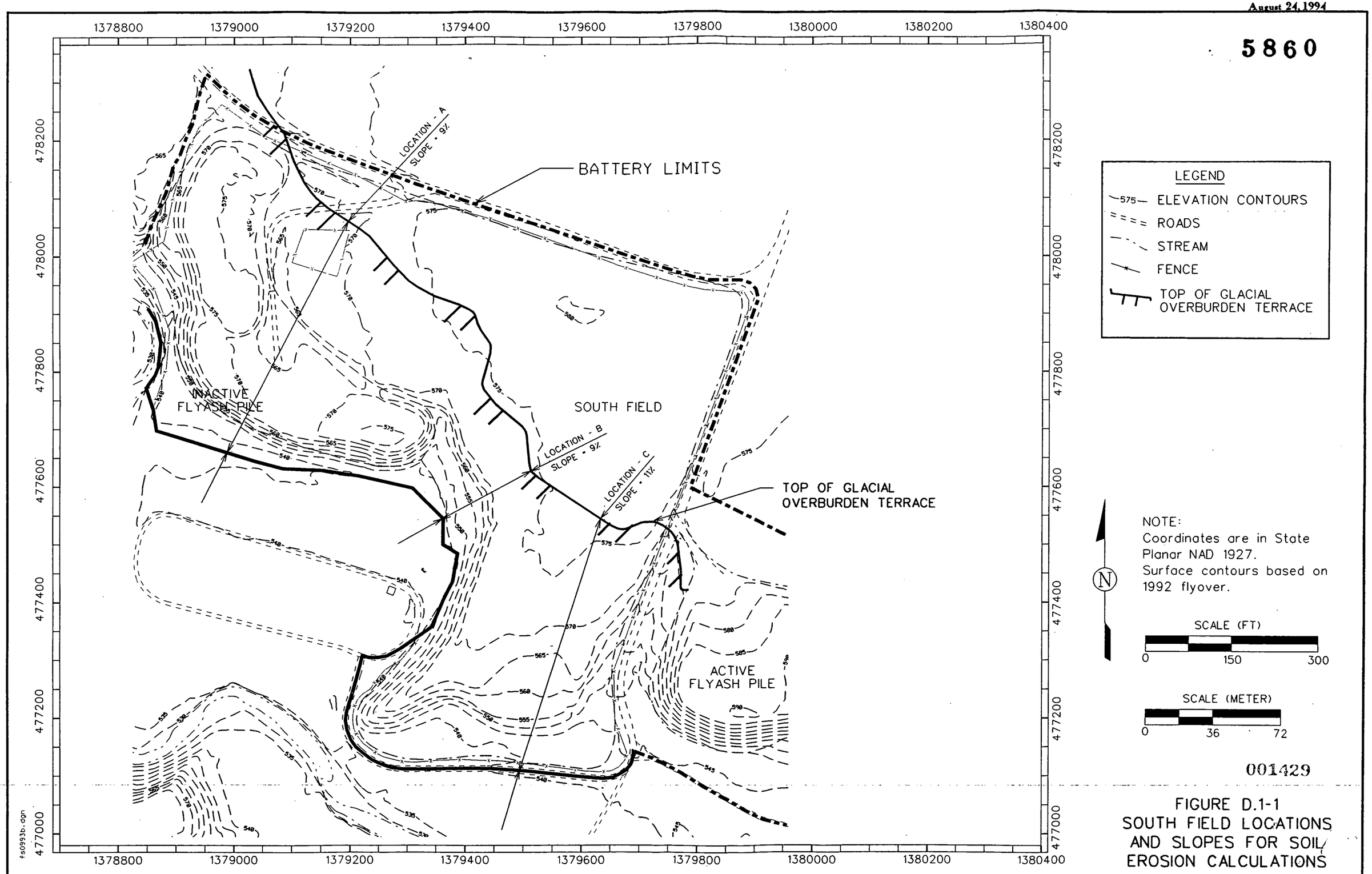

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FIGURE D.1-1
SOUTH FIELD LOCATIONS
AND SLOPES FOR SOIL
EROSION CALCULATIONS

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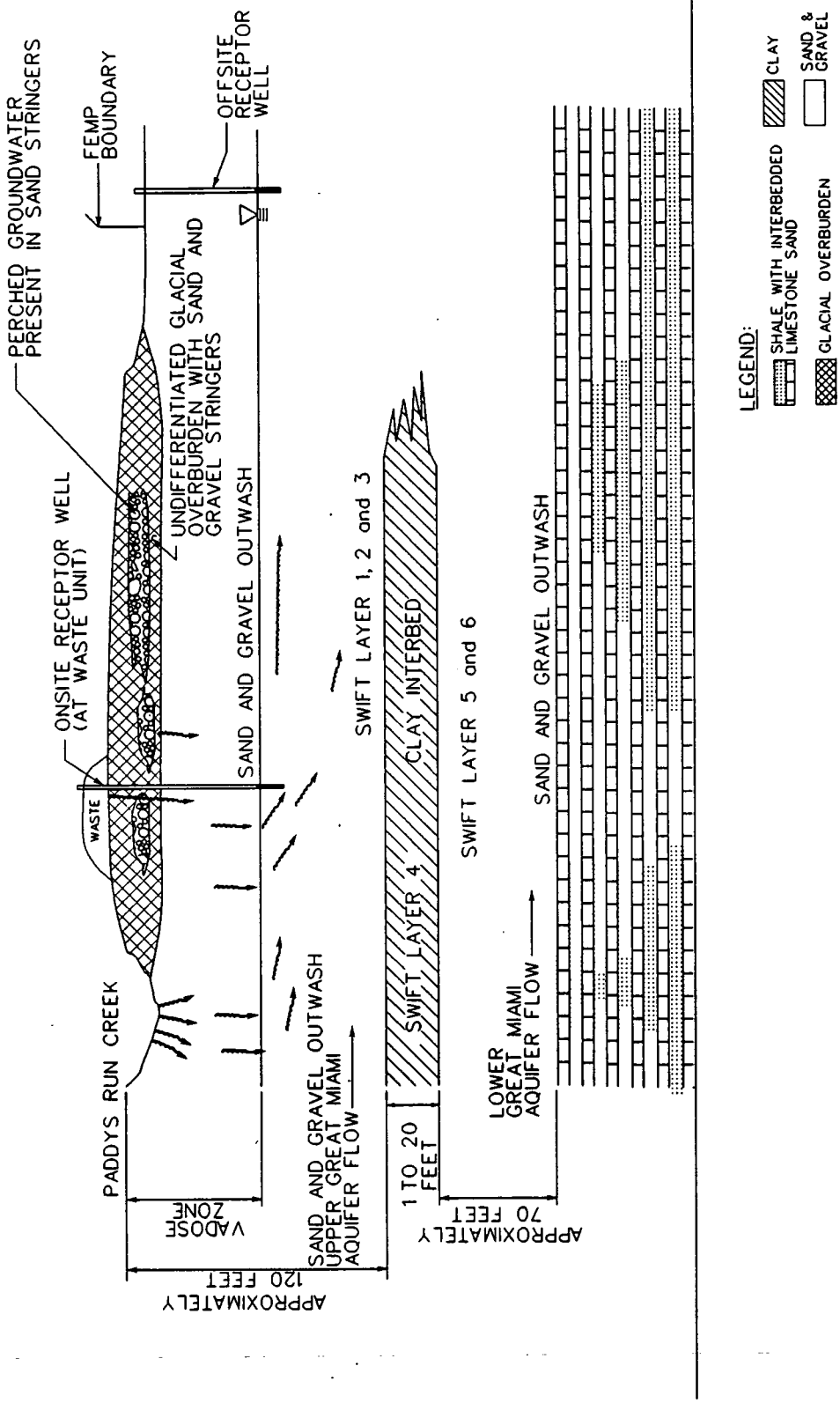

FIGURE D.1-2
CONCEPTUAL MODEL OF LOADING TO THE GREAT MIAMI AQUIFER AND CONTAMINANT TRANSPORT BY GROUNDWATER

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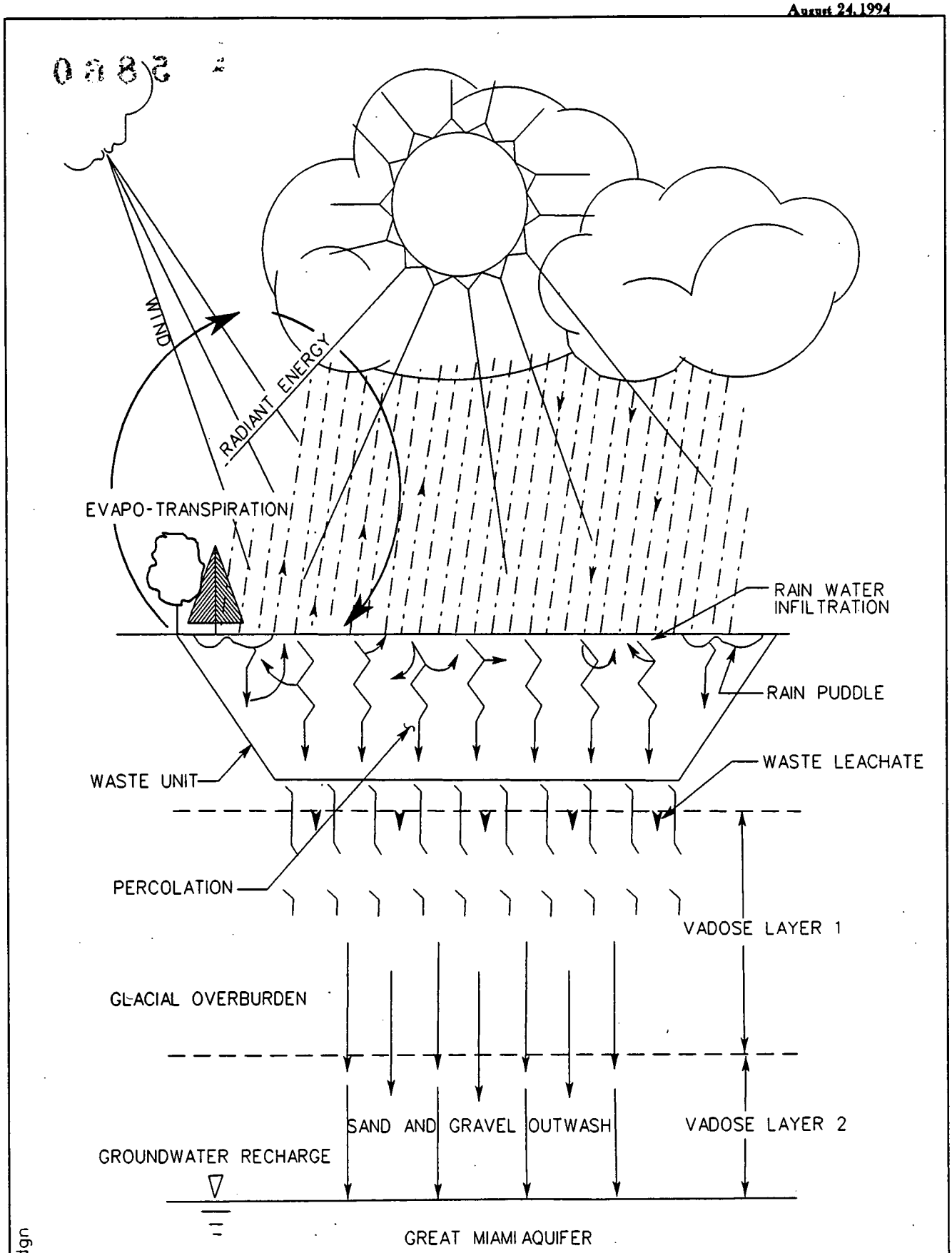

FIGURE D.1-3
CONCEPTUAL VADOSE ZONE MODEL

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- Perched Water Subsurface Seep Pathway: Lateral migration of CPCs occurs when perched water in sand and gravel layers within the glacial overburden comes in contact with waste material. Perched water moves laterally in the sand layer until it is intercepted at the sand/gravel and waste interface. At that point, perched water moves along the slope of the waste and till interface until it comes in contact with the unsaturated Great Miami Aquifer. This water containing CPCs then infiltrates vertically to the aquifer.

- Seep Pathway: Migration of CPCs from seeps to an area where glacial overburden is not present, and then through the unsaturated portion of the Great Miami Aquifer to the groundwater was designated as the seep pathway.

- Surface Water Pathway: Migration of CPCs from the surface soils due to storm-event runoff to Paddys Run or the Storm Sewer Outfall Ditch, and then vertically to the aquifer as the surface water pathway.

This appendix considers all of the steps of the vadose zone, perched water infiltration pathways, and perched water subsurface seep. The seep pathway was not included because seeps are present at only two limited sites, and under every scenario these seeps would be excavated. The RI modeling indicated that the impact of the surface water (runoff) pathway on the Great Miami Aquifer is very small for contaminants of concern (COCs). Furthermore, all remediation areas would be covered with backfill and vegetated to eliminate surface water pathways to the Great Miami Aquifer. Therefore, the surface water pathway was not included in the fate and transport modeling for groundwater.

Vadose Zone Pathway: The vadose zone, applicable to all subunits and modeled disposal areas, was modeled as two layers (Figure D.1-3), the glacial overburden underlying the subunits (Layer 1) and the unsaturated portion of the underlying Great Miami Aquifer (Layer 2). Layer 1 soils consist of tills in the glacial overburden. The travel time through the sand and gravel unit within the glacial overburden was not included in the vadose zone modeling, because this layer has much higher permeability and less adsorption potential than the clays and silts in the glacial overburden. Similarly, weathered till was not included in the vadose zone modeling since vertical permeability of this zone can be significantly higher than the unweathered till. The thickness of till (till below the perched water) for the vadose zone model ranges between 0 and 6.7 m (0 and 22 ft) for Operable Unit 2 subunits. Beneath the till is the unsaturated sand and gravel outwash layer (Layer 2), which is present beneath all the subunits. The thickness of Layer 2 ranges from 4.8 to 10.1 m (16 to 33 ft).

The lithology under the Inactive Flyash Pile and South Field is variable. The southwestern portion contains virtually no tills, while the till thickness increases to 6.7 m (22 ft) toward the northeastern portion of the South Field. When leachate from waste arrives at the interface of waste and till, a portion of the leachate infiltrates through the glacial overburden (till and sand/gravel stringers) and the remainder drains laterally to areas where till does not exist. Figure D.1-4 shows the conceptual model for lateral drainage. The area receiving lateral drainage, has increased flow. One vadose zone modeling run was used to simulate vertical infiltration. A separate vadose zone modeling run was used to simulate contaminant contribution from lateral drainage, and contaminant mass loading was added to the Great Miami Aquifer. Lateral drainage and infiltration through waste were summed to calculate total vertical percolation rate and interstitial fluid velocity for the areas receiving lateral drainage from upgradient waste areas.

Perched Water Infiltration Pathway: Another pathway that would apply after remediation is the perched water infiltration pathway. The conceptual model for the perched water infiltration pathway is similar to that of the vadose zone pathway. This pathway was modeled with two layers. Layer 1 soils consist of tills below the perched water zone, and Layer 2 soils consist of the unsaturated portion of the Great Miami Aquifer. Contaminant mass in the perched water and adsorbed to the sand layer, were considered in the source term for the perched water infiltration. The perched water was simulated as an additional source of contaminant loading based on the contaminant concentrations detected in the 1,000-series wells located within the Operable Unit 2 subunits.

Perched Water Subsurface Seep Pathway: Perched water not only represents a source for vertical infiltration, but it also serves as a source for perched water subsurface seeps. Figure D.1-5 shows the conceptual model for the perched water subsurface seeps. Sand and gravel within the glacial overburden (containing perched water) comes in contact with the waste in sections of the Inactive Flyash Pile and South Field. Perched water moves laterally in the sand and gravel layer until it is intercepted at the sand/gravel and waste interface. At that point, perched water moves along the slope of waste and till interface until it comes in contact with the unsaturated Great Miami Aquifer. The subsurface seep water then infiltrates vertically to the aquifer.

Based on characteristics of the material underlying each Operable Unit 2 subunit and the disposal cell, a detailed conceptual model was developed for the pathways between each subunit and the receptor locations. These more detailed models were developed to account for the variable stratigraphies of

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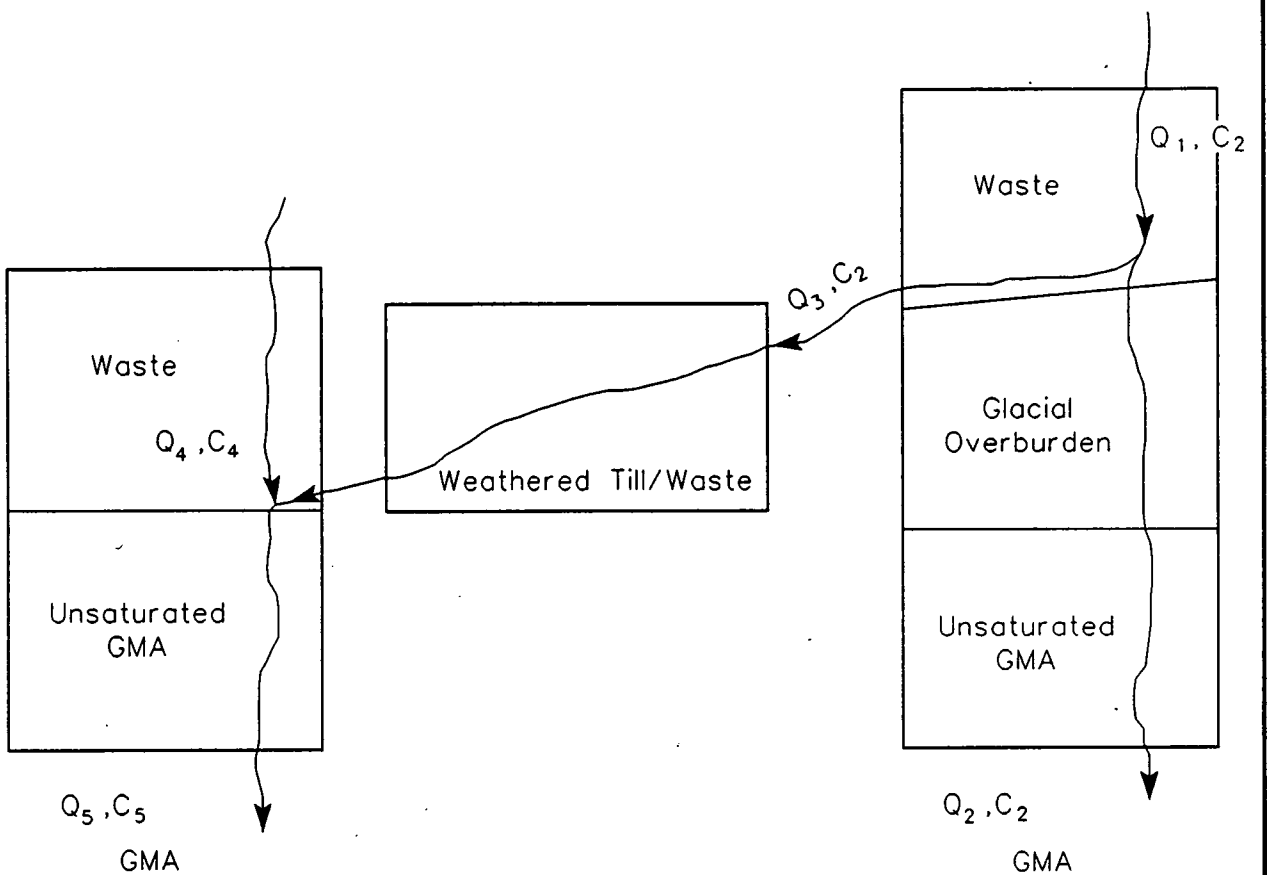

$$Q_1 = Q_2 + Q_3$$

$$Q_5 = Q_3 + Q_4$$

$$C_5 = \frac{Q_3 C_2 + Q_4 C_4}{Q_3 + Q_4}$$

NOTE:
C_i - CONSTITUENT CONCENTRATION
Q_i - FLOW RATE

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FIGURE D.1-4
CONCEPTUAL MODEL FOR LATERAL DRAINAGE INFILTRATING TO THE UNSATURATED GREAT MIAMI AQUIFER

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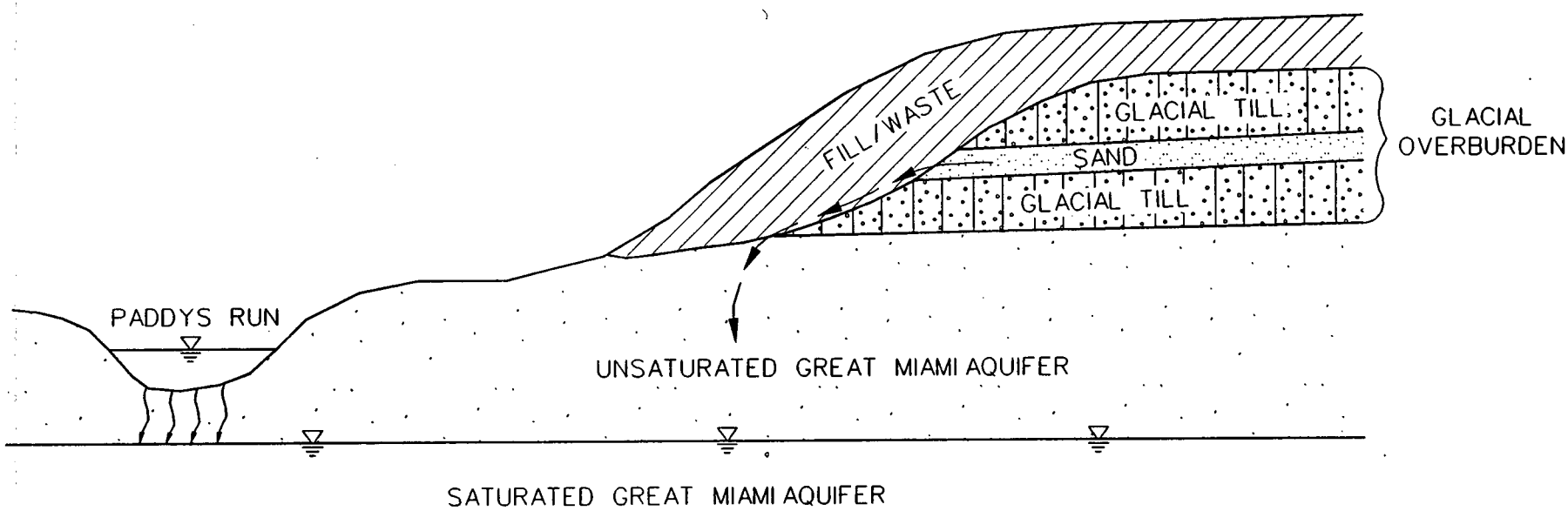

FIGURE D.1-5
CONCEPTUAL MODEL FOR PERCHED WATER SUBSURFACE SEEPS

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the soils of the subunits of Operable Unit 2. Areas overlying each SWIFT III grid block in all subunits were modeled separately with individual stratigraphy, contaminant concentration, and infiltration rate parameters, and each COC was simulated using retardation and decay factors taken from literature studies or site-specific data.

Contributions to COC concentrations from other FEMP sources and from soils at background concentrations were not included in the modeling and results presented in this appendix. The results presented here represent the incremental change in COC concentrations in the Great Miami Aquifer due to loading from Operable Unit 2 areas only.

D.1.3 TECHNICAL APPROACH

This section describes the technical approach used for defining parameters required for groundwater modeling. Section D.1.4 provides a brief description of the models used in groundwater fate and transport modeling. The groundwater COCs identified in the final RI Report for Operable Unit 2 were uranium isotopes. Of these isotopes, only uranium-238 was modeled in order to more efficiently utilize computation time. Uranium-238 was selected for modeling because more samples were analyzed for uranium-238 than any other uranium isotope, and uranium-238 constitutes more than 99 percent of total uranium mass. All uranium isotopes are assumed to have the same flow and transport properties (for example, adsorption) as uranium-238. Furthermore, the radioactive half-lives of uranium-234, uranium-235, uranium-236, and uranium-238 exceed 200,000 years. Therefore, modeling results for uranium-238 can be used to predict concentrations of uranium-234, uranium-235/236, and total uranium. Preliminary remediation goals (PRGs) for other uranium isotopes were estimated by applying scaling factors proportional to their groundwater incremental lifetime cancer risk (ILCR) concentration. For example, 10^{-6} ILCR groundwater concentrations for uranium-238 and uranium-234 are 0.72 pCi/L and 1.10 pCi/L, respectively. Therefore, if the modified soil PRG for uranium-238 was 5 pCi/g, then the modified soil PRG for uranium-234 was 7.64 [=(5)(1.1)/(.72)] pCi/g.

The modified soil PRGs were first estimated using the ECTran model. Results of the ECTran modeling were used as the initial estimates of the modified soil PRGs to be used in the ODAST/SWIFT models. These concentrations were adjusted so that groundwater concentrations at the receptor points do not exceed risk-based concentrations. If the predicted groundwater concentration at the receptor point was close to the desired concentration level, the modified soil

PRGs were calculated by applying a scaling factor to the maximum soil concentration used in the model. The scaling factor was calculated as a ratio of risk-based groundwater concentration to the model-predicted groundwater concentration.

For long-term risk estimation, concentrations of uranium-234 and uranium-235/236 were estimated by using site-specific activity ratios for uranium. The following relationships were derived between various uranium forms in the Final RI Report for Operable Unit 2:

Uranium-234 = 0.91 (Uranium-238)	activity ratio
Uranium-235/236 = 0.048 (Uranium-238)	activity ratio
Uranium-238 = 0.9925 (Uranium-total)	mass ratio

Note that these ratios are very close to the uranium isotope ratios for naturally occurring uranium. Although these relationships were developed from soil samples, the relationships should apply to uranium concentrations in the groundwater, because all uranium isotopes have very long half-lives (greater than 10,000 years). The simulation time period of 1,000 years was selected based on the Risk Assessment Work Plan Addendum (DOE 1992).

D.1.3.1 Source Term Development

The source included waste as well as the impacted till. The impacted till was defined as the till immediately below the fill and waste to a depth of 0.8 m (2.5 ft) for the Solid Waste Landfill, 1.2 m (4 ft) for the South Field, 0.6 m (2 ft) for the Inactive Flyash Pile, and 0.8 m (2.5 ft) for the Active Flyash Pile. Depths of impacted till were selected from the analytical results for uranium for the soil samples. See Section 1.7.1 of the FS for more detail on defining impacted till thickness.

The uranium-238 concentration in each block was estimated using kriging, as described in Appendix A.2 of the Operable Unit 2 RI Report. This approach was selected for uranium, because uranium controls the risk from groundwater pathways and to simulate known hot spots identified during field investigations. All validated uranium-238 results from Remedial Investigation/Feasibility Study (RI/FS) Phase I and Phase II field investigations for each subunit were segregated by waste/fill, impacted till, remaining glacial overburden, and the unsaturated Great Miami Aquifer soils. Uranium-238 concentrations in each 7.6 x 7.6 x 0.76 m (25 x 25 x 2.5 ft) block were estimated using three-dimensional kriging for each media type. Average waste concentrations in each 38 x 38 m

(125 x 125 ft) SWIFT III grid cell were then calculated from all 7.6 x 7.6 x 0.76 m (25 x 25 x 2.5 ft) thick blocks within each SWIFT III grid cell.

Source terms for residual soils were determined by evaluating the kriged uranium-238 concentration on a block-by-block basis against the remediation criteria selected for the alternative. All blocks above a block containing a uranium-238 concentration exceeding the remediation level were removed from the source term. Within a grid cell, when uranium-238 concentration in any block exceeded the remediation level, then all remaining blocks in that grid cell were conservatively assigned a uranium-238 concentration equal to the remediation level. However, if all the blocks in a grid cell were below the remediation level, the kriged average concentration in that grid cell was used as the source term for modeling purposes.

Because excavated soils can be placed anywhere under the cap, the source term for fate and transport modeling for consolidation and placement under a cap was based on maximum detected uranium-238 concentration in each media type. If existing soils in a grid cell contained uranium-238 (at the South Field, for example), the uranium-238 mass from existing soils was added to the total mass for that grid cell. However, leachate concentrations were estimated from the layer containing the highest level of uranium-238. This approach was selected to simulate a "worst-case" scenario, since the sequence of contaminated soil removal and placement was not determined in detail during this Feasibility Study.

The source terms for perched water infiltration pathways were estimated using the following equation:

$$\text{Mass} = (\phi\, C_w + \rho_b K_d C_w)\, Ab \qquad \text{(D.1-1)}$$

where

- A = area of cell [1,452 square meters (m^2) (125 ft x 125 ft)]
- b = average perched water zone thickness
- C_w = upper 95 percent confidence level on the mean (UCL) of the perched water concentration
- K_d = distribution coefficient
- ϕ = porosity
- ρ_b = bulk (dry) density

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D.1.3.2 Methods of Estimating Leachate Concentrations

An exponentially declining source leachate concentration term was used:

$$C = C_o \, Exp(-\alpha t) \qquad \text{(D.1- 2)}$$

where

$$\alpha = \frac{qAC_o}{M} \qquad \text{(D.1-3)}$$

A = area of the grid cell [1,452 m^2 (125 ft x 125 ft)]
C_o = initial leachate concentration
M = mass of contaminant in the grid cell
q = infiltration rate

The depletion factor (α) is inversely proportional to the depletion half life. The preferred data for estimating initial contaminant concentrations (C_o) in leachate was analyses of in situ leachate or toxicity characteristic leaching procedure (TCLP) analysis. However, in-situ leachate or TCLP analyses were not available for uranium-238 at all soil concentration levels needed for PRG development. Therefore, initial leachate concentration (C_o) for uranium-238 was estimated from the ratio between waste concentration and distribution coefficient for the waste. Distribution coefficients (K_d) for the uranium-238 were 75 mL/g for the Solid Waste Landfill, 200 mL/g for the Lime Sludge Ponds and berm material, 177 mL/g for the South Field waste, and 37.5 mL/g for flyash. These values represent the lowest desorption K_d's measured on waste/fill samples collected at the Operable Unit 2 subunits (see Appendix D.3).

D.1.3.3 Parameters

Most of the input parameters were taken directly from the Operable Unit 2 RI fate and transport modeling sections. Physical parameters of the media for the Operable Unit 2 subunits are presented in Table D.1-2. These parameters values were taken from the Final RI report for Operable Unit 2.

The vertical hydraulic conductivity values for Layer 1 were obtained from the geometric average horizontal hydraulic conductivities of 1000-series wells completed in dark gray clay or clayey silt or from the maximum permeability measurements conducted on core samples. The vertical hydraulic conductivity for Layer 2 was obtained by dividing the horizontal hydraulic conductivity of the Great Miami Aquifer by 10. The factor of 10 (or a ratio of 0.1) represents a typical horizontal to vertical

TABLE D.1-2

MEDIA PARAMETERS

Parameter	Unit	Solid Waste Landfill	Lime Sludge Pond	Active Flyash Pile/ Inactive Flyash Pile	South Field	Disposal Cell
Bulk Density	gm/cm^3					
Waste/Fill		1.83	0.76	0.86	1.70	-[a]
Glacial Till		1.85	1.85	1.85	1.85	1.85
Unsaturated GMA[b]		1.60	1.60	1.60	1.60	1.60
Hydraulic Conductivity	cm/sec					
Waste/Fill		1.10×10^{-4}	1.00×10^{-3}	1.80×10^{-4}	2.00×10^{-4}	1.80×10^{-4}
Glacial Till		1.90×10^{-6}	1.90×10^{-6}	1.40×10^{-7}	1.40×10^{-7}	1.9×10^{-6}
Unsaturated GMA		1.59×10^{-2}	1.59×10^{-2}	1.59×10^{-2}	1.59×10^{-2}	1.59×10^{-2}
Porosity	%					
Waste/Fill		52	55	44	52	52
Glacial Till		41	41	41	41	41
Unsaturated GMA		39	39	39	39	39
Field Capacity	%					
Waste/Fill		29.4	37.8	28.4	29.4	29.4
Glacial Till		37.1	37.1	37.1	37.1	37.1
Unsaturated GMA		4.5	4.5	4.5	4.5	4.5
Wilting Point	%					
Waste/Fill		14.0	26.5	13.5	14.0	14
Glacial Till		25.1	25.1	25.1	25.1	25.1
Unsaturated GMA		2.0	2.0	2.0	2.0	2.0
Vegetative Cover		fair grass	fair grass	fair grass	fair grass	fair grass
Evaporation Zone Depth	in.	12	12	12	12	12

[a]- = not used
[b]GMA = Great Miami Aquifer

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hydraulic conductivity ratio. Results of the recent South Plume pump test calculated aquifer values for vertical to horizontal hydraulic conductivity ratios from 0.07 to 0.17 (i.e., over a range which includes this value) (Parsons 1993). The vertical hydraulic conductivity was estimated to be 2.4×10^{-6} to 1.4×10^{-7} centimeter per second (cm/sec) for Layer 1. The vertical hydraulic conductivity of Layer 2 was estimated to be 1.6×10^{-2} cm/sec for all Operable Unit 2 subunits and the disposal cell area.

The vertical seepage velocities (v) used in the vadose zone transport model were calculated from the infiltration rates and equations presented in the EPA's Superfund Exposure Assessment Manual (EPA 1988). For the saturated glacial till, seepage velocities were calculated from:

$$v = \frac{q}{P_e} = \frac{q}{\theta_s - \theta_w} \qquad \text{(D.1-4)}$$

where

q = infiltration rate (length/time)
P_e = effective porosity (volume fraction)
Θ_s = saturated moisture content (volume fraction)
Θ_w = wilting point moisture content (volume fraction)

The seepage velocity in the unsaturated Great Miami Aquifer was calculated from:

$$v = \frac{q}{\theta} \qquad \text{(D.1-5)}$$

where

q = infiltration rate (length/time)
Θ = moisture content (volume fraction)

The longitudinal dispersion coefficients (D_x), a function of dispersivity, interstitial seepage, velocity, and molecular diffusion coefficient were estimated by the methods presented by Biggar and Nielsen (1976), and Mills et al. (1982).

$$D = 0.6 + 2.93\, v^{1.11} \qquad \text{(D.1-6)}$$

where

D = dispersion coefficient in square centimeters per second (cm^2/sec)
v = seepage velocity in cm/sec

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Flow and solute transport through the porous media are not only determined by the parameters considered in the conceptual model description above, but they are also affected by decay rates and retardation factors (R). The radioactive half life for uranium-234 is 2.45 x 10^5 years, for uranium-235, 7.04 x 10^8 years, and for uranium-238, 4.47 x 10^9 years. The retardation factor was used to account for those reversible reactions that slow the arrival of a contaminant front, but do not act as a sink. The retardation factor can be expressed as the ratio between the rate of groundwater movement and the rate of contaminant movement. These parameters are both chemical- and media-specific. The retardation factors were calculated from Walton (1984) and Mills et al. (1982):

$$R = 1 + \frac{\rho_b K_d}{\theta} \qquad \text{(D.1-7)}$$

where

K_d = distribution coefficient
R = retardation factor
ρ_b = bulk dry density
Θ = soil moisture content

During the improvement of the SWIFT-based Great Miami Aquifer model and subsequent calibration, the distribution coefficient for uranium-238 in the Great Miami Aquifer was determined to be 1.78 mL/g. The uranium-238 distribution coefficient for glacial overburden used in the RI modeling was 200 mL/g. The Operable Unit 5 Geochemical Study presented in Appendix D.4 recommends that 24 mL/g be used as the K_d for uranium-238 in glacial overburden. This value is considered to be applicable at the Operable Unit 2 subunits. Attachment D.1-III describes how lysimeter data from Operable Unit 5 were matched with the ODAST model using a K_d value of 3.1 mL/g for glacial till. Since a disposal cell could receive waste from sources outside Operable Unit 2, it seems possible that the geochemical circumstances that resulted in the lysimeter data could present themselves again. Therefore, preliminary waste acceptance criteria (WAC) for the on-site disposal of Operable Unit 2 material were developed using the conservative assumption that 3.1 mL/g is the glacial till K_d.

Till (Layer 1) thickness at the South Field for the ODAST/SWIFTLOAD model was modified from the RI values to delete impacted till that is now included in the source term. Furthermore, only the thickness of the gray till below the perched water was used as Layer 1 thickness. Thus, it is assumed that travel time to the perched water is negligible due to increased hydraulic conductivity or potential for fractures in the brown till layer above the perched water.

D.1.3.4 Vadose Zone Modeling

Vadose zone modeling was performed by using the leachate concentrations as input to a one-dimensional unsaturated flow model to simulate transport through the vadose zone to the Great Miami Aquifer. The ODAST model was used to simulate dispersion, retardation, and decay through unsaturated materials. The HELP model was used to estimate infiltration rates. For estimating infiltration rates, it was assumed that the geomembrane water barrier will deteriorate and that the leachate collection system in the liner will be ineffective. Waste above each SWIFT III grid cell was modeled separately with individual stratigraphy, contaminant type and concentration, and infiltration rate parameters.

D.1.3.5 Great Miami Aquifer Modeling

The improved and calibrated SWIFT-based groundwater flow model for the FEMP site was used to simulate the solute transport of COCs in the Great Miami Aquifer. The Operable Unit 2 fate and transport modeling involved incorporating the vadose zone modeling results (for the vadose zone and perched water infiltration pathways) to determine loading rates to the Great Miami Aquifer from the subunits or disposal areas. The model then simulated the transport of constituents away from these source areas. Dispersion, retardation, and decay were factored into the contaminant transport process. SWIFT III simulations of COC transport in the Great Miami Aquifer were run for up to 1,000 years.

The loading from each grid cell impacted by the subunit was entered into the SWIFT III model as a discrete source, making multiple sources for each constituent. Due to the proximity of the Inactive Flyash Pile to the South Field, sources from the Inactive Flyash Pile and South Field were combined into one SWIFT III run. The modeling runs produced simulations of the aggregate effects of loading from these two subunits for the COCs.

D.1.4 MODEL DESCRIPTIONS

A description of each of the models used in the groundwater fate and transport modeling is contained in the following sections.

D.1.4.1 HELP Model

Infiltration (seepage) rates through the waste to the Great Miami Aquifer for various conceptual models were calculated using the HELP model. The HELP model is a quasi-two-dimensional

hydrologic model of water movement across, into, through, and out of a waste unit. The model accepts climatologic, soil, and design data and simulates a number of hydraulic processes, including surface storage, runoff, infiltration, percolation, evapotranspiration, soil moisture storage, and lateral drainage. The systems that can be simulated by the HELP model include various combinations of vegetation, cover soils, waste cells, drainage layers, and relatively impermeable barrier soils.

The HELP model is designed to perform water budget calculations for a system having as many as 12 layers. Each layer must be identified as either a vertical percolation, lateral drainage, barrier soil layer, or barrier soil layer with a geomembrane. Two barrier layers, other than geomembrane over the soil barrier layer, next to each other cannot be simulated in the HELP model. The identification of each layer used in the model is critical because the program models water flow through various types of layers in different ways. Runoff is calculated using the Soil Conservation Service (SCS) runoff curve number method by considering daily precipitation. Percolation and vertical water routing are modeled using Darcy's Law for saturated flow, with modifications for unsaturated conditions. Evapotranspiration is estimated by a modified Penman method adjusted for limiting soil moisture conditions.

The HELP model output consists of input data echo, optional simulation details, and a summary of results. The input data echo includes all the information used for input, including the values chosen from the model's built-in data base and manually input data. Following the input data echo, the program produces a table of daily results, monthly totals, and annual totals for each year if the option for detailed output was used. The summary includes average monthly totals, average annual totals, peak daily values on any day during the simulation period, and final moisture contents in all layers modeled. The average totals include precipitation, runoff, evapotranspiration, percolation, and lateral drainage for appropriate layers.

D.1.4.2 <u>ODAST/SWIFTLOAD Model</u>

The ODAST/SWIFTLOAD model was used in the Operable Unit 2 analysis to define vertical contaminant transport from contaminated soil or perched water to the Great Miami Aquifer. ODAST, which is a subroutine of SWIFTLOAD, evaluates the basic one-dimensional analytical solute transport equation as a function of seepage velocity, dispersion coefficient, source decay, retardation factor, depletion time, and source rate. SWIFTLOAD has been developed as a data processing program to create an appropriate input file for the SWIFT model. It runs ODAST as a subroutine on a cell-by-

cell basis using the same 120-by-112 grid as the SWIFT Great Miami Aquifer model. SWIFTLOAD reads an external file defining the layer thickness for each model cell and hydraulic and transport properties for each block.

The ODAST computer code is based on the solution originally developed by Ogata and Banks (1961) and calculates the normalized concentrations of a given constituent in a uniform flow field from a source having a constant or varying concentration in the initial layer (Javendel et al. 1984). ODAST has been extensively verified against STRIP1B (Batu 1989).

The ODAST model implements an analytical solution to the partial differential equation

$$D\frac{\partial^2 C}{\partial x^2} - V\frac{\partial C}{\partial x} - \lambda RC = R\frac{\partial C}{\partial t} \qquad \text{(D.1-8)}$$

where

C	=	solute concentration (mass/volume)
		and with the constant coefficients
D	=	dispersion coefficient (length^2/time)
V	=	seepage velocity (length/time)
R	=	retardation factor (dimensionless)
x	=	vertical distance (length)
t	=	time (time)
λ	=	solute decay factor (time^{-1})

The solution must satisfy the initial and boundary conditions

$$C(x,0) = 0 \qquad \text{(D.1-9)}$$

$$-D\frac{\partial C}{\partial x} + VC\,\Big|_{x=0} = \begin{cases} VC_0\, e^{-\alpha t}, & 0 \le t \le \tau_0 \\ 0, & t > \tau_0 \end{cases} \qquad \text{(D.1-10)}$$

$$\frac{\partial C}{\partial x}\Big|_{x\to\infty} = 0 \qquad \text{(D.1-11)}$$

where the constants

C_o	=	initial source concentration (mass/vol)
α	=	source depletion factor (time^{-1})
τ_o	=	source depletion time (time)

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The solution is obtained using a Laplace transform technique and involves products of exponential and complementary error functions (Javandel et al. 1984). The solution for C is divided by C_0 to yield normalized concentrations.

Because the coefficients in the governing equation are constant, and the solution must satisfy a zero concentration gradient condition as x approaches infinity, ODAST is only strictly applicable to one-dimensional transport in homogeneous, semi-infinite media. However, the present application of ODAST is intended only to provide conservative estimates of aquifer mass loading.

ODAST model runs can be executed for only one constituent at a time, and the solution may be applied over any arbitrary segment of a waste area that is judged to contain a subsurface which does not change over time. A superposition technique is used to combine calculations for the two homogeneous layers comprising the vadose zone conceptual model. The ODAST solution at the bottom of Layer 1 is divided into 1,000 small time steps and a Layer 2 run is performed for each of these steps. Each of these Layer 2 runs assumes no source decay, a recharge period 1/1,000 of the total modeling time, and a source concentration equal to the averaged Layer 1 solution for that time period. The solution at the bottom of Layer 2 is obtained by summing the results of the 1,000 Layer 2 runs at specified time steps. For RI/FS modeling, concentrations are calculated for up to 1,000 years, typically in steps of 20 years. Constituents that migrate quickly, such as technetium-99, require smaller time steps for accurate representation of loading curves.

Input parameters for ODAST are the dispersion coefficient, seepage velocity, retardation factor, source depletion time, solute decay factor, and source depletion factor. These are discussed below.

- Seepage velocity and the dispersion coefficient depend on the characteristics of the waste area and the vadose zone medium. Seepage velocity is calculated as an empirical function of the percolation rate obtained from the HELP model, saturated hydraulic conductivity, and effective porosity (EPA 1988). The dispersion coefficient is obtained as an empirical function of seepage velocity (Biggar and Nielsen 1976).

- The retardation factor accounts for transport delays due to reversible reactions between the chemical constituent and the vadose zone solid matrix. It is thus dependent on both solute and medium characteristics, and is calculated as a function of the constituent's partitioning coefficient and the vadose zone bulk density and moisture content (Walton 1984; Mills et al. 1985).

- The solute decay factor is constituent dependent. This parameter accounts for biodegradation in organics and radioactive decay in radionuclides, and is zero for stable inorganics.

- Source depletion time and factor control the mass flux history of the constituent at the top of the modeled layer. Based on the upstream boundary condition, source mass flux decays exponentially. To calculate depletion time and factor for the waste at the top of Layer 1, the time-dependent expression for mass flow from the source is integrated from zero to the source depletion time. This integral is equated to the depleted mass of the constituent to provide a single equation in two unknowns. A second equation is obtained by arbitrarily specifying a mass depletion fraction. This is the level (very close to, but less than one) at which the source is declared depleted; technically, the source is depleted only as time approaches infinity. As stated previously, depletion factor is zero and depletion time is 1/1000 of the total modeling time for the Layer 2 runs.

D.1.4.3 SWIFT Model

The SWIFT model is used for simulating three dimensional contaminant transport in the Great Miami Aquifer. The SWIFT code is a fully coupled, transient, three-dimensional finite-difference model for groundwater flow and transport through both porous and fractured media. The mass transport equations solved include terms for convection, dispersion, retardation by sorption, and decay or degradation of the contaminant. The SWIFT code, originally developed by Sandia National Laboratory in the late 1970s for the High Level Waste Program (GeoTrans 1987), has been revised several times to increase its capability and to change computer platforms. These revisions include the addition of fractured media, a free water surface, extended boundary conditions, conversion to Fortran 77, and extended options for matrix solutions and post processing. GeoTrans has converted SWIFT for use on 386 and 486 personal computers and made additional changes to improve user friendliness and input and output control, the most recent version being SWIFT 2.52 (GeoTrans 1992).

SWIFT was selected from among several codes for use in developing a flow and transport model of the Great Miami Aquifer in the vicinity of the FEMP. Subsequent to selection of the code, the SWIFT code was specifically verified for use at the FEMP (IT 1990). A model of the Great Miami Aquifer (using SWIFT) was originally developed and calibrated from 1988 through 1990 (DOE 1993a). This model-building effort consisted of

- Developing and calibrating two- and three-dimensional regional flow models

- Developing and calibrating a telescoped and more refined grid of a three-dimensional flow model of the FEMP and its adjacent areas

- Developing and calibrating two- and three-dimensional solute transport models on the more refined grid.

The original model consisted of five layers. The two uppermost layers represented the upper and lower parts of the upper Great Miami Aquifer, the middle layer included a clay interbed that is present beneath the FEMP site and the lower two layers represented the lower Great Miami Aquifer. The layers extended laterally into bedrock at the edges of the buried valley that contains the aquifer. This original FEMP steady-state flow model was calibrated to 1986 water elevation data.

Since that time, additional data have been collected, new wells have been installed, and a large-scale pumping test (South Plume Pumping Test) has been conducted. Based on these factors and agency comments, a model improvement program was initiated (DOE 1993b). The essential elements of this model improvement program were completed in March 1994 (DOE 1994c). The Operable Unit 2 Feasibility Study modeling makes use of this "improved" model. Model improvements consisted of the following:

- The model grid for steady-state flow and solute transport was expanded. The previous solute transport grid of 78 cells by 102 cells was enlarged by adding a band approximately 5,250 feet wide along the eastern side and a band approximately 1,250 feet wide along the northern side. The new grid contains 120 cells by 112 cells, each 125 feet square. The layering of the model also has been refined. The five layers of the original model have been replaced with six layers to better match existing well screen elevations. This allowed field data to be more accurately depicted and provided better vertical control over contaminant dispersion.

- Geostatistical analysis has been conducted to understand and correlate the spatial distribution of key data sets. These data sets include the water elevation data and the uranium analytical data from the 2000-, 3000- and 4000-series monitoring wells. Calculations included the sample semivariogram, and kriging and cokriging estimators, along with their estimation variance. This analysis was used to help determine calibration criteria and to identify areas of the site where there is lower confidence in the analyzed data sets.

- A transient flow calibration was performed using the South Plume Pumping Test results. Parameter values for porosity and rock compressibility were developed from this calibration. Because of the scale and orientation of the pumping test wells, a telescoped grid (25 foot cell size) was created in the south plume area to effectively simulate the results of the pumping test.

- A steady-state flow calibration was conducted using the expanded and reconstructed steady-state grid. Steady-state heads were matched to the established calibration criteria. This recalibrated steady-state model is the primary model used for flow and solute transport simulations.

- The solute transport model was recalibrated to determine reasonable values of K_d (for uranium) and dispersivity for a representative source loading. The range of acceptable uranium K_d values has been established by reviewing site data related to K_d and by reviewing sensitivity runs of previously utilized K_d values corresponding to retardation factors of 9 and 12.

- The historical source loading terms were decoupled from the model and monitoring data were used to define initial conditions of uranium concentrations. Results from the glacial overburden and Paddys Run models were used to define future loading terms.

- Sensitivity analysis was performed on horizontal hydraulic conductivity (K_h), ratio between horizontal hydraulic conductivity and vertical hydraulic conductivity (K_h/K_v), porosity, uranium distribution coefficient, and dispersivity (α) in order to understand the effect of variation of these parameters on the maximum concentration and transport of a normalized plume.

- Quality assurance/quality control procedures for modeling were defined to control and confirm the quality of the modeling effort.

New data sets have been used in the construction and calibration of the model. In summary, new data sets include:

- Monitoring data from the 1990 to 1993 time period
- Monitoring data from new wells installed since the original calibration
- Results of additional aquifer analysis to define K_d
- Geostatistical analysis of data sets
- Results from the South Plume Pumping Test
- Results from construction and operation of the South Plume Recovery Well System
- Output from additional models (glacial overburden, surface water) to define hydraulic and solute loading terms

Model simulations of the improved site SWIFT model were performed using a Silicon Graphics Computer (Unix based). Simulation execution times for 1,000-year solute transport runs varied between 30 and 40 hours. These 1,000-year simulations generate extremely large output files and require peripheral hardware. Output was written to files from which relevant data was extracted using data manipulation programs written for that purpose. Contour plots were made using SURFER for selected constituents at different simulation times. Report graphics were imported into Intergraph workstations for preparation of final graphics.

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D.1.5 Cross-Media PRG Development to be Protective of the Great Miami Aquifer

D.1.5.1 Solid Waste Landfill

Without Source Controls

Figure D.1-6 shows the SWIFT III grid blocks directly beneath the waste at the Solid Waste Landfill. Table D.1-3 presents the physical parameters for the SWIFT grid cells impacted by the Solid Waste Landfill. The HELP model was used to estimate the infiltration rate (see Attachment D.1-I) as 24 centimeters per year (cm/yr) [9.61 inches per year (in./yr)]. Calculated seepage rates were 153 and 320 cm/yr (60.4 and 126 in./yr) in the glacial till and unsaturated Great Miami Aquifer, respectively. The vadose zone and the perched water infiltration pathways were applicable for this alternative. Based on the Operable Unit 2 RI data, initial perched water concentration was set to 15.2 pCi/L.

Figure D.1-7 shows the loading curve for the Solid Waste Landfill without source controls. Based on the parameters shown in Table D.1-3, the fenceline maximum uranium-238 concentration predicted by the SWIFT model was 0.80 pCi/L. This run assumed that maximum uranium-238 concentration in the source will be 45 pCi/g. Therefore, for uranium-238 concentrations at the FEMP fenceline not to exceed 0.72 pCi/L (10^{-6} ILCR level), the source concentration should not exceed 40.5 pCi/g. In other words, the modified soil PRG for the off-property resident farmer is 40.5 pCi/g. Modified soil PRGs for other risk levels were similarly calculated. Table D.1-4 provides a summary of modified soil PRGs for the off-property resident farmer without source controls. The 10^{-6} ILCR groundwater concentration for uranium-234 and uranium-235/236 is 1.1 pCi/L. Modified soil PRGs for uranium-234 and uranium-235/236 are greater than uranium-238. Modified soil PRGs for uranium-234, uranium-235/236, and total uranium are also shown in Table D.1-4.

The maximum on-subunit concentration predicted by the SWIFT model was 23.3 pCi/L for the parameters shown in Table D.1-3. Therefore, for uranium-238 concentrations at the subunit not to exceed 0.72 pCi/L (10^{-6} ILCR level), the source concentration should not exceed 1.39 pCi/g (45*0.72/23.3). In other words, the modified soil PRG for the on-property resident farmer is 1.39 pCi/g. Modified soil PRGs for other risk levels were similarly calculated. Table D.1-4 also provides a summary of modified soil PRGs for the on-property resident farmer without source controls.

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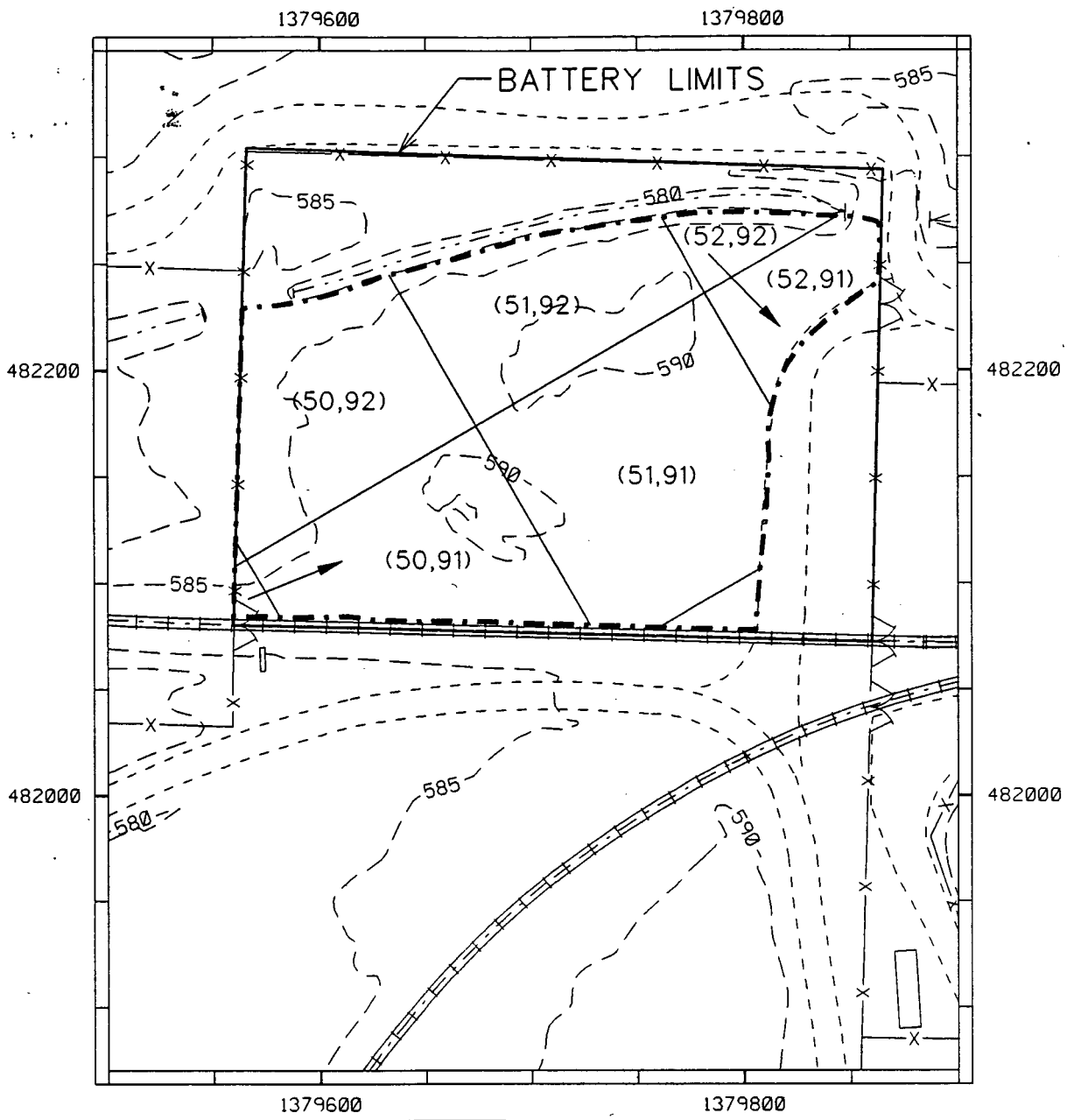

LEGEND

- 575 ELEVATION CONTOURS
- ROADS
- DRAINAGE
- FENCE
- RAILROAD
- EXTENT OF WASTE
- WASTE FROM CELL IS INCLUDED IN OTHER CELL
- (51,91) SWIFT MODEL CELL (COLUMN, ROW)

NOTE:
Coordinates are in State Planar NAD 1927.
Surface contours based on 1992 flyover.

SCALE (FT)
0 40 80 160

FIGURE D.1-6
EXTENT OF WASTE AND MODELED SWIFT GRID CELLS, SOLID WASTE LANDFILL

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TABLE D.1–3

PARAMETERS FOR THE SWIFT CELLS
SOLID WASTE LANDFILL WITHOUT A CAP

Row	Column	Source Volume (ft^3)	U–238 Concentration (pCi/g)	Source Inventory (Kg)	Initial Leachate Concentration (pCi/L)	Source Thickness (ft)	Gray Till Thickness (ft)	Unsaturated GMA[a] Thickness (ft)
50	91	85160	45.00	591.48	600.00	9.7	16.3	21.7
50	92	73090	34.27	386.60	456.93	7.8	16.6	19.4
51	90	4375	40.66	27.46	542.13	7.0	9.4	25.7
51	91	121906	45.00	846.70	600.00	8.5	14.4	23.5
51	92	66213	18.01	184.05	240.13	8.2	17.3	20.6
52	91	38990	20.19	121.50	269.20	8.8	14.1	23.3
52	92	11388	1.81	3.18	24.15	9.1	15.4	22.2

[a]GMA = Great Miami Aquifer.

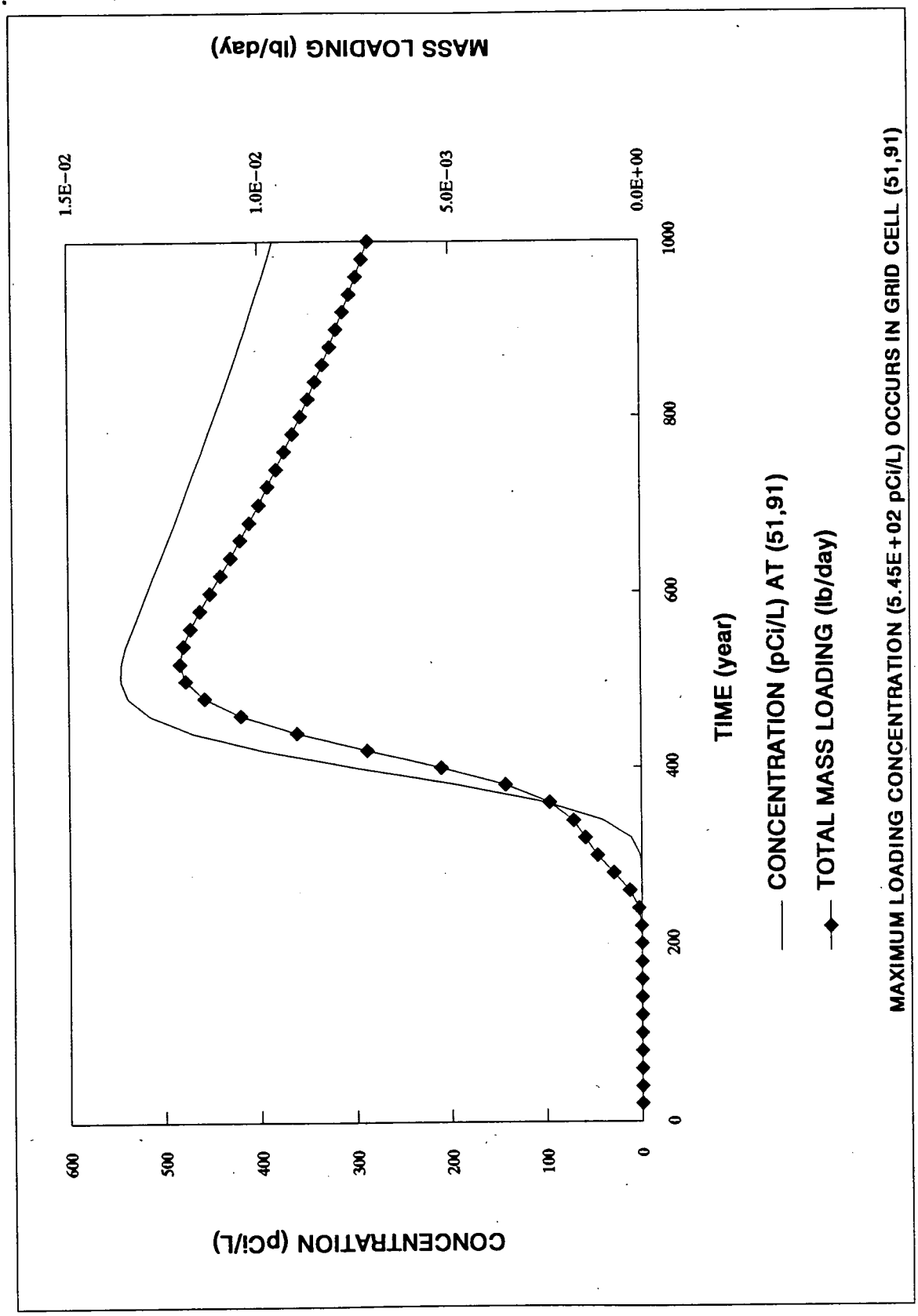

Figure D.1–7 Uranium–238 Loading Curve for Source Materials at 60 pCi/g
Solid Waste Landfill Without Source Controls

TABLE D.1-4

SOLID WASTE LANDFILL
CROSS-MEDIA MODIFIED SOIL PRGs
PROTECTIVE OF THE GREAT MIAMI AQUIFER
WITHOUT SOURCE CONTROLS

COCs Impacting Groundwater	Units	Private Ownership On-Property Resident Farmer PRGs					Federal Ownership Off-Property Resident Farmer PRGs					Background Concentration
		10^{-4} ILCR[a]	10^{-5} ILCR	10^{-6} ILCR	0.2 HI[b]	ARAR	10^{-4} ILCR	10^{-5} ILCR	10^{-6} ILCR	0.2 HI	ARAR	
Uranium-234	pCi/g	212	21.2	2.12	NA[c]	NA	6190	619	61.9	NA	NA	1.04
Uranium-235/236	pCi/g	212	21.2	2.12	NA	NA	6190	619	61.9	NA	NA	0.15
Uranium-238	pCi/g	139	13.9	1.39	NA	NA	4050	405	40.5	NA	NA	1.12
Uranium-Total	mg/kg	NA	NA	NA	32.8	38.6	NA	NA	NA	956	38.6	3.4

[a]ILCR = incremental lifetime cancer risk.

[b]HI = hazard index.

[c]NA = not applicable.

With Source Controls

Consolidation and capping was another alternative for which PRGs were developed. Table D.1-5 provides the physical parameters of various layers for each of the blocks modeled. The HELP model was used to estimate infiltration as 2.9 cm/yr (1.14 in./yr). Infiltration is controlled by the cap, and glacial overburden properties have negligible influence on the infiltration rate.

Based on the parameters shown in Table D.1-5, the predicted maximum uranium-238 concentration was 4.3 x 10^{-7} pCi/L. This run assumed that none of the waste was removed. In other words, current uranium-238 concentration under a cap at the Solid Waste Landfill will not cause the Great Miami Aquifer concentrations to exceed the 10^{-6} ILCR level. Table D.1-6 provides a summary of modified soil PRGs with source controls for the off-property resident farmer.

D.1.5.2 Lime Sludge Ponds

Without Source Controls

Figure D.1-8 shows the SWIFT III grid blocks directly beneath the waste at the Lime Sludge Ponds. Table D.1-7 presents the physical parameters for the SWIFT grid cells impacted by the Lime Sludge Ponds. The HELP model was used to estimate the infiltration rate (see Attachment D.1-I as 24 cm/yr (9.61 in./yr). Calculated seepage rates were 153 and 320 cm/yr (60.4 and 124 in./yr) in the glacial till and unsaturated Great Miami Aquifer, respectively. The vadose zone and the perched water infiltration pathways were applicable for this alternative. Based on the Operable Unit 2 RI data, initial perched water concentration was set to 2.72 pCi/L.

Figure D.1-9 shows the loading curve for the Lime Sludge Ponds without source controls. Based on the parameters shown in Table D.1-7, the FEMP fenceline maximum uranium-238 concentration predicted by the SWIFT model was 0.041 pCi/L. This run used current source uranium-238 concentration. Because maximum FEMP fenceline uranium-238 concentrations does not exceed 0.72 pCi/L (10^{-6} ILCR level), the modified soil PRG for the off-property resident farmer is greater than current source concentrations. Table D.1-8 provides a summary of modified soil PRGs for the off-property resident farmer without source controls.

The maximum on-subunit concentration predicted by the SWIFT model was 1.07 pCi/L for the parameters shown in Table D.1-7. Therefore, for uranium-238 concentrations at the subunit not to exceed 0.72 pCi/L (10^{-6} ILCR level), the source concentration should not exceed 4.66 pCi/g

TABLE D.1–5

PARAMETERS FOR THE SWIFT CELLS
SOLID WASTE LANDFILL WITH A CAP

Row	Column	Source Volume (ft^3)	U–238 Concentration (pCi/g)	Source Inventory (Kg)	Initial Leachate Concentration (pCi/L)	Source Thickness (ft)	Gray Till Thickness (ft)	Unsaturated GMA[a] Thickness (ft)
50	91	85160	107.18	1408.77	1429.07	9.7	16.3	21.7
50	92	73090	34.27	386.62	456.96	7.8	16.6	19.4
51	90	4375	40.66	27.45	542.08	7.0	9.4	25.7
51	91	121906	67.20	1264.40	896.00	8.5	14.4	23.5
51	92	66213	18.01	184.05	240.13	8.2	17.3	20.6
52	91	38990	20.19	121.52	269.25	8.8	14.1	23.3
52	92	11388	1.81	3.18	24.15	9.1	15.4	22.2

[a]GMA = Great Miami Aquifer.

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TABLE D.1-6

SOLID WASTE LANDFILL
MODIFIED SOIL PRGs
PROTECTIVE OF THE GREAT MIAMI AQUIFER USING A CAP

COCs Impacting Groundwater	Units	Modified Soil PRGs[a] (Off-Property Farmer)			Background Concentration
		10^{-6} ILCR[b]	0.2 HI[c]	ARAR	
Uranium-234	pCi/g	>100,000	NA[d]	NA	1.04
Uranium-235/236	pCi/g	>100,000	NA	NA	0.15
Uranium-238	pCi/g	>100,000	NA	NA	1.12
Uranium-Total	mg/kg	NA	>100,000	>100,000	3.4

[a]Modified soil PRGs are based on ODAST/SWIFT modeling and assume an infiltration rate of 1.14 in./yr through the cap and soils (HELP model results). Glacil till K_d and Great Miami Aquifer K_d were assumed to be .24 mL/g and 1.78 mL/g, respectively.

[b]ILCR = incremental lifetime cancer risk.

[c]HI = hazard index.

[d]NA = not applicable.

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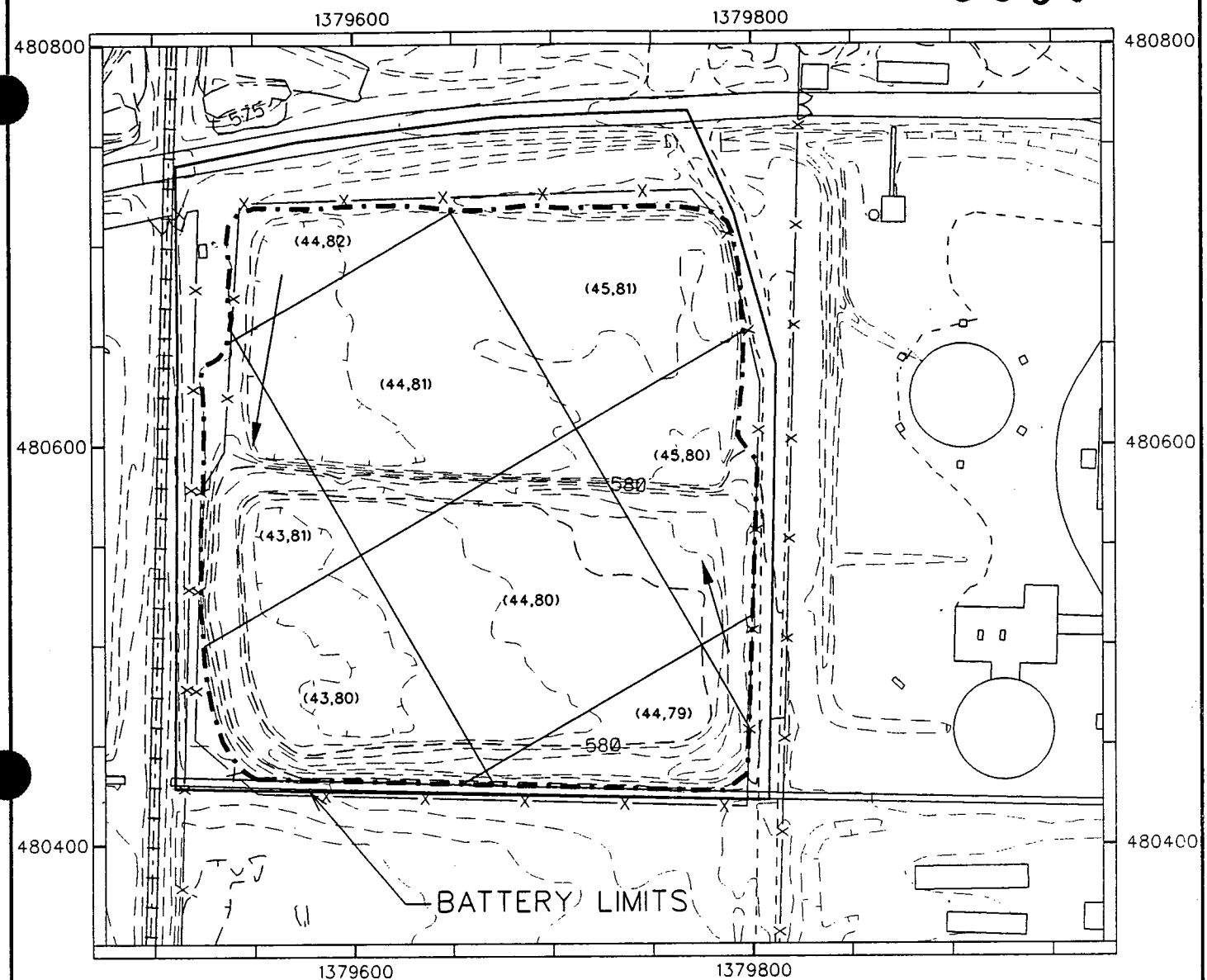

LEGEND

- ELEVATION CONTOURS
- ROADS
- DRAINAGE
- FENCE
- RAILROAD
- WASTE FROM CELL IS INCLUDED IN OTHER CELL
- EXTENT OF WASTE
- SWIFT MODEL CELL (COLUMN, ROW)

NOTE:
Coordinates are in State Planar NAD 1927.
Surface contours based on 1992 flyover.

SCALE (FT)
0 50 100

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FIGURE D.1-8
EXTENT OF WASTE AND MODELED SWIFT GRID CELLS, LIME SLUDGE PONDS

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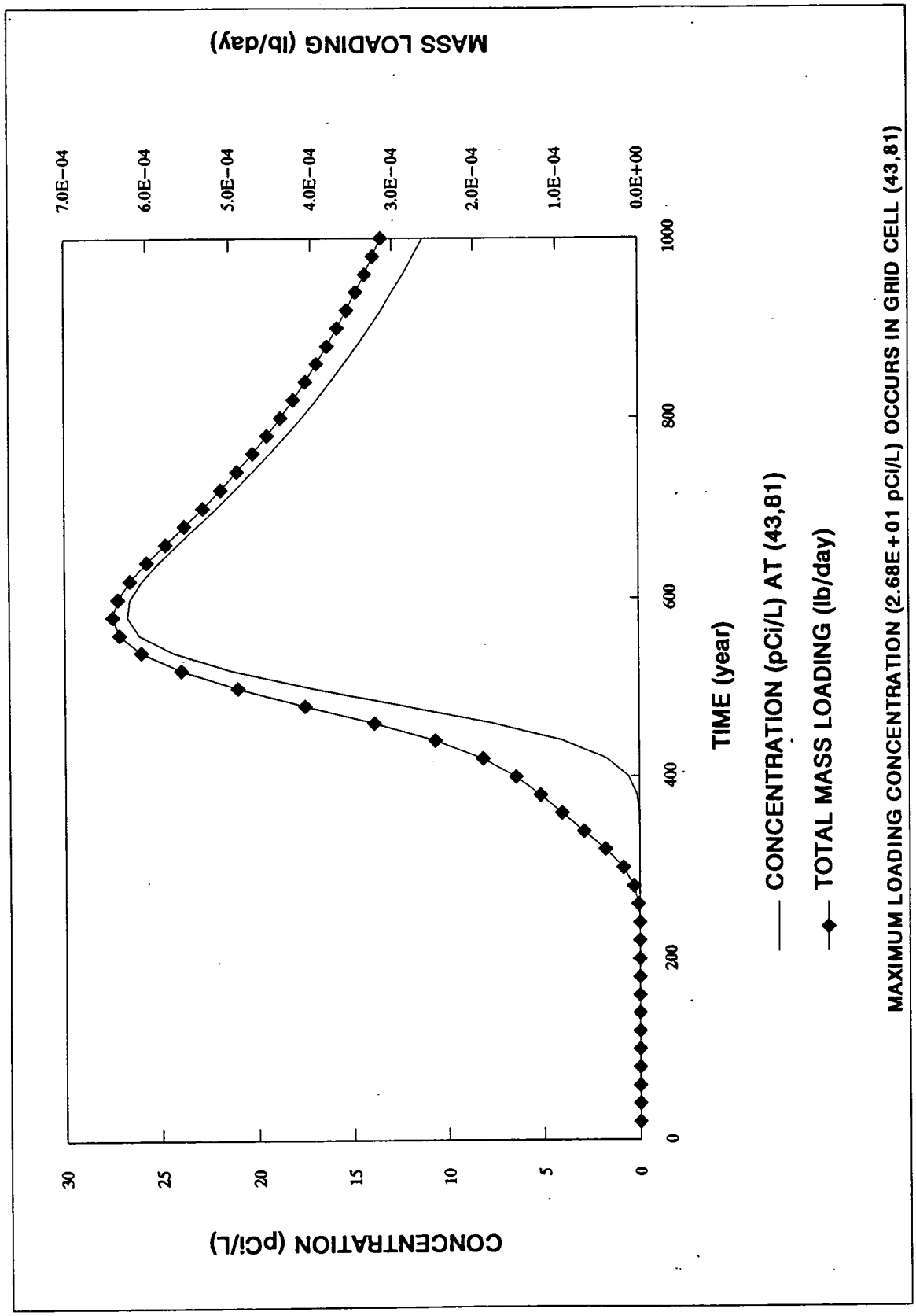

Figure D.1−9 Uranium−238 Loading Curve for The Lime Sludge Ponds Without Source Controls

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TABLE D.1–7

PARAMETERS FOR THE SWIFT CELLS
LIME SLUDGE PONDS WITHOUT A CAP

Row	Column	Source Volume (ft^3)	U–238 Concentration (pCi/g)	Source Inventory (Kg)	Initial Leachate Concentration (pCi/L)	Source Thickness (ft)	Gray Till Thickness (ft)	Unsaturated GMA[a] Thickness (ft)
43	80	69238	5.33	23.64	26.63	6.9	22	16.7
43	81	36381	6.94	16.18	34.69	3.9	19.7	18.3
44	79	15019	7.25	6.98	36.24	2.7	18.9	17.7
44	80	146931	2.84	26.74	14.20	9.4	18.6	18.2
44	81	100156	0.78	5.03	3.91	6.4	16.6	19.7
45	80	31863	2.56	5.24	12.82	3.6	13.5	19.0
45	81	89781	1.81	10.42	9.06	8.5	11.6	20.5

[a]GMA = Great Miami Aquifer.

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TABLE D.1-8

LIME SLUDGE PONDS
CROSS-MEDIA MODIFIED SOIL PRGs
PROTECTIVE OF THE GREAT MIAMI AQUIFER
WITHOUT SOURCE CONTROLS

COCs Impacting Groundwater	Units	Private Ownership On-Property Resident Farmer PRGs					Federal Ownership Off-Property Resident Farmer PRGs					Background Concentration
		10^{-4} ILCR[a]	10^{-5} ILCR	10^{-6} ILCR	0.2 HI[b]	ARAR	10^{-4} ILCR	10^{-5} ILCR	10^{-6} ILCR	0.2 HI	ARAR	
Uranium-234	pCi/g	712	71.2	7.12	NA[c]	NA	19500	1950	195	NA	NA	1.04
Uranium-235/236	pCi/g	712	71.2	7.12	NA	NA	19500	1950	195	NA	NA	0.15
Uranium-238	pCi/g	466	46.6	4.66	NA	NA	12700	1270	127	NA	NA	1.12
Uranium-Total	mg/kg	NA	NA	NA	115	136	NA	NA	NA	3000	136	3.4

[a]ILCR = incremental lifetime cancer risk.

[b]HI = hazard index.

[c]NA = not applicable.

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(= 6.94*0.72/1.07). In other words, the modified soil PRG for the on-property resident farmer is 4.66 pCi/g. Modified soil PRGs for other risk levels were similarly calculated. Table D.1-8 also provides a summary of modified soil PRGs for the on-property resident farmer without source controls.

With Source Controls

On-property resident farmer PRGs are not applicable for the consolidation and capping alternative. Furthermore, current uranium-238 concentrations are less than the 10^{-6} ILCR level for the off-property resident farmer. Therefore, modified soil PRGs for source control alternatives were not developed for the Lime Sludge Ponds.

D.1.5.3 Inactive Flyash Pile/South Field

Figure D.1-10 shows the areal extent of the waste in the South Field/Inactive Flyash Pile and the SWIFT III grid cells impacted by direct loading from these subunits. The vadose zone pathway, the perched water infiltration pathway, and the perched water subsurface seep pathway were applicable for FS modeling for the South Field/Inactive Flyash Pile. The lithology of the South Field/Inactive Flyash Pile area is variable. The southwestern portion contains virtually no glacial overburden, while the glacial overburden thicknesses increase to 6.7 m (22 ft) toward the northeastern side. The thickness of the unsaturated zone in the Great Miami Aquifer (Layer 2) ranges from 4.9 to 10.1 m (16 to 33 ft). Therefore, the vadose zone model depicting flow in the subsurface soils at the South Field/Inactive Flyash Pile used two layers in the area where till is present and used one layer (unsaturated Great Miami Aquifer) where till is not present. The HELP model was used to estimate infiltration through the residual soils and the composite cap. Results from the HELP run are presented in Attachment D.1-I.

D.1.5.3.1 Impact of the Perched Water Subsurface Seep Pathway

Fate and transport modeling for the Operable Unit 2 RI indicated that the perched water subsurface seep pathway has a major impact on the Great Miami Aquifer. This modeling scenario quantifies the impact of the perched water subsurface seep pathway on the Great Miami Aquifer. Figure D.1-10 identifies grid cells that may receive perched water from the subsurface seep pathways. Figure D.1-5 shows the conceptual model for perched water subsurface seeps. Perched water has been observed in 0 to 1 m (0 to 3 ft) thick sand and gravel layers in the glacial overburden. Perched water not only represents a source for vertical infiltration, it also serves as a source for the current surface seeps and

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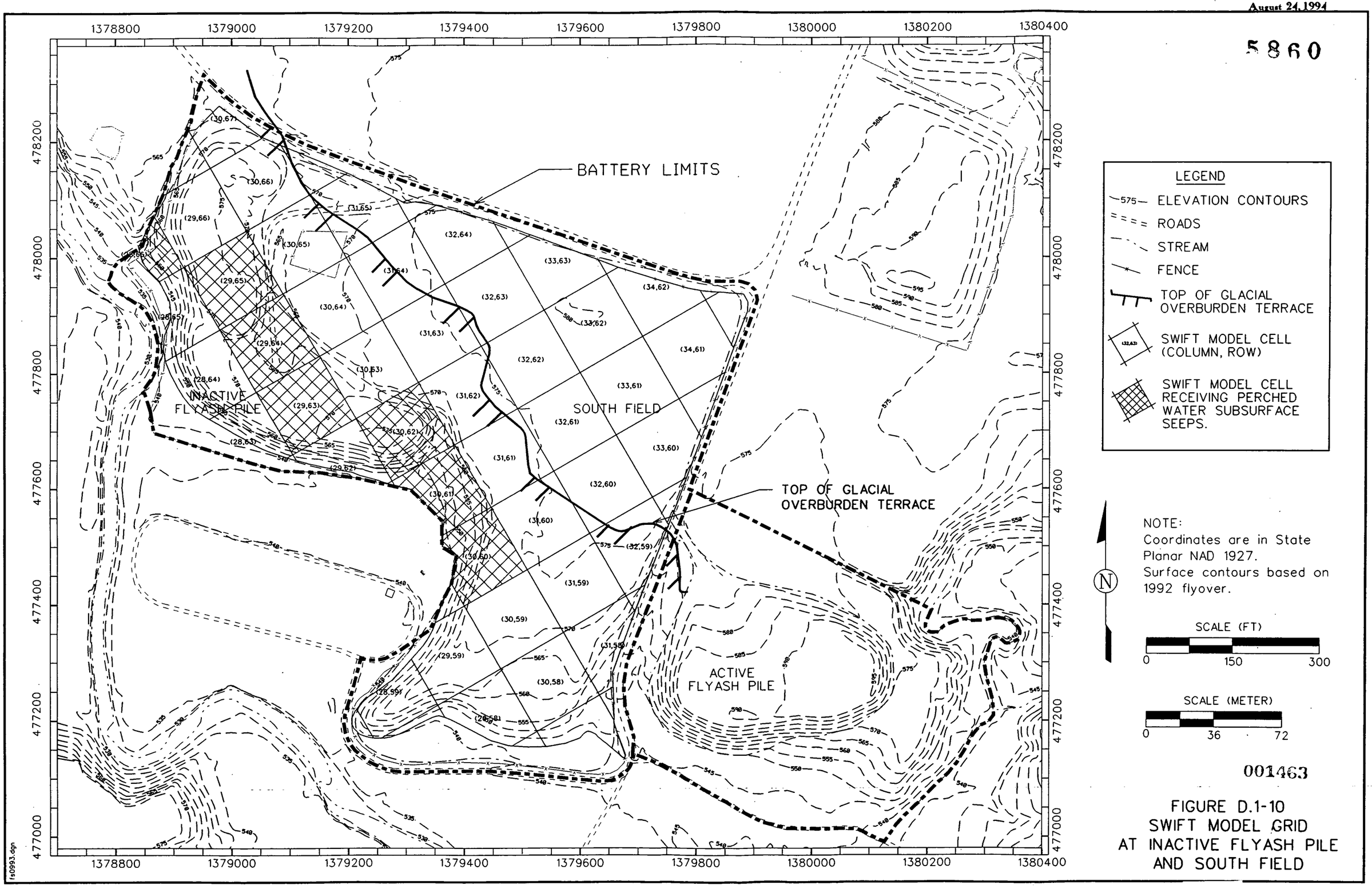

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FIGURE D.1-10
SWIFT MODEL GRID
AT INACTIVE FLYASH PILE
AND SOUTH FIELD

subsurface seeps. As shown in Figure D.1-5, perched water moves laterally in the sand/gravel layer until it is intercepted at the sand/gravel and waste interface. At that point, perched water moves along the slope of waste and till interface until it comes in contact with the unsaturated Great Miami Aquifer. The subsurface seep water then infiltrates vertically to the aquifer. The travel time for lateral movement of the perched water was assumed to be short compared to the travel time for the vertical movement of the perched water.

The source term for the perched water subsurface seep pathways included uranium-238 in perched water, as well as uranium-238 adsorbed in the sand and gravel in the glacial overburden underneath the Inactive Flyash Pile and South Field. Table D.1-9 shows the physical parameters for this simulation. Figure D.1-11 shows the loading curve for uranium-238 to the Great Miami Aquifer due to the perched water subsurface seep pathway. The predicted maximum uranium-238 loading concentration for the Great Miami Aquifer was 1,670 pCi/L. This loading curve was used as input to the SWIFT model to calculate impact of the perched water subsurface seep pathway on the Great Miami Aquifer. The maximum predicted uranium-238 concentration in the Great Miami Aquifer was 303 pCi/L, and maximum concentration at the FEMP fenceline was 15.6 pCi/L. The maximum uranium-238 concentrations on site and at the FEMP fenceline were predicted to occur at 80 and 160 years, respectively. Figure D.1-12 shows the projected increase in uranium-238 concentrations due the perched water subsurface seep pathways at 80 years. Figure D.1-12 indicates that uranium-238 concentrations due to perched water subsurface seeps alone may exceed the 10^{-4} ILCR level and total uranium concentration may exceed maximum contaminant level (MCL) (20 μg/l). Therefore, perched water lateral migration should be controlled. Furthermore, if perched water is not remediated, modified soil PRGs at the Inactive Flyash Pile/South Field are zero.

D.1.5.3.2 Remediated Perched Water and No Source Controls

This alternative assumes that the perched water is remediated and no source controls are applied. In other words, perched water is clean for the purposes of this modeling scenario. Figure D.1-10 shows the areal extent of the waste in the South Field/Inactive Flyash Pile and the SWIFT III grid cells impacted by direct loading from these subunits. Tables D.1-10 and D.1-11 presents the physical parameters and infiltration rates for the SWIFT grid cells impacted by the Inactive Flyash Pile/South Field. The HELP model was used to estimate infiltration rates (see Attachment D.1-I). The vadose zone pathway was the only applicable pathway for this alternative. Note that the vadose zone pathway includes lateral migration of infiltrated leachate at the top of the gray till (see Figure D.1-4).

TABLE D.1-9

PARAMETERS FOR THE SWIFT CELLS IMPACTED BY THE PERCHED WATER SUBSURFACE SEEP PATHWAY, SOUTH FIELD AND INACTIVE FLYASH PILE

Row	Column	Perched Water Concentration (pCi/L)	Flow Rate		Unsaturated GMA[a] Thickness
			Gallons/Minute	Inches/Year	
28	66	1880	0.44	23.6	21.3
29	62	257	0.15	8.1	18.5
29	63	257	0.45	24.4	20.8
29	64	257	0.77	41.8	25.5
29	65	1880	1.73	93.6	24.8
30	60	257	0.20	10.9	29.0
30	61	257	0.40	21.7	24.8
30	62	257	0.40	21.7	24.1

[a]GMA = Great Miami Aquifer.

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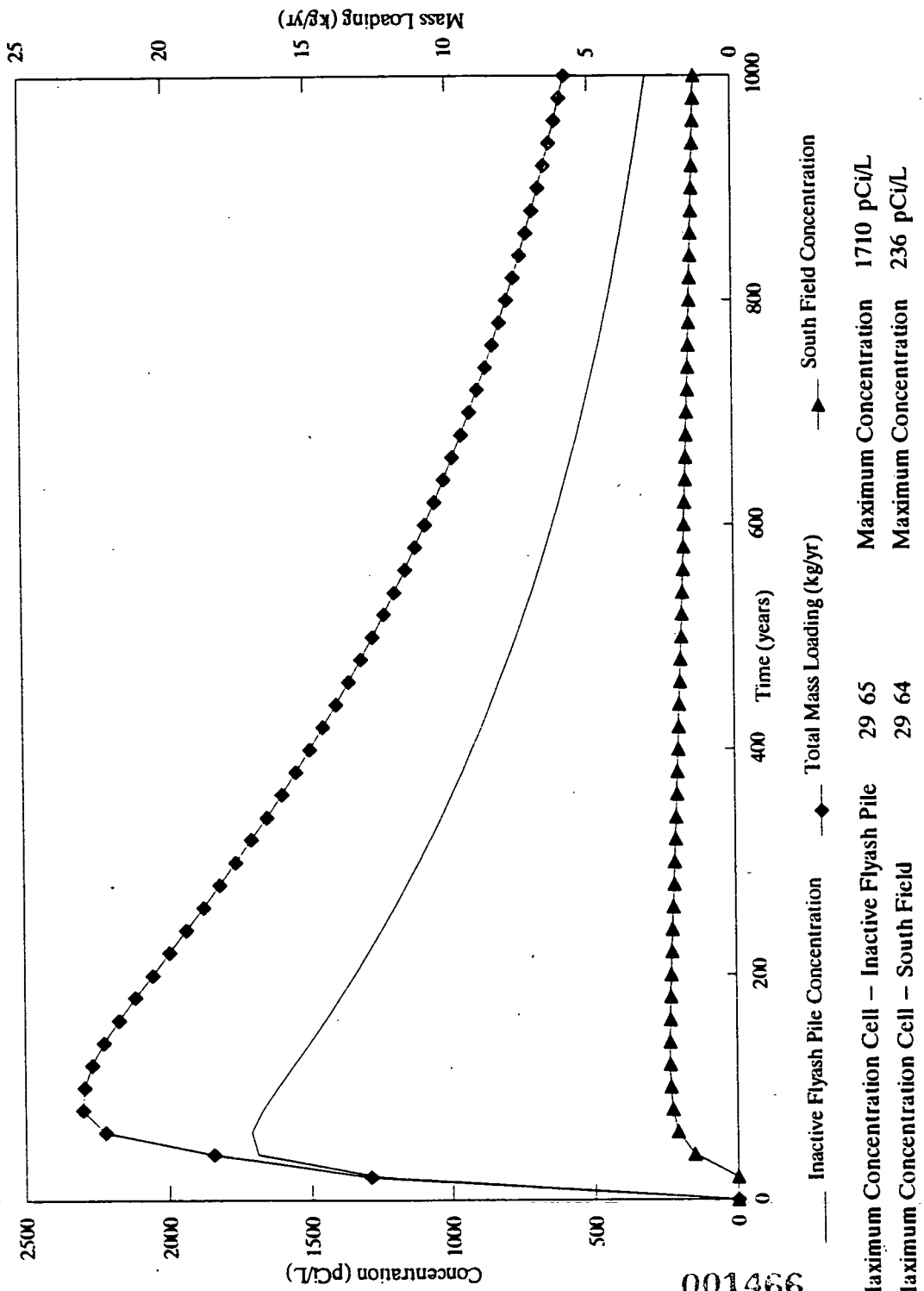

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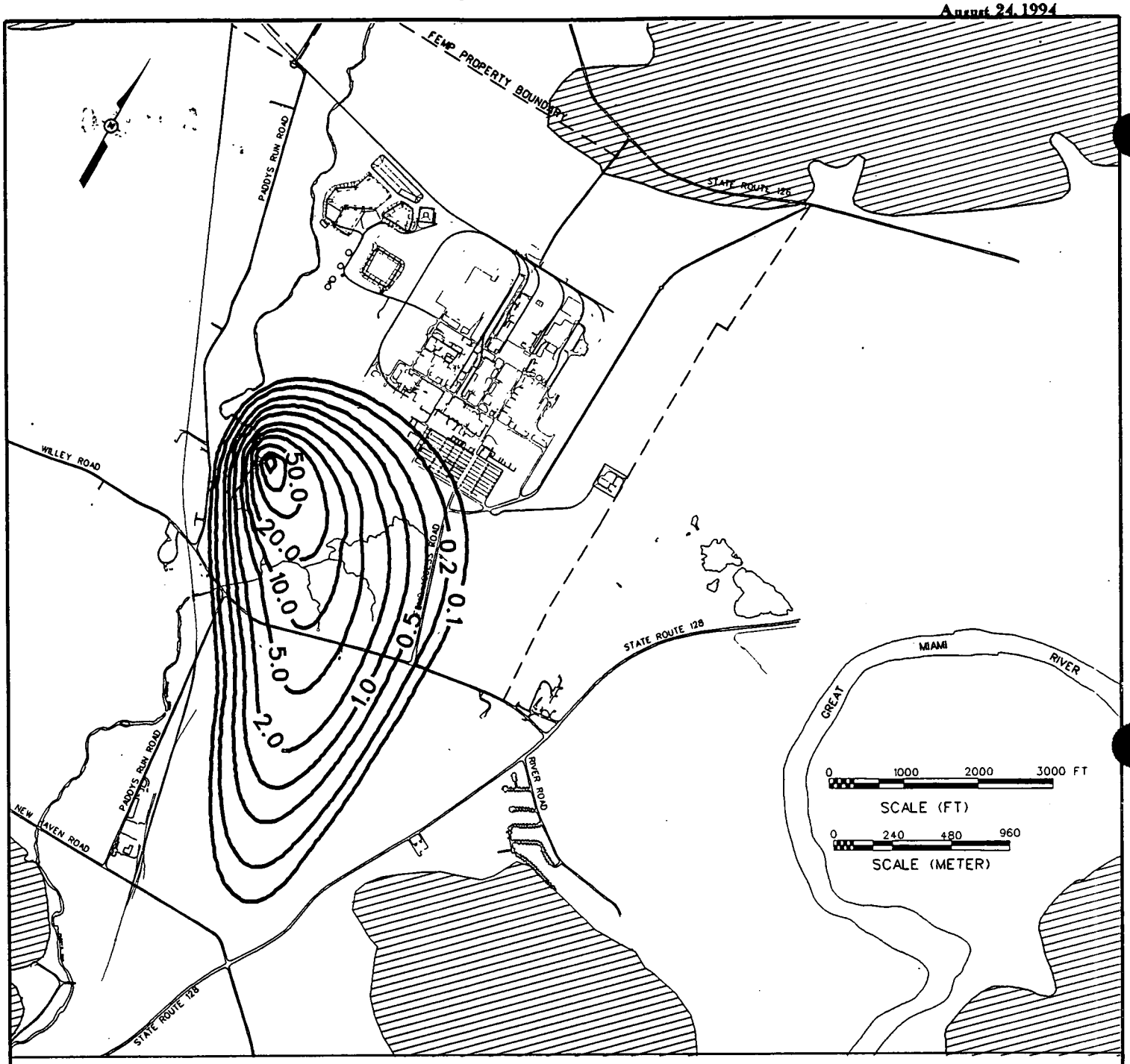
Figure D.1-11 Uranium–238 Loading to the Great Miami Aquifer from the South Field / Inactive Flyash Pile for Perched Water Subsurface Seep Pathway



LEGEND:

0.1 CONCENTRATION CONTOUR (pCi/L)

BEDROCK

FIGURE D.1-12
PROJECTED INCREASE IN URANIUM-238 CONCENTRATIONS IN THE GREAT MIAMI AQUIFER AT 80 YEARS DUE TO LOADING FROM THE INACTIVE FLYASH PILE/SOUTH FIELD VIA SUBSURFACE PATHWAY

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TABLE D.1–10

PARAMETERS FOR THE SWIFT CELLS AFTER REMOVAL OF WASTE TO 2.5 pCi/g
SOUTH FIELD AND INACTIVE FLYASH PILE

Row	Column	Source Volume (ft^3)	U–238 Concentration (pCi/g)	Source Inventory (Kg)	Initial Leachate Concentration[a] (pCi/L)	Source Thickness (ft)	Till Thickness (ft)	Unsaturated GMA[b] Thickness (ft)
ZONE 1 – SOURCE DIRECTLY UNDERLAIN BY THE GREAT MIAMI AQUIFER								
28	59	54675	2.50	19.59	14.12	5.5	0.0	16.7
28	65	37500	2.50	13.44	66.67	4.4	0.0	19.6
28	66	10940	2.50	3.92	66.67	2.5	0.0	19.3
29	59	23430	2.50	8.40	14.12	1.6	0.0	20.2
29	60	4690	2.22	1.49	12.54	4.3	0.0	21.4
29	63	51550	2.50	18.47	66.67	3.3	0.0	20.8
30	58	1560	2.50	0.56	14.12	0.1	0.0	21.7
30	62	3135	2.50	1.12	14.12	0.6	0.0	24.1
30	63	25000	2.50	8.96	14.12	1.9	0.0	22.8
Zone Average		23609	2.47	8.44	31.46	2.7	0.0	20.7
ZONE 2 – ZERO FILL, IMPACTED TILL AS SOURCE ON THE TERRACE FACE								
29	67	10950	2.50	4.09	66.67	2.9	2.2	32.5
30	59	7800	2.50	4.75	14.12	0.5	2.5	28.2
31	58	18750	2.50	8.00	14.12	1.8	1.9	29.6
31	59	14060	2.50	7.00	14.12	0.9	7.8	31.4
31	61	3120	2.50	3.08	14.12	0.2	6.8	30.8
31	62	20300	2.50	9.24	14.12	1.3	7.5	30.1
31	63	17170	2.50	8.10	14.12	1.1	8.2	29.5
32	59	48430	2.50	18.93	14.12	3.9	10.1	32.5
Zone Average		17573	2.50	7.90	20.69	1.6	5.9	30.6

See footnotes at end of table.

TABLE D.1–10

PARAMETERS FOR THE SWIFT CELLS AFTER REMOVAL OF WASTE TO 2.5 pCi/g
SOUTH FIELD AND INACTIVE FLYASH PILE

Row	Column	Source Volume (ft^3)	U–238 Concentration (pCi/g)	Source Inventory (Kg)	Initial Leachate Concentration[a] (pCi/L)	Source Thickness (ft)	Till Thickness (ft)	Unsaturated GMA[b] Thickness (ft)
ZONE 3 – AREAS WITH TILL AND NO LATERAL DRAINAGE								
29	66	3120	2.50	1.22	66.67	0.2	2.6	32.0
30	60	9370	2.50	5.04	14.12	0.7	3.0	29.0
30	64	17190	2.50	6.70	14.12	1.1	0.4	26.4
30	67	9370	2.50	3.75	66.67	1.5	3.9	29.7
Zone Average		9763	2.50	4.18	40.40	0.9	2.5	29.3
ZONE 4 – SOURCE ON THE TOP OF TERRACE								
31	64	15620	2.50	7.51	14.12	1.0	0.5	25.5
31	65	6240	2.50	4.02	14.12	0.4	1.8	22.8
32	60	26560	2.50	11.33	14.12	1.9	3.6	20.2
32	61	25000	2.50	10.89	14.12	1.6	3.7	20.8
32	62	7800	2.50	4.76	14.12	0.5	3.3	24.1
32	63	6240	2.50	4.15	14.12	0.4	4.4	22.8
32	64	21900	2.50	9.59	14.12	1.6	6.6	20.8
33	59	6250	2.50	2.44	14.12	4.0	5.8	21.3
33	60	28130	2.50	12.00	14.12	1.9	6.7	21.7
33	61	34375	2.50	14.17	14.12	2.4	6.7	29.0
34	60	3140	2.50	1.22	14.12	0.8	8.8	21.3
34	61	17175	2.50	8.14	14.12	1.1	7.0	21.7
Zone Average		16535.8	2.50	7.52	14.12	1.5	4.9	22.7

[a]Initial leachate concentration was calculated using a desorption K_d of 177 mL/g for the South Field and 37.5 mL/g for the Inactive Flyash Pile.
[b]GMA = Great Miami Aquifer.

TABLE D.1 – 11

HELP MODEL RESULTS FOR THE SWIFT CELLS AFTER REMOVAL OF WASTE TO 2.5 pCi/g AND NO SOURCE CONTROLS, SOUTH FIELD AND INACTIVE FLYASH PILE

Row	Column	Vertical Infiltration Rate (in./yr)	Lateral Drainage Rate (in./yr)	Waste Infiltration Rate (in./yr)	Receives Lateral Drainage From	Vadose Layer 1 & 2 Infiltration Rate (in./yr)	Layer 2 Moisture Content (Vol %)	Layer 1 Seepage Rate (in./yr)	Layer 2 Seepage Rate (in./yr)
ZONE 1 – ZERO TILL, LESS THAN 7 FEET OF SOURCE									
28	59	9.61	NA[a]	9.61	NA	9.61	7.33	NA	131.1
28	65	9.61	NA	9.61	NA	9.61	7.95	NA	120.9
28	66	9.61	NA	9.61	(29,67)	17.70	7.95	NA	222.6
29	59	9.61	NA	9.61	(32,60)	17.70	7.33	NA	241.5
29	60	9.61	NA	9.61	NA	9.61	7.95	NA	120.9
29	63	9.61	NA	9.61	(32,64)	17.70	7.33	NA	241.5
30	58	9.61	NA	9.61	(31,59) & (33,60) & (34,61)	33.88	7.95	NA	426.2
30	62	9.61	NA	9.61	(31,62) & (32,62)	25.79	7.95	NA	324.4
30	63	9.61	NA	9.61	(31,63) & (32,63)	25.79	7.95	NA	324.4
ZONE 2 – ZERO FILL, IMPACTED TILL AS SOURCE ON THE TERRACE FACE									
29	67	1.52	8.09	9.61	NA	1.52	5.88	3.71	25.9
30	59	1.52	8.09	9.61	NA	1.52	5.88	3.71	25.9
31	58	1.52	8.09	9.61	NA	1.52	5.88	3.71	25.9
31	59	1.52	8.09	9.61	NA	1.52	5.88	3.71	25.9
31	61	1.52	8.09	9.61	NA	1.52	5.88	3.71	25.9
31	62	1.52	8.09	9.61	NA	1.52	5.88	3.71	25.9
31	63	1.52	8.09	9.61	NA	1.52	5.88	3.71	25.9
32	59	1.52	8.09	9.61	NA	1.52	5.88	3.71	25.9

See footnote at end of table.

TABLE D.1-11

HELP MODEL RESULTS FOR THE SWIFT CELLS AFTER REMOVAL OF WASTE TO 2.5 pCi/g AND NO SOURCE CONTROLS, SOUTH FIELD AND INACTIVE FLYASH PILE

Row	Column	Vertical Infiltration Rate (in./yr)	Lateral Drainage Rate (in./yr)	Waste Infiltration Rate (in./yr)	Receives Lateral Drainage From	Vadose Layer 1 & 2 Infiltration Rate (in./yr)	Layer 2 Moisture Content (Vol %)	Layer 1 Seepage Rate (in./yr)	Layer 2 Seepage Rate (in./yr)
ZONE 3 – AREAS WITH TILL AND NO LATERAL DRAINAGE									
29	66	1.73	NA	1.73	NA	1.73	5.95	4.22	29.1
30	60	3.99	NA	3.99	(31,60) & (33,61)	12.08	5.88	29.46	205.4
30	64	1.73	NA	1.73	NA	1.73	5.95	4.22	29.1
30	67	1.73	NA	1.73	NA	1.73	5.95	4.22	29.1
ZONE 4 – SOURCE ON THE TOP OF TERRACE									
31	64	1.52	8.09	9.61	NA	1.52	5.88	3.71	25.9
31	65	1.52	8.09	9.61	NA	1.52	5.88	3.71	25.9
32	60	1.52	8.09	9.61	NA	1.52	5.88	3.71	25.9
32	61	1.52	8.09	9.61	NA	1.52	5.88	3.71	25.9
32	62	1.52	8.09	9.61	NA	1.52	5.88	3.71	25.9
32	63	1.52	8.09	9.61	NA	1.52	5.88	3.71	25.9
32	64	1.52	8.09	9.61	NA	1.52	5.88	3.71	25.9
33	59	1.52	8.09	9.61	NA	1.52	5.88	3.71	25.9
33	60	1.52	8.09	9.61	NA	1.52	5.88	3.71	25.9
33	61	1.52	8.09	9.61	NA	1.52	5.88	3.71	25.9
34	60	1.52	8.09	9.61	NA	1.52	5.88	3.71	25.9
34	61	1.52	8.09	9.61	NA	1.52	5.88	3.71	25.9
ZONE 5 – AREAS WITH NO SOURCE BUT RECEIVING LATERAL DRAINAGE									
29	58	NA	NA	NA	(30,59)	8.09	7.95	NA	101.8
29	64	NA	NA	NA	(31,64)	8.09	7.95	NA	101.8
29	65	NA	NA	NA	(31,65)	8.09	7.95	NA	101.8
30	57	NA	NA	NA	(31,58) & (33,59) & (32,59) & (34,60)	32.36	7.95	NA	407.0
30	61	NA	NA	NA	(31,61) & (32,61)	16.18	7.95	NA	203.5

[a]NA = Not applicable.

For this modeling scenario, the maximum source uranium-238 concentration was 2.5 pCi/g. It was assumed that source material above this concentration has been excavated.

Figure D.1-13 shows the loading curve. The maximum on-subunit concentration predicted by the SWIFT model was 2.02 pCi/L for the parameters shown in Tables D.1-10 and D.1-11. Therefore, for uranium-238 concentrations at the subunit not to exceed 0.72 pCi/L (10^{-6} ILCR level), the source concentration should not exceed 0.89 pCi/g (= 6.94*0.72/2.02). In other words, the modified soil PRG for on-property resident farmer is 0.89 pCi/g. Modified soil PRGs for other risk levels were similarly calculated. Table D.1-12 also provides a summary of modified soil PRGs for the on-property resident farmer without any source controls and remediated perched water.

Based on the parameters shown in Tables D.1-10 and D.1-11, the FEMP fenceline maximum uranium-238 concentration predicted by SWIFT model was 0.34 pCi/L. This run limited source uranium-238 concentrations to 2.5 pCi/g. Therefore, for uranium-238, concentrations at the FEMP fenceline did not exceed 0.72 pCi/L (10^{-6} ILCR level). Tables D.1-13 and D.1-14 present parameter and infiltration rates for SWIFT cells impacted by source material at 5 pCi/g on the Great Miami Aquifer and on the terrace face. For this case, the maximum predicted fenceline concnetration was 0.49 pCi/L. Table D.1-12 provides a summary of modified soil PRGs for the off-property resident farmer if source material on the Great Miami Aquifer is left at 5 pCi/g uranium-238. In this case, source material above 2.1 pCi/g on top of the terrace may result in uranium-238 concentrations at the FEMP fenceline that exceed 10^{-6} ILCR levels. Table D.1-12 provides a summary of modified soil PRGs for the off-property resident farmer without any source controls and remediated perched water.

D.1.5.3.3 Source Controls for Lateral Migration of Perched Water

This alternative assumes that lateral migration of perched water is controlled. However, perched water is assumed to provide a source to the Great Miami Aquifer via vertical infiltration. For this alternative, two sets of PRGs were developed. The first set of PRGs were applicable for source material directly underlain by the Great Miami Aquifer or source material on the terrace face. Figure D.1-14 identifies the location of terrace face at the Inactive Flyash Pile and South Field. It is defined as the area where glacial overburden thickness is less than 5.5 m (18 ft). The second set of PRGs was developed for the source material underlain by at least 5.5 m (18 ft) of glacial overburden. This area is also referred to as "top of terrace."

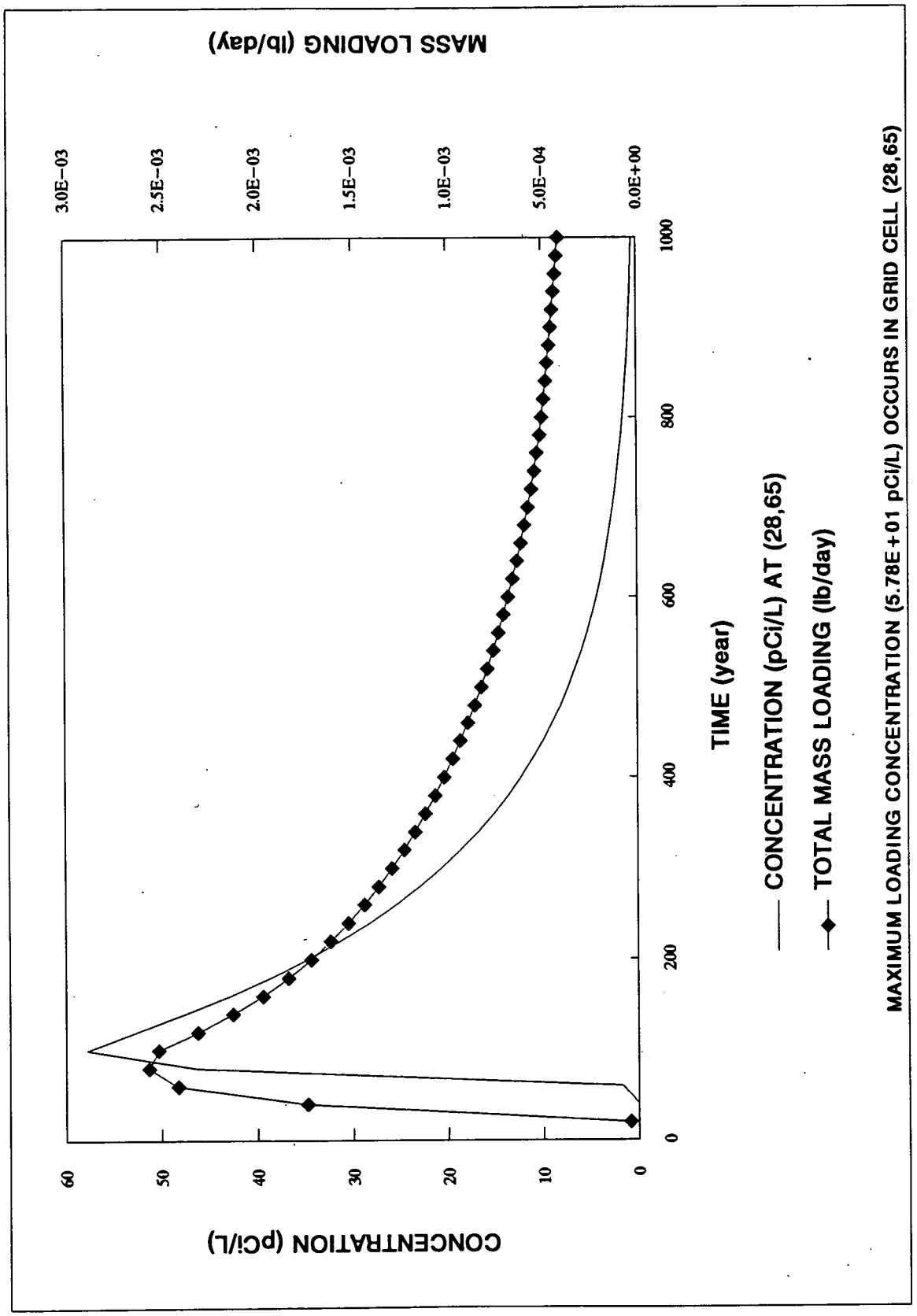

Figure D.1–13 Uranium–238 Loading Curve for Source Materials at 2.5 pCi/g and Clean Perched Water, Inactive Flyash Pile and South Field

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TABLE D.1-12

INACTIVE FLYASH PILE/SOUTH FIELD CROSS-MEDIA MODIFIED SOIL PRGs[a] PROTECTIVE OF THE GREAT MIAMI AQUIFER WITHOUT SOURCE CONTROLS

COCs Impacting Groundwater	Units	Private Ownership On-Property Resident Farmer PRG-Carcinogenic Risk Based					Federal Ownership Off-Property Resident Farmer PRGs					Background Concentration
		10^{-4} ILCR[b]	10^{-5} ILCR	10^{-6} ILCR	0.2 HI[c]	ARAR	10^{-4} ILCR	10^{-5} ILCR	10^{-6} ILCR	~ 0.2 HI	ARAR	
SOURCE MATERIAL OVER THE GREAT MIAMI AQUIFER												
Uranium-234	pCi/g	136	13.6	1.36	NA[d]	NA	1250	91	7.64	NA	NA	1.04
Uranium-235/236	pCi/g	136	13.6	1.36	NA	NA	1250	91	7.64	NA	NA	0.15
Uranium-238	pCi/g	89	8.9	0.89	NA	NA	819	60	5	NA	NA	1.12
Uranium-Total	mg/kg	NA	NA	NA	21	24.8	NA	NA	NA	17	20	3.4
SOURCE MATERIAL ON THE TOP OF THE TERRACE (GLACIAL TILL)												
Uranium-234	pCi/g	136	13.6	1.36	NA	NA	320	32	3.2	NA	NA	1.04
Uranium-235/236	pCi/g	136	13.6	1.36	NA	NA	320	32	3.2	NA	NA	0.15
Uranium-238	pCi/g	89	8.9	0.89	NA	NA	210	21	2.1	NA	NA	1.12
Uranium-Total	mg/kg	NA	NA	NA	21	24.8	NA	NA	NA	8.5	10	3.4

[a]Those data were developed by considering future impacts on perched groundwater and do not include current perched groundwater contamination.

[b]ILCR = incremental lifetime cancer risk.

[c]HI = hazard index.

[d]NA = not applicable.

001474

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TABLE D.1–13

PARAMETERS FOR THE SWIFT CELLS AFTER REMOVAL OF WASTE TO 5 pCi/g ON THE GREAT MIAMI AQUIFER AND ON THE TERRACE FACE, SOUTH FIELD AND INACTIVE FLYASH PILE

Row	Column	Source Volume (ft^3)	U–238 Concentration (pCi/g)	Source Inventory (Kg)	Initial Leachate Concentration (pCi/L)	Source Thickness (ft)	Till Thickness (ft)	Unsaturated GMA[a] Thickness (ft)
ZONE 1 – ZERO TILL, LESS THAN 8 FEET OF SOURCE								
28	65	68770	5.00	49.29	133.33	8.0	0.0	19.6
28	66	12530	5.00	8.98	133.33	2.9	0.0	19.3
29	58	15620	5.00	11.20	28.25	1.3	0.0	18.2
29	60	4690	1.90	1.28	10.72	4.3	0.0	21.4
29	62	57830	5.00	41.45	133.33	6.3	0.0	18.5
30	58	42190	5.00	30.24	28.25	2.8	0.0	21.7
30	61	10930	5.00	7.83	28.25	0.9	0.0	20.8
30	62	6240	5.00	4.47	28.25	1.1	0.0	24.1
30	63	31260	5.00	22.41	28.25	2.4	0.0	22.8
Zone Average		27784	4.66	19.68	61.33	3.3	0.0	20.7
ZONE 2 – ZERO TILL, MORE THAN 15 FEET OF SOURCE								
28	59	157810	2.62	59.27	14.80	15.7	0.0	16.7
29	59	298440	5.00	213.91	28.25	21.0	0.0	20.2
29	63	278150	5.00	199.37	133.33	17.9	0.0	20.8
Zone Average		244800	4.21	157.52	58.79	18.2	0.0	19.2
ZONE 3 – ZERO FILL, IMPACTED TILL AS SOURCE								
29	66	4670	5.00	3.64	133.33	0.3	2.6	32.0
30	64	18750	5.00	14.62	28.25	1.2	0.4	26.4
30	67	9370	5.00	7.50	133.33	1.5	3.9	29.7
31	61	56250	5.00	44.32	28.25	3.5	6.8	30.8
31	62	60930	5.00	47.60	28.25	3.9	7.5	30.1
31	63	54680	5.00	43.12	28.25	3.5	8.2	29.5
Zone Average		34108	5.00	26.80	63.28	2.3	4.9	29.8

See footnote at end of table.

TABLE D.1–13

PARAMETERS FOR THE SWIFT CELLS AFTER REMOVAL OF WASTE TO 5 pCi/g ON THE GREAT MIAMI AQUIFER AND ON THE TERRACE FACE, SOUTH FIELD AND INACTIVE FLYASH PILE

Row	Column	Source Volume (ft^3)	U–238 Concentration (pCi/g)	Source Inventory (Kg)	Initial Leachate Concentration (pCi/L)	Source Thickness (ft)	Till Thickness (ft)	Unsaturated GMA[a] Thickness (ft)
ZONE 4 – LESS THAN 3 FEET OF TILL BELOW SOURCE								
29	67	10950	5.00	8.18	133.33	2.9	2.2	32.5
30	59	135940	5.00	101.36	28.25	8.7	2.5	28.2
30	60	134370	3.63	72.36	20.51	10.1	3.0	29.0
31	58	76560	5.00	57.45	28.25	7.5	1.9	29.6
Zone Average		89455	4.66	59.84	52.58	7.3	2.4	29.8
ZONE 5 – 7 to 10 FEET OF NOT IMPACTED TILL, 9 to 12 FEET OF SOURCE								
31	59	154680	5.00	114.79	28.25	9.9	7.8	31.4
31	60	176560	5.00	130.31	28.25	11.8	8.6	31.6
32	59	110940	2.45	40.50	13.84	8.9	10.1	32.5
Zone Average		147393	4.15	95.20	23.45	10.2	8.8	31.8

[a]GMA = Great Miami Aquifer.

TABLE D.1 – 14

HELP MODEL RESULTS FOR THE SWIFT CELLS AFTER REMOVAL OF WASTE TO 5 pCi/g ON THE GREAT MIAMI AQUIFER AND ON THE TERRACE FACE, SOUTH FIELD AND INACTIVE FLYASH PILES

Row	Column	Vertical Infiltration Rate (in./yr)	Lateral Drainage Rate (in./yr)	Waste Infiltration Rate (in./yr)	Receives Lateral Drainage From	Vadose Layer 1 & 2 Infiltration Rate (in./yr)	Layer 2 Moisture Content (Vol %)	Layer 1 Seepage Rate (in./yr)	Layer 2 Seepage Rate (in./yr)
ZONE 1 – ZERO TILL, LESS THAN 8 FEET OF SOURCE									
28	65	9.61	NA[a]	9.61	NA	9.61	7.95	NA	120.9
28	66	9.61	NA	9.61	(29,67)	15.56	7.95	NA	195.7
29	58	9.61	NA	9.61	(30,59)	15.56	7.95	NA	195.7
29	60	9.61	NA	9.61		9.61	7.95	NA	120.9
29	62	9.61	NA	9.61		9.61	7.95	NA	120.9
30	58	9.61	NA	9.61	(31,59)	17.02	7.95	NA	214.1
30	61	9.61	NA	9.61	(31,61)	17.70	7.95	NA	222.6
30	62	9.61	NA	9.61	(31,62)	17.70	7.95	NA	222.6
30	63	9.61	NA	9.61	(31,63)	17.70	7.95	NA	222.6
ZONE 2 – ZERO TILL, MORE THAN 15 FEET OF SOURCE									
28	59	9.61	NA	9.61		9.61	7.33	NA	131.1
29	59	9.61	NA	9.61		9.61	7.33	NA	131.1
29	63	9.61	NA	9.61		9.61	7.33	NA	131.1
ZONE 3 – ZERO FILL, IMPACTED TILL AS SOURCE									
29	66	1.73	NA	1.73		1.73	5.95	4.22	29.1
30	64	1.73	NA	1.73		1.73	5.95	4.22	29.1
30	67	1.73	NA	1.73		1.73	5.95	4.22	29.1
31	61	1.52	8.09	9.61		1.52	5.88	3.71	25.9
31	62	1.52	8.09	9.61		1.52	5.88	3.71	25.9
31	63	1.52	8.09	9.61		1.52	5.88	3.71	25.9

See footnote at end of table.

TABLE D.1 – 14

HELP MODEL RESULTS FOR THE SWIFT CELLS AFTER REMOVAL OF WASTE TO 5 pCi/g ON THE GREAT MIAMI AQUIFER AND ON THE TERRACE FACE, SOUTH FIELD AND INACTIVE FLYASH PILE

Row	Column	Vertical Infiltration Rate (in./yr)	Lateral Drainage Rate (in./yr)	Waste Infiltration Rate (in./yr)	Receives Lateral Drainage From	Vadose Layer 1 & 2 Infiltration Rate (in./yr)	Layer 2 Moisture Content (Vol %)	Layer 1 Seepage Rate (in./yr)	Layer 2 Seepage Rate (in./yr)
ZONE 4 – LESS THAN 3 FEET OF TILL BELOW SOURCE									
29	67	2.59	5.95	8.54		2.59	6.28	6.32	41.2
30	59	2.59	5.95	8.54		2.59	6.28	6.32	41.2
30	60	3.99	NA	3.99	(31,60)	11.40	6.28	27.80	181.5
31	58	2.59	5.95	8.54		2.59	6.28	6.32	41.2
ZONE 5 – 7 to 10 FEET OF NOT IMPACTED TILL, 9 to 15 FEET OF SOURCE									
31	59	2.21	7.41	9.62		2.21	6.16	5.39	35.9
31	60	2.21	7.41	9.62		2.21	6.16	5.39	35.9
32	59	2.21	7.41	9.62		2.21	6.16	5.39	35.9
ZONE 6 – ALL SOURCE MATERIAL REMOVED									
30	57	NA	NA	NA	(31,58)	5.95	7.95	NA	74.8

[a]NA = not applicable.

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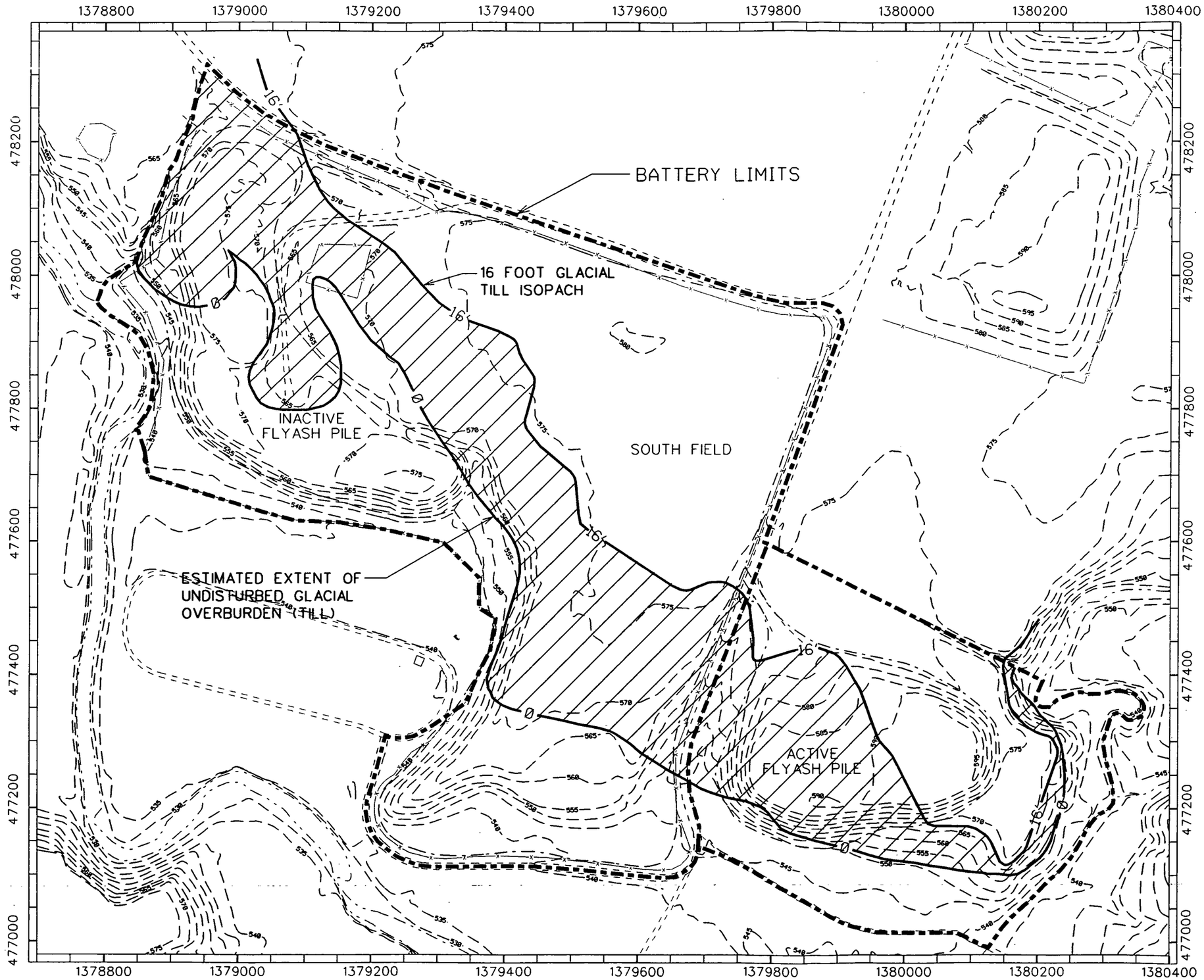

LEGEND

- 575 — ELEVATION CONTOURS
- ROADS
- STREAM
- FENCE
- GLACIAL OVERBURDEN TERRACE

NOTE:
Coordinates are in State Planar NAD 1927.
Surface contours based on 1992 flyover.

N

SCALE (FT)
0 150 300

SCALE (METER)
0 36 72

001479

FIGURE D.1-14
PRE-CONSTRUCTION GLACIAL TILL TERRACE SLOPE AT INACTIVE FLYASH PILE, SOUTH FIELD AND ACTIVE FLYASH PILE AREA

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Source Directly Underlain by The Great Miami Aquifer and on Terrace Face

This alternative assumes that the only source material impacting the Great Miami Aquifer is directly underlain by the Great Miami Aquifer, or the source material is on the terrace face. The source material directly underlain by the Great Miami Aquifer provides only a source for vertical infiltration. However, the leachate from the source material on the terrace face can infiltrate vertically through the gray till or can migrate laterally before vertically infiltrating through the unsaturated sands and gravels of the Great Miami Aquifer. Tables D.1-13 and D.1-14 present the physical parameters and infiltration rates for the SWIFT grid cells impacted for this scenario. The HELP model was used to estimate infiltration rates (see Attachment D.1-I). The vadose zone pathway was the only applicable pathway for this alternative. Note that the vadose zone pathway includes lateral migration of infiltrated leachate at the top of the gray till (see Figure D.1-4). For this modeling scenario, maximum source uranium-238 concentration was 5 pCi/g. It was assumed that source material above this concentration has been excavated.

Figure D.1-15 shows the loading curve. The maximum on-subunit concentration predicted by the SWIFT model was 3.55 pCi/L for the parameters shown in Tables D.1-13 and D.1-14. For the same parameters, the FEMP fenceline maximum uranium-238 concentration predicted by the SWIFT model was 0.49 pCi/L, less than 0.72 pCi/L (10^{-6} ILCR level). To be conservative, the source concentration of 5 pCi/g used for this modeling scenario was also taken as the modified soil PRG for the off-property resident farmer. Table D.1-15 provides a summary of modified soil PRGs for the off-property resident farmer with source controls for lateral migration of perched water.

Tables D.1-16 and D.1-17 present the physical parameters and infiltration rates for the modeling run to estimate PRGs for 10^{-5} ILCR. The HELP model was used to estimate infiltration rates (see Attachment D.1-I). For this modeling scenario, the maximum source uranium-238 concentration was 60 pCi/g. It was assumed that source material above this concentration has been excavated.

Figure D.1-16 shows the loading curve. The maximum on-subunit concentration predicted by the SWIFT model was 50.5 pCi/L for the parameters shown in Tables D.1-16 and D.1-17. For the same parameters, the FEMP fenceline maximum uranium-238 concentration predicted by the SWIFT model was 4.29 pCi/L, less than 7.2 pCi/L (10^{-5} ILCR level). To be conservative, the source concentration of 60 pCi/g used for this modeling scenario was also taken as the modified soil PRG for the off-

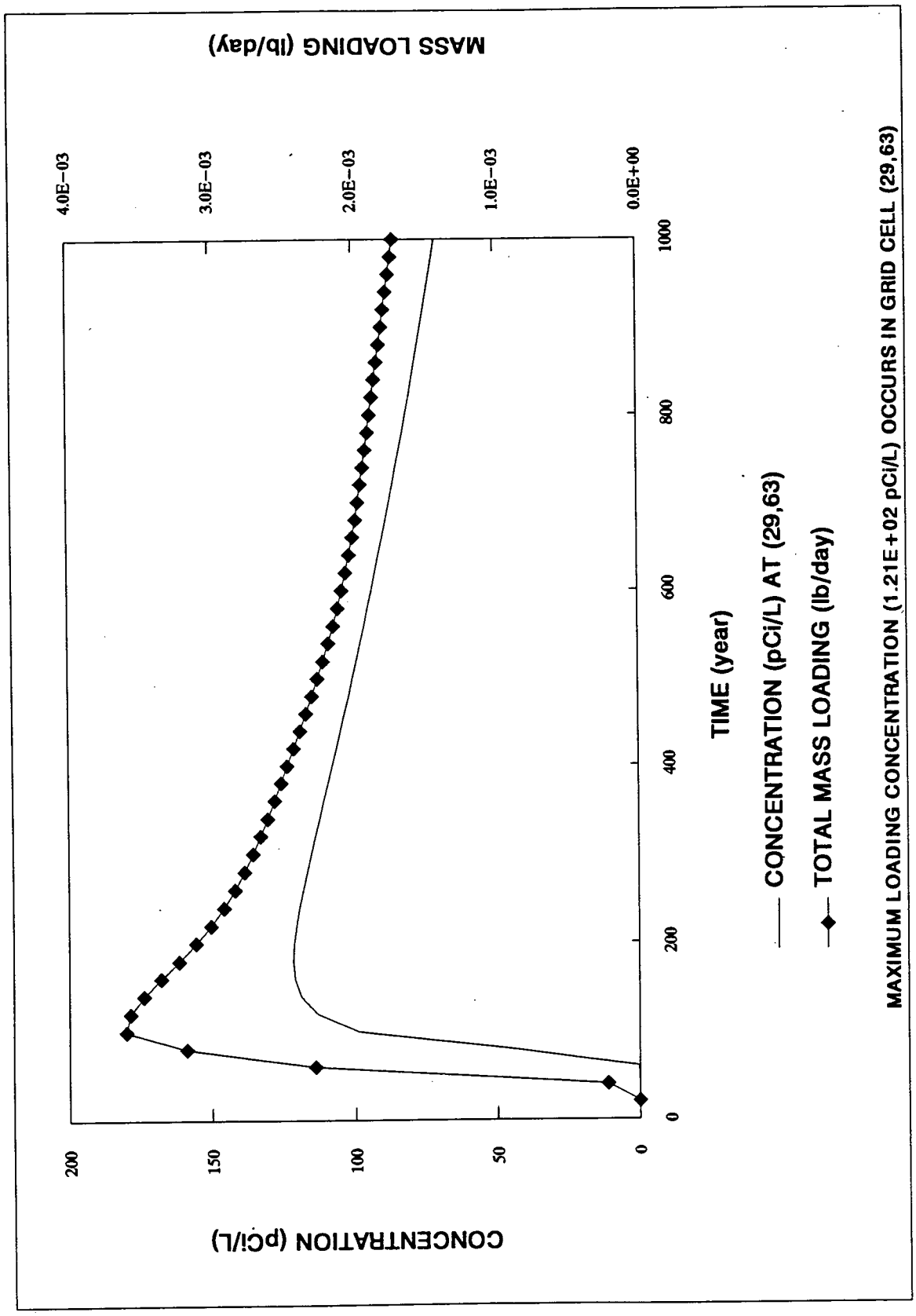

Figure D.1–15 Uranium–238 Loading Curve for Source Materials at 5 pCi/g on the Terrace Face and on the Great Miami Aquifer, Inactive Flyash Pile and South Field

001481

TABLE D.1-15

INACTIVE FLYASH PILE/SOUTH FIELD CROSS-MEDIA MODIFIED SOIL PRGs PROTECTIVE OF THE GREAT MIAMI AQUIFER USING LATERAL MIGRATION SOURCE CONTROLS

COCs Impacting Groundwater	Units	Federal Ownership Off-Property Resident Farmer PRGs					Background Concentration
		10^{-4} ILCR[a]	10^{-5} ILCR	10^{-6} ILCR	0.2 HI[b]	ARAR	
Source Material Over The Great Miami Aquifer							
Uranium-234	pCi/g	1250	91	7.64	NA[c]	NA	1.04
Uranium-235/236	pCi/g	1250	91	7.64	NA	NA	0.15
Uranium-238	pCi/g	819	60	5	NA	NA	1.12
Uranium-Total[d]	mg/kg	NA	NA	NA	172	28	3.4
Source Material On The Top Of The Terrace (Glacial Till)							
Uranium-234	pCi/g	10700	1070	107	NA	NA	1.04
Uranium-235/236	pCi/g	10700	1070	107	NA	NA	0.15
Uranium-238	pCi/g	7000	700	70	NA	NA	1.12
Uranium-Total	mg/kg	NA	NA	NA	2975	450	3.4

[a]ILCR = incremental lifetime cancer risk.
[b]HI = hazard index.
[c]NA = not applicable
[d]Total uranium PRGs and PRLs were developed for a HI of 0.2.

001482

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TABLE D.1–16

PARAMETERS FOR THE SWIFT CELLS AFTER REMOVAL OF WASTE TO 60 pCi/g ON THE GREAT MIAMI AQUIFER AND ON THE TERRACE FACE, SOUTH FIELD AND INACTIVE FLYASH PILE

Row	Column	Perched Water Source?	Source Volume (ft^3)	U–238 Concentration (pCi/g)	Source Inventory (Kg)	Initial Leachate Concentration (pCi/L)	Source Thickness (ft)	Till Thickness (ft)	Unsaturated GMA[a] Thickness (ft)
ZONE 1 – ZERO TILL, LESS THAN 5 FEET OF SOURCE									
28	63	No	1570	60.00	13.50	1600.00	0.1	0.0	16.9
28	66	No	15630	5.80	13.00	154.67	4.6	0.0	19.3
29	60	No	4690	1.90	1.28	10.72	4.3	0.0	21.4
29	64	No	1570	60.00	14.69	1600.00	0.1	0.0	24.8
29	65	No	1570	60.00	13.50	1600.00	0.1	0.0	22.8
30	57	No	15630	5.18	11.61	29.27	0.1	0.0	21.3
30	61	No	34370	3.83	18.87	21.64	2.8	0.0	20.8
Zone Average			10719	28.10	12.35	716.61	1.7	0.0	21.0
ZONE 2 – ZERO TILL, MORE THAN 8 FEET OF SOURCE									
28	59	No	157810	2.62	59.27	14.80	15.7	0.0	16.7
28	64	No	215600	60.00	1854.43	1600.00	13.8	0.0	19.7
28	65	No	129700	60.00	1115.58	1600.00	8.3	0.0	19.6
29	58	No	154690	4.43	98.24	25.03	12.5	0.0	18.2
29	59	No	318750	2.95	134.80	16.67	22.4	0.0	20.2
29	62	No	150000	15.65	336.52	417.33	16.2	0.0	18.5
29	63	No	390600	60.00	3359.65	1600.00	25.0	0.0	20.8
30	58	No	215600	5.94	183.59	33.56	14.1	0.0	21.7
30	62	No	310900	7.94	353.88	211.73	19.2	0.0	24.1
30	63	No	332800	8.22	392.16	46.44	21.3	0.0	22.8
Zone Average			237645	22.78	788.81	556.56	16.8	0.0	20.2

See footnote at end of table.

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TABLE D.1 – 16

PARAMETERS FOR THE SWIFT CELLS AFTER REMOVAL OF WASTE TO 60 pCi/g ON THE GREAT MIAMI AQUIFER AND ON THE TERRACE FACE, SOUTH FIELD AND INACTIVE FLYASH PILE

Row	Column	Perched Water Source?	Source Volume (ft^3)	U–238 Concentration (pCi/g)	Source Inventory (Kg)	Initial Leachate Concentration (pCi/L)	Source Thickness (ft)	Till Thickness (ft)	Unsaturated GMA[a] Thickness (ft)
ZONE 3 – ZERO FILL, IMPACTED TILL AS SOURCE									
29	66	No	29700	60.00	277.83	1600.00	1.9	2.6	32.0
30	64	No	35950	60.00	336.30	338.98	2.3	0.4	26.4
30	65	No	17180	60.00	160.71	338.98	1.1	6.1	27.3
30	66	No	14070	60.00	131.62	1600.00	0.9	7.1	28.6
Zone Average			24225	60.00	226.62	969.49	1.5	4.1	28.6
ZONE 4 – LESS THAN 4 FEET OF TILL BELOW SOURCE									
29	67	No	18750	13.40	36.91	357.33	5.0	2.2	32.5
30	59	No	293750	5.60	240.21	31.64	18.8	2.5	28.2
30	60	No	134374	3.63	72.36	20.51	10.1	3.0	29.0
30	67	No	68750	6.30	63.10	168.00	10.8	3.9	29.7
31	58	No	89060	4.01	53.26	22.66	8.7	1.9	29.6
Zone Average			120937	6.59	93.17	120.03	10.7	2.7	29.8
ZONE 5 – 7 to 10 FEET OF NOT IMPACTED TILL, 9 to 15 FEET OF SOURCE									
31	59	No	193750	4.44	126.80	25.08	12.4	7.8	31.4
31	60	Yes	178120	4.47	117.58	25.27	11.8	8.6	31.6
31	61	Yes	214050	4.47	140.74	25.25	13.4	6.8	30.8
31	62	Yes	196875	2.96	85.86	16.72	12.6	7.5	30.1
31	63	Yes	221875	3.14	102.31	17.74	14.4	8.2	29.5
32	59	Yes	110940	2.45	40.50	13.84	8.9	10.1	32.5
Zone Average			185935	3.66	102.30	20.65	12.2	8.2	31.0

[a]GMA = Great Miami Aquifer.

TABLE D.1–17

HELP MODEL RESULTS FOR THE SWIFT CELLS AFTER REMOVAL OF WASTE TO 60 pCi/g ON THE GREAT MIAMI AQUIFER AND ON THE TERRACE FACE, SOUTH FIELD AND INACTIVE FLYASH PILE

Row	Column	Vertical Infiltration Rate (in./yr)	Lateral Drainage Rate (in./yr)	Waste Infiltration Rate (in./yr)	Receives Lateral Drainage From	Vadose Layer 1 & 2 Infiltration Rate (in./yr)	Layer 2 Moisture Content (Vol %)	Layer 1 Seepage Rate (in./yr)	Layer 2 Seepage Rate (in./yr)
ZONE 1 – ZERO TILL, LESS THAN 5 FEET OF SOURCE									
28	63	9.61	NA[a]	9.61	NA	9.61	7.95	NA	120.9
28	66	9.61	NA	9.61	(29,67)	16.54	7.95	NA	208.1
29	60	9.61	NA	9.61	NA	9.61	7.95	NA	120.9
29	64	9.61	NA	9.61	NA	9.61	7.95	NA	120.9
29	65	9.61	NA	9.61	NA	9.61	7.95	NA	120.9
30	57	9.61	NA	9.61	(31,58)	16.54	7.95	NA	208.1
30	61	9.61	NA	9.61	(31,61)	16.60	7.95	NA	208.8
ZONE 2 – ZERO TILL, MORE THAN 8 FEET OF SOURCE									
28	59	9.61	NA	9.61	NA	9.61	7.33	NA	131.1
28	64	9.61	NA	9.61	NA	9.61	7.33	NA	131.1
28	65	9.61	NA	9.61	NA	9.61	7.33	NA	131.1
29	58	9.61	NA	9.61	(30,59)	16.54	7.33	NA	225.6
29	59	9.61	NA	9.61	NA	9.61	7.33	NA	131.1
29	62	9.61	NA	9.61	NA	9.61	7.33	NA	131.1
29	63	9.61	NA	9.61	NA	9.61	7.33	NA	131.1
30	58	9.61	NA	9.61	(31,59)	16.60	7.33	NA	226.5
30	62	9.61	NA	9.61	(31,62)	16.60	7.33	NA	226.5
30	63	9.61	NA	9.61	(31,63)	ERR	7.33	NA	ERR
ZONE 3 – ZERO FILL, IMPACTED TILL AS SOURCE									
29	66	1.48	NA	1.48	NA	1.48	5.83	9.31	25.4
30	64	1.48	NA	1.48	NA	1.48	5.83	9.31	25.4
30	65	1.48	NA	1.48	NA	1.48	5.83	9.31	25.4
30	66	1.48	NA	1.48	NA	1.48	5.83	9.31	25.4

TABLE D.1–17

HELP MODEL RESULTS FOR THE SWIFT CELLS AFTER REMOVAL OF WASTE TO 60 pCi/g ON THE GREAT MIAMI AQUIFER AND ON THE TERRACE FACE, SOUTH FIELD AND INACTIVE FLYASH PILE

Row	Column	Vertical Infiltration Rate (in./yr)	Lateral Drainage Rate (in./yr)	Waste Infiltration Rate (in./yr)	Receives Lateral Drainage From	Vadose Layer 1 & 2 Infiltration Rate (in./yr)	Layer 2 Moisture Content (Vol %)	Layer 1 Seepage Rate (in./yr)	Layer 2 Seepage Rate (in./yr)
ZONE 4 – LESS THAN 4 FEET OF TILL BELOW SOURCE									
29	67	2.68	6.93	9.61	NA	2.68	6.70	16.86	40.0
30	59	2.68	6.93	9.61	NA	2.68	6.70	16.86	40.0
30	60	3.99	NA	3.99	(31,60)	10.98	6.70	69.06	163.9
30	67	2.68	6.93	9.61	NA	2.68	6.70	16.86	40.0
31	58	2.68	6.93	9.61	NA	2.68	6.70	16.86	40.0
ZONE 5 – 7 to 10 FEET OF NOT IMPACTED TILL, 9 to 15 FEET OF SOURCE									
31	59	2.23	6.99	9.22	NA	2.23	6.30	14.03	35.4
31	60	2.23	6.99	9.22	NA	2.23	6.30	14.03	35.4
31	61	2.23	6.99	9.22	NA	2.23	6.30	14.03	35.4
31	62	2.23	6.99	9.22	NA	2.23	6.30	14.03	35.4
31	63	2.23	6.99	9.22	NA	2.23	6.30	14.03	35.4
32	59	2.23	6.99	9.22	NA	2.23	6.30	14.03	35.4

[a]NA = not applicable

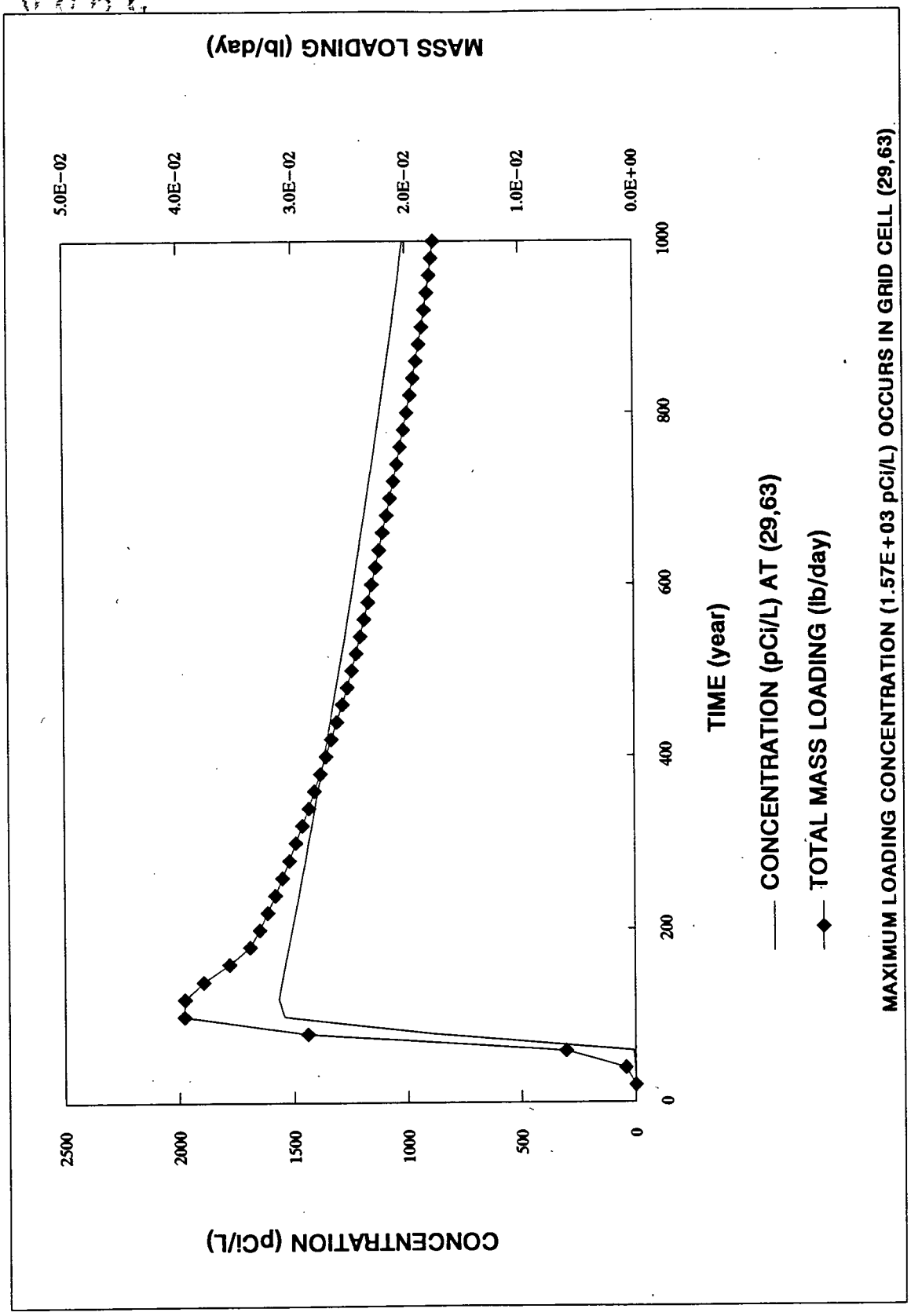

Figure D.1–16 Uranium–238 Loading Curve for Source Materials at 60 pCi/g on the Terrace Face and on the Great Miami Aquifer, Inactive Flyash Pile and South Field

property resident farmer. Table D.1-15 provides a summary of modified soil PRGs for the off-property resident farmer with source controls for lateral migration of perched water.

Tables D.1-18 and D.1-19 presents the physical parameters and infiltration rates for the modeling run to estimate PRGs for 10^{-4} ILCR. The HELP model was used to estimate infiltration rates (see Attachment D.1-I). For this modeling scenario, maximum source uranium-238 concentration in each grid cell was used. It was assumed that no source material is removed.

Figure D.1-17 shows the loading curve. The maximum on-subunit concentration predicted by the SWIFT model was 498 pCi/L for the parameters shown in Tables D.1-16 and D.1-17. For the same parameters, the FEMP fenceline maximum uranium-238 concentration predicted by the SWIFT model was 36.2 pCi/L, less than the 72 pCi/L (10^{-4} ILCR level). Therefore, the modified soil PRG for off-property resident farmer exceeds the maximum uranium-238 concentration (819 pCi/g) by about a factor of 2. Table D.1-15 provides a summary of modified soil PRGs for the off-property resident farmer with source controls for lateral migration of perched water.

Source on the Top of Terrace

This alternative assumes that the only source material impacting the Great Miami Aquifer is on the top of terrace [i.e., underlain by at least 5.5 m (18 ft) of glacial overburden]. For modeling purposes, only gray till in the glacial overburden is assumed to provide any barrier. The leachate from the source material and perched water infiltrate vertically through the gray till and the unsaturated sands and gravels of the Great Miami Aquifer. Tables D.1-20 and D.1-21 present the physical parameters and infiltration rates for the SWIFT grid cells impacted for this scenario. The HELP model was used to estimate infiltration rates (see Attachment D.1-I). For this modeling scenario, the maximum source uranium-238 concentration was 70 pCi/g. It was assumed that source material above this concentration has been excavated.

Figure D.1-18 shows the loading curve. The maximum on-subunit concentration predicted by the SWIFT model was 3.11 pCi/L for the parameters shown in Table D.1-20. For the same parameters, the FEMP fenceline maximum uranium-238 concentration predicted by the SWIFT model was 0.40 pCi/L, less than 0.72 pCi/L (10^{-6} ILCR level). To be conservative, the source concentration of 70 pCi/g used for this modeling scenario was also taken as the modified soil PRG for the off-property

TABLE D.1–18

PARAMETERS FOR THE SWIFT CELLS WITH NO REMOVAL OF WASTE ON THE GREAT MIAMI AQUIFER AND ON THE TERRACE FACE, SOUTH FIELD AND INACTIVE FLYASH PILE

Row	Column	Perched Water Source?	Source Volume (ft^3)	U–238 Concentration (pCi/g)	Source Inventory (Kg)	Initial Leachate Concentration (pCi/L)	Source Thickness (ft)	Till Thickness (ft)	Unsaturated GMA[a] Thickness (ft)
ZONE 1 – ZERO TILL									
28	59	No	157810	3.80	85.97	21.47	15.7	0.0	16.7
28	63	No	109375	135.08	2117.97	3602.13	16.0	0.0	16.9
28	64	No	293750	282.23	11884.78	7526.13	21.4	0.0	19.7
28	65	No	135950	98.12	1912.26	2616.53	15.9	0.0	19.6
28	66	No	20300	13.03	37.92	347.47	4.6	0.0	19.3
29	58	No	154690	6.72	149.02	37.97	12.5	0.0	18.2
29	59	No	318750	6.69	305.69	37.80	22.4	0.0	20.2
29	60	No	4690	2.22	1.49	12.54	4.3	0.0	21.4
29	62	No	150000	55.28	1188.69	1474.13	16.2	0.0	18.5
29	63	No	393750	64.58	3645.26	1722.13	25.3	0.0	20.8
29	64	No	289060	223.76	10084.35	5966.93	18.5	0.0	24.8
29	65	No	407800	818.99	47877.97	21839.73	26.6	0.0	22.8
30	57	No	15630	5.18	11.61	29.27	0.1	0.0	21.3
30	58	No	215600	9.48	293.00	53.56	14.1	0.0	21.7
30	61	No	34370	7.32	36.07	41.36	2.8	0.0	20.8
30	62	No	310900	58.46	2605.49	1558.93	19.9	0.0	24.1
30	63	No	332800	33.54	1600.13	189.49	21.3	0.0	22.8
Zone Average			215460	127.88	6734.41	3288.81	14.9	0.0	21.9

See footnote at end of table.

TABLE D.1–18

PARAMETERS FOR THE SWIFT CELLS WITH NO REMOVAL OF WASTE ON THE GREAT MIAMI AQUIFER AND ON THE TERRACE FACE, SOUTH FIELD AND INACTIVE FLYASH PILE

Row	Column	Perched Water Source?	Source Volume (ft^3)	U–238 Concentration (pCi/g)	Source Inventory (Kg)	Initial Leachate Concentration (pCi/L)	Source Thickness (ft)	Till Thickness (ft)	Unsaturated GMA[a] Thickness (ft)
ZONE 2 – LESS THAN 4 FEET OF TILL BELOW SOURCE									
29	66	No	259375	130.01	4933.72	3466.93	17.0	2.6	32.0
29	67	No	18750	23.27	66.97	620.53	5.0	2.2	32.5
30	59	No	293750	8.76	375.76	49.49	18.8	2.5	28.2
30	60	No	134374	4.90	97.67	27.68	10.1	3.0	29.0
30	64	No	285950	216.85	9057.49	1225.14	18.5	0.4	26.4
30	67	No	68750	39.83	404.98	1062.13	11.1	3.9	29.7
31	58	No	89060	7.00	92.97	39.55	8.7	1.9	29.6
Zone Average			164287	61.52	2147.08	927.35	12.7	2.4	29.6
ZONE 3 – 6 to 10 FEET OF NOT IMPACTED TILL, 9 to 15 FEET OF SOURCE									
30	65	No	162500	547.30	13178.90	3092.09	10.4	6.1	27.3
30	66	No	181250	147.97	3960.82	3945.87	11.6	7.1	28.6
31	59	No	193750	7.12	203.34	40.23	12.4	7.8	31.4
31	60	Yes	178120	5.08	133.57	28.70	11.8	8.6	31.6
31	61	Yes	214050	7.24	227.96	40.90	13.4	6.8	30.8
31	62	Yes	196875	5.86	169.99	33.11	12.6	7.5	30.1
31	63	Yes	221875	6.65	216.67	37.57	14.4	8.2	29.5
32	59	Yes	110940	3.06	50.59	17.29	8.9	10.1	32.5
Zone Average			182420	91.29	2267.73	904.47	11.9	7.8	30.2

[a]GMA – Great Miami Aquifer

TABLE D.1 – 19

HELP MODEL RESULTS FOR THE SWIFT CELLS WITH NO REMOVAL OF WASTE ON THE GREAT MIAMI AQUIFER AND ON THE TERRACE FACE, SOUTH FIELD AND INACTIVE FLYASH PILE

Row	Column	Vertical Infiltration Rate (in./yr)	Lateral Drainage Rate (in./yr)	Waste Infiltration Rate (in./yr)	Receives Lateral Drainage From	Vadose Layer 1 & 2 Infiltration Rate (in./yr)	Layer 2 Moisture Content (Vol %)	Layer 1 Seepage Rate (in./yr)	Layer 2 Seepage Rate (in./yr)
ZONE 1 – ZERO TILL									
28	59	9.61	NA	9.61	NA	9.61	7.33	NA	131.1
28	63	9.61	NA	9.61	NA	9.61	7.33	NA	131.1
28	64	9.61	NA	9.61	NA	9.61	7.33	NA	131.1
28	65	9.61	NA	9.61	NA	9.61	7.33	NA	131.1
28	66	9.61	NA	9.61	(29,66) & (30,66)	23.94	7.33	NA	326.6
29	58	9.61	NA	9.61	(30,59)	16.58	7.33	NA	226.2
29	59	9.61	NA	9.61	NA	9.61	7.33	NA	131.1
29	60	9.61	NA	9.61	NA	9.61	7.33	NA	131.1
29	62	9.61	NA	9.61	NA	9.61	7.33	NA	131.1
29	63	9.61	NA	9.61	NA	9.61	7.33	NA	131.1
29	64	9.61	NA	9.61	(30,64)	16.58	7.33	NA	226.2
29	65	9.61	NA	9.61	(30,65)	16.97	7.33	NA	231.5
30	57	9.61	NA	9.61	(31,58)	16.58	7.33	NA	226.2
30	58	9.61	NA	9.61	(31,59)	16.97	7.33	NA	231.5
30	61	9.61	NA	9.61	(31,61)	16.97	7.33	NA	231.5
30	62	9.61	NA	9.61	(31,62)	16.97	7.33	NA	231.5
30	63	9.61	NA	9.61	(31,63)	16.97	7.33	NA	231.5

See footnote at end of table.

TABLE D.1–19

HELP MODEL RESULTS FOR THE SWIFT CELLS WITH NO REMOVAL OF WASTE ON THE GREAT MIAMI AQUIFER AND ON THE TERRACE FACE, SOUTH FIELD AND INACTIVE FLYASH PILE

Row	Column	Vertical Infiltration Rate (in./yr)	Lateral Drainage Rate (in./yr)	Waste Infiltration Rate (in./yr)	Receives Lateral Drainage From	Vadose Layer 1 & 2 Infiltration Rate (in./yr)	Layer 2 Moisture Content (Vol %)	Layer 1 Seepage Rate (in./yr)	Layer 2 Seepage Rate (in./yr)
ZONE 2 – LESS THAN 4 FEET OF TILL BELOW SOURCE									
29	66	2.64	6.97	9.61	NA	9.61	6.74	60.44	142.6
29	67	4.17	NA	4.17	NA	2.68	6.28	16.86	42.7
30	59	2.64	6.97	9.61	NA	2.68	6.28	16.86	42.7
30	60	4.17	NA	4.17	(31,60)	11.53	6.74	72.52	171.1
30	64	2.64	6.97	9.61	NA	9.61	6.74	60.44	142.6
30	67	4.17	NA	4.17	NA	2.68	6.28	16.86	42.7
31	58	2.64	6.97	9.61	NA	2.68	6.28	16.86	42.7
ZONE 3 – 6 to 10 FEET OF NOT IMPACTED TILL, 9 to 15 FEET OF SOURCE									
30	65	2.25	7.36	9.61	NA	9.61	6.43	60.44	149.5
30	66	2.25	7.36	9.61	NA	9.61	6.43	60.44	149.5
31	59	2.25	7.36	9.61	NA	2.23	6.17	14.03	36.1
31	60	2.25	7.36	9.61	NA	2.23	6.17	14.03	36.1
31	61	2.25	7.36	9.61	NA	2.23	6.17	14.03	36.1
31	62	2.25	7.36	9.61	NA	2.23	6.17	14.03	36.1
31	63	2.25	7.36	9.61	NA	2.23	6.17	14.03	36.1
32	59	2.25	7.36	9.61	NA	2.23	6.17	14.03	36.1

[a]NA = not applicable

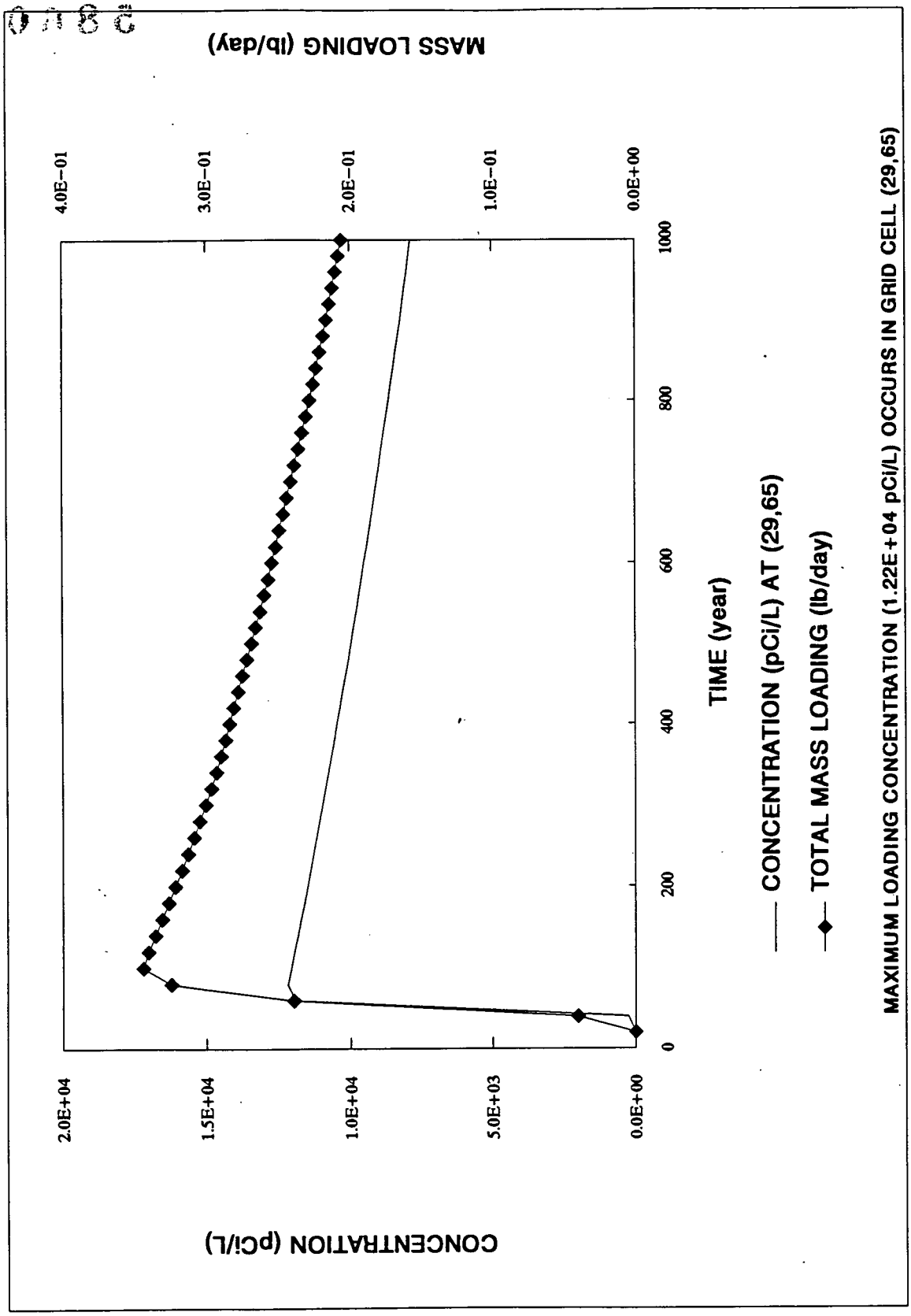

Figure D.1–17 Uranium–238 Loading Curve for Source Materials up to 819 pCi/g on the Terrace Face and on the Great Miami Aquifer, Inactive Flyash Pile and South Field

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TABLE D.1–20

PARAMETERS FOR THE SWIFT CELLS FOR PRG DEVELOPMENT FOR THE WASTE ON THE TOP OF THE TERRACE, SOUTH FIELD AND INACTIVE FLYASH PILE

Row	Column	Source Volume (ft^3)	U–238 Concentration (pCi/g)	Source Inventory (Kg)	Initial Leachate Concentration (pCi/L)	Source Thickness (ft)	Till Thickness (ft)	Unsaturated GMA[a] Thickness (ft)
ZONE 1 – About 4.25 Feet of Source Material								
34	60	9374	5.48	34	31	4.3	7.8	32.7
35	61	4687	25.95	79	147	4.2	9.1	32.2
Zone Average		7031	15.72	57	89	4.3	8.5	32.5
ZONE 2 – About 6 Feet of Source Material								
31	65	98125	35.63	3336	201	6.3	10.7	28.6
31	66	93749	24.37	2081	138	6.0	9.4	28.7
32	64	96876	6.26	641	35	7.0	9.6	29.6
33	59	93125	2.55	215	14	6.0	7.2	33.0
33	60	90625	5.93	474	34	5.8	7.7	32.7
33	61	101875	12.00	1205	68	6.5	9.2	31.8
33	62	51560	70.00	1869	395	3.3	9.8	31.1
33	63	78125	63.54	4836	359	6.4	9.6	30.6
34	61	104690	42.48	4447	240	6.6	9.1	32.1
34	62	64060	62.50	4107	353	6.8	9.7	31.5
Zone Average		87281	32.53	2321	184	6.1	9.2	31.0
ZONE 3 – 8 to 11 Feet of Source Material								
31	64	167188	17.56	4654	99	10.7	10.6	29.1
32	59	110938	3.06	449	17	8.9	7.9	32.5
32	60	121875	5.66	877	32	8.5	7.5	32.3
32	61	126563	7.09	1110	40	8.3	8.6	31.4
32	62	157812	25.22	6024	142	10.2	9.0	30.7
32	63	154688	21.95	5139	124	10.2	9.3	30.1
Zone Average		139844	13.42	3042	76	9.5	8.8	31.0

[a]GMA = Great Miami Aquifer.

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TABLE D.1-21

HELP MODEL RESULTS FOR THE SWIFT CELLS FOR PRG DEVELOPMENT FOR THE TOP OF TERRACE SOUTH FIELD AND INACTIVE FLYASH PILE

Row	Column	Vertical Infiltration Rate (in./yr)	Layer 2 Moisture Content (Vol %)	Layer 1 Seepage Rate (in./yr)	Layer 2 Seepage Rate (in./yr)
ZONE 1 – ABOUT 4.25 FEET OF SOURCE					
34	60	2.55	6.31	16.04	40.4
35	61	2.55	6.31	16.04	40.4
ZONE 2 – ABOUT 6 FEET OF SOURCE					
31	65	3.05	6.46	19.18	47.2
31	66	3.05	6.46	19.18	47.2
32	64	3.05	6.46	19.18	47.2
33	59	3.05	6.46	19.18	47.2
33	60	3.05	6.46	19.18	47.2
33	61	3.05	6.46	19.18	47.2
33	62	3.05	6.46	19.18	47.2
33	63	3.05	6.46	19.18	47.2
34	61	3.05	6.46	19.18	47.2
34	62	3.05	6.46	19.18	47.2
ZONE 3 – 8 TO 11 FEET OF SOURCE					
31	64	3.68	6.63	23.14	55.5
32	59	3.68	6.63	23.14	55.5
32	60	3.68	6.63	23.14	55.5
32	61	3.68	6.63	23.14	55.5
32	62	3.68	6.63	23.14	55.5
32	63	3.68	6.63	23.14	55.5

5860

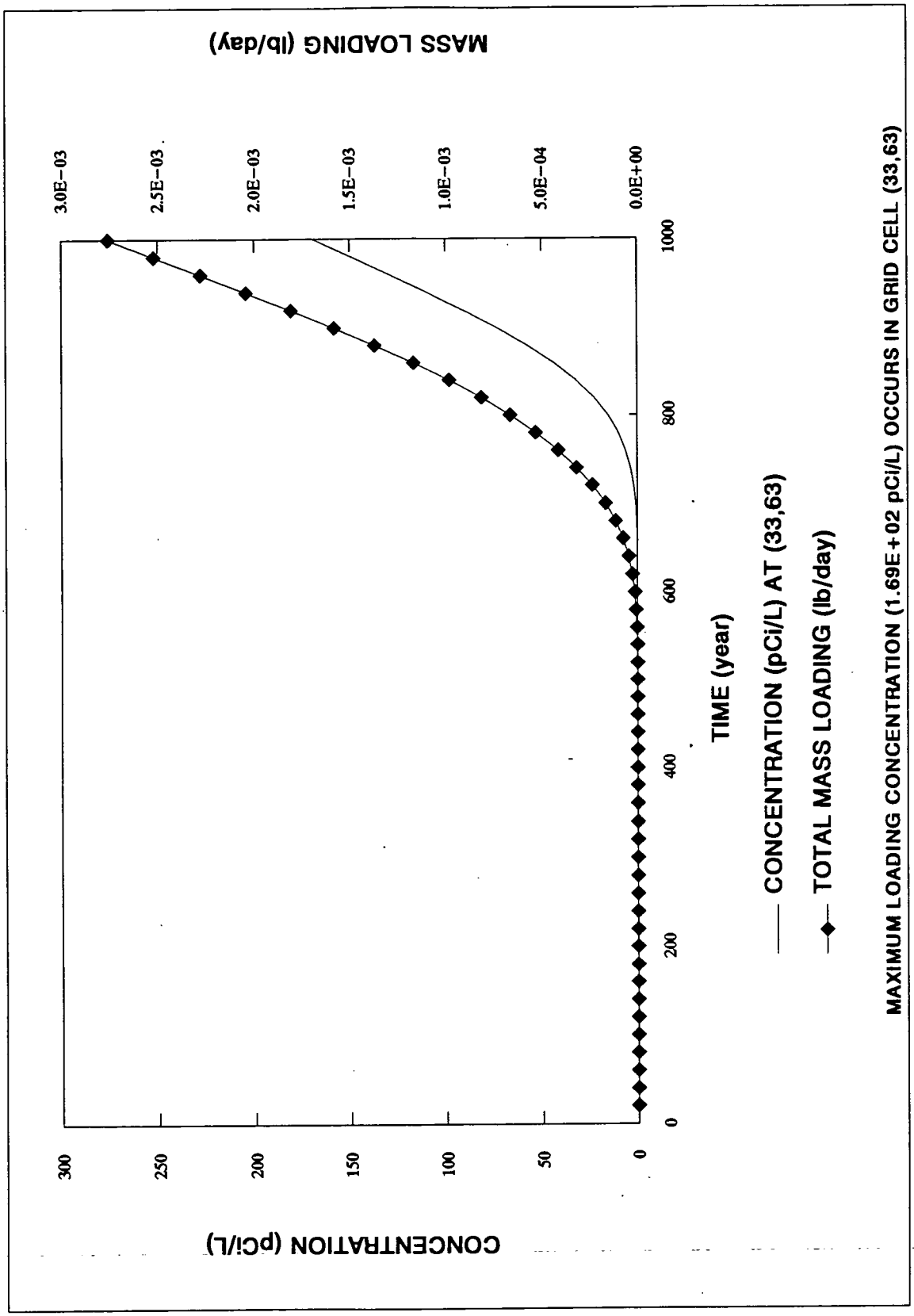

Figure D.1–18 Uranium–238 Loading Curve for Source Materials up to 70 pCi/g on the Terrace Face, Inactive Flyash Pile and South Field

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resident farmer. Table D.1-15 provides a summary of modified soil PRGs for the off-property resident farmer with source controls for lateral migration of perched water.

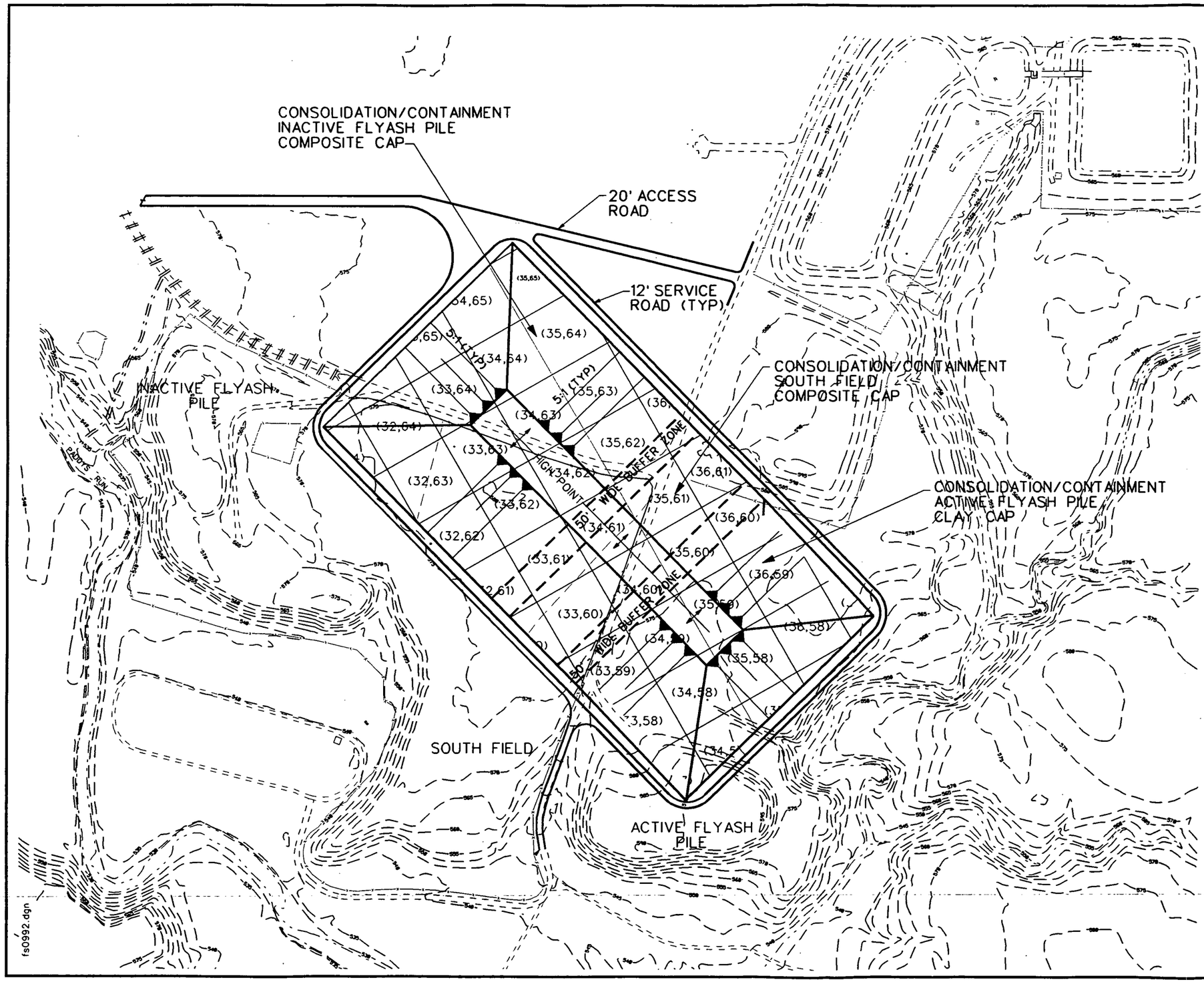
D.1.5.3.4 Consolidation and Capping with Source Controls for Lateral Migration of Perched Water

Figure D.1-19 shows the areal extent of the South Field, Inactive Flyash Pile, and Active Flyash Pile waste consolidation area and the SWIFT III grid cells impacted by direct loading from this area. For this alternative, waste containing uranium-238 at concentrations greater than 5 pCi/g was consolidated and capped as shown in Figure D.1-19. This modeling scenario evaluates the impact of the consolidation area on the Great Miami Aquifer from the South Field, Inactive Flyash Pile, and Active Flyash Pile. These three units are evaluated together, because wastes from these areas will be placed under one capped consolidation area. The fate and transport modeling assumed that the lateral migration of the perched water will be controlled and, therefore, will not require seepage modeling. However, the perched water still represents a source for vertical infiltration, and was modeled.

Table D.1-22 shows the physical parameters for this alternative. To be conservative, all source material form a subunit was assumed to be at its maximum concentration. In other words, all source from the Inactive Flyash Pile was assumed to be at 1,570 pCi/g, while all source material from the South Field was assumed to be at 397 pCi/g, and all source material from the Active Flyash Pile was assumed to be at 12.6 pCi/g. These assumptions were made because exact placement of the waste is not known and to calculate worst-case modified soil PRGs. The maximum predicted loading concentration and maximum on-subunit Great Miami Aquifer concentrations were 2.17×10^{-4} pCi/L and 1.46×10^{-6} pCi/L, respectively. These concentrations are well below 0.72 pCi/L (10^{-6} ILCR level). Therefore, consolidation and capping should be protective of the Great Miami Aquifer. Table D.1-23 provides a summary of modified soil PRGs for the off-property resident farmer for consolidation and capping with source controls for lateral migration of perched water.

D.1.5.4 Active Flyash Pile

Two alternatives were considered for the Active Flyash Pile. The first alternative (Alternative 3) deals with excavation and disposal away from the subunit. The Operable Unit 2 RI modeling indicated that the Active Flyash Pile is nearly homogenous with respect to the uranium-238 concentrations. Furthermore, the Active Flyash Pile is either underlain by the Great Miami Aquifer,



LEGEND

- 575 ELEVATION CONTOURS
- 575 PROPOSED CONTOURS
- ROADS
- PROPOSED ROADS
- STREAM
- FENCE
- RAILROAD
- (35,64) SWIFT GRID (COLUMN,ROW)

NOTE:
Surface contours based on 1992 flyover.

SCALE (FT)
0 100 200 400

SCALE (METER)
0 24 48 96

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FIGURE D.1-19
SITE RESTORATION
CONSOLIDATION/CONTAINMENT
SWIFT MODEL GRID
FOR INACTIVE
FLYASH PILE, SOUTH FIELD,
AND ACTIVE FLYASH PILE

TABLE D.1–22

PARAMETERS FOR THE SWIFT CELLS AFTER CONSOLIDATION AND CAPPING
SOUTH FIELD, INACTIVE FLYASH PILE, AND ACTIVE FLYASH PILE

Row	Column	Source Volume (ft^3)	U–238 Concentration (pCi/g)	Source Inventory (Kg)	U–238 Leachate Concentration (pCi/L)	Till Thickness (ft)	Unsaturated GMA[a] Thickness (ft)
ZONE 1 – CAPPED WASTE FROM INACTIVE FLYASH PILE							
32	61	208550	1570.00	23749.1	41866.7	8.6	31.4
32	62	208550	1570.00	23749.1	41866.7	9.0	30.7
32	63	208550	1570.00	23749.1	41866.7	9.3	30.1
33	61	208550	1570.00	23749.1	41866.7	9.2	31.8
33	62	208550	1570.00	23749.1	41866.7	9.8	31.1
33	63	208550	1570.00	23749.1	41866.7	9.6	30.6
34	61	208550	1570.00	23749.1	41866.7	9.1	32.1
34	62	208550	1570.00	23749.1	41866.7	9.7	31.5
34	63	208550	1570.00	23749.1	41866.7	9.0	31.1
34	64	208550	1570.00	23749.1	41866.7	9.0	31.0
35	61	208550	1570.00	23749.1	41866.7	9.1	32.2
35	62	208550	1570.00	23749.1	41866.7	9.0	32.0
35	63	208550	1570.00	23749.1	41866.7	9.0	31.9
ZONE 2 – CAPPED WASTE FROM SOUTH FIELD							
33	59	203750	397.00	5867.1	2243	7.2	33.0
33	60	203750	397.00	5867.1	2243	7.7	32.7
34	60	203750	397.00	5867.1	2243	7.8	32.7
35	60	203750	397.00	5867.1	2243	7.5	32.7
36	60	203750	397.00	5867.1	2243	7.5	33.4

See footnote at end of table.

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TABLE D.1–22

PARAMETERS FOR THE SWIFT CELLS AFTER CONSOLIDATION AND CAPPING
SOUTH FIELD, INACTIVE FLYASH PILE, AND ACTIVE FLYASH PILE

Row	Column	Source Volume (ft^3)	U–238 Concentration (pCi/g)	Source Inventory (Kg)	U–238 Leachate Concentration (pCi/L)	Till Thickness (ft)	Unsaturated GMA[a] Thickness (ft)
ZONE 3 – CAPPED WASTE FROM THE ACTIVE FLYASH PILE							
33	58	219650	12.60	200.7	336.0	7.5	32.6
34	57	219650	12.60	200.7	336.0	7.5	32.1
34	58	219650	12.60	200.7	336.0	7.5	32.6
34	59	219650	12.60	200.7	336.0	7.5	32.3
35	57	219650	12.60	200.7	336.0	7.5	33.2
35	58	219650	12.60	200.7	336.0	7.5	33.3
35	59	219650	12.60	200.7	336.0	7.5	33.0
36	58	219650	12.60	200.7	336.0	7.5	33.9
36	59	219650	12.60	200.7	336.0	7.5	33.7

[a]GMA = Great Miami Aquifer.

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TABLE D.1-23

INACTIVE FLYASH PILE/SOUTH FIELD/ACTIVE FLYASH PILE CROSS-MEDIA MODIFIED SOIL PRGs PROTECTIVE OF THE GREAT MIAMI AQUIFER USING A CAP AND SOURCE CONTROLS FOR PERCHED WATER

COCs Impacting Groundwater	Units	Federal Ownership Off-Property Resident Farmer PRGs[a]					Background
		10^{-4} ILCR[b]	10^{-5} ILCR	10^{-6} ILCR	0.2 HI[c]	ARAR	
SOURCE MATERIAL ON THE TOP OF THE TERRACE (GLACIAL TILL)							
Uranium-234	pCi/g	> 100,000	> 100,000	> 10,000	NA	NA	1.04
Uranium-235/236	pCi/g	> 100,000	> 100,000	> 10,000	NA	NA	0.15
Uranium-238	pCi/g	> 100,000	> 100,000	> 10,000	NA	NA	1.12
Uranium-Total[d]	mg/kg	NA	NA	NA	> 10,000	> 10,000	3.4

[a]Cap is not considered in an area where source material is directly underlain by the Great Miami Aquifer; therefore, no PRGs were developed for this case.

[b]ILCR - incremental lifetime cancer risk.

[c]HI - hazard index.

[d]Total uranium PRGs and PRLs were developed only for a HI of 0.2.

or it is on the terrace face. Therefore, PRGs developed for the similar scenario for the South Field/Inactive Flyash Pile are applicable to the Active Flyash Pile. Table D.1-24 provides a summary of modified soil PRGs for the Active Flyash Pile for excavation.

The second alternative (Alternative 2) considered was consolidation and capping. Figure D.1-19 shows the SWIFT III grid blocks directly beneath the flyash from the Active Flyash Pile after consolidation. As shown in Section D.1.5.3.4, impact of the Active Flyash Pile source was included in the modeling for the Inactive Flyash Pile and South Field. Modeling indicated that modified soil PRGs are much higher than the maximum soil concentrations detected in the Active Flyash Pile.

D.1.6 PRELIMINARY WASTE ACCEPTANCE CRITERIA FOR ON-SITE DISPOSAL OF OPERABLE UNIT 2 MATERIALS

Figure D.1-20 shows the proposed Operable Unit 2 disposal cell in relation to the area available for an overall disposal facility for the FEMP. The proposed Operable Unit 2 disposal cell is relatively small compared to this area. Figures D.1-21 and D.1-22 show the gray till and unsaturated Great Miami Aquifer thicknesses. The minimum gray till thickness in the proposed disposal cell area is 3.7 m (12 ft). Furthermore, groundwater flow is from the west toward the east-southeast under the disposal cell. To consider cumulative impacts on the groundwater, preliminary WAC were developed from modeling an area which included the proposed Operable Unit 2 disposal cell and areas to the east and west of the proposed cell (see Figure D.1-20).

Wastes from the Lime Sludge Ponds, South Field, Inactive Flyash Pile, Active Flyash Pile, and Solid Waste Landfill were considered for containment at the disposal cell. If a contaminant was not a COC for subunits based on the Baseline Risk Assessment, it did not become a COC at the disposal cell because the infiltration rate is much less at the disposal cell than at the unremediated subunits. Because uranium isotopes were the only COCs at the Operable Unit 2 subunits, the only COCs for groundwater at the proposed disposal cell were uranium isotopes. It was assumed that waste will not be treated before disposal; this represents the worst-case scenario. Furthermore, wastes from other operable units might be placed in a site-wide disposal facility. Due to the unknown nature of the geochemistry of wastes from other sources, 3.1 mL/g was used as the K_d of the gray till. Only the vadose zone pathway was applicable for the disposal cell.

TABLE D.1-24

ACTIVE FLYASH PILE
CROSS-MEDIA MODIFIED SOIL PRGs
PROTECTIVE OF THE GREAT MIAMI AQUIFER
WITHOUT SOURCE CONTROLS

COCs Impacting Groundwater	Units	Private Ownership On-Property Resident Farmer PRG-Carcinogenic Risk Based					Federal Ownership Off-Property Resident Farmer PRGs					Background Concentration
		10^{-4} ILCR[a]	10^{-5} ILCR	10^{-6} ILCR	0.2 HI[b]	ARAR	10^{-4} ILCR	10^{-5} ILCR	10^{-6} ILCR	0.2 HI	ARAR	
Uranium-234	pCi/g	155	15.5	1.55	NA[c]	NA	760	76	7.6	NA	NA	1.04
Uranium-235/236	pCi/g	155	15.5	1.55	NA	NA	760	76	7.6	NA	NA	0.15
Uranium-238	pCi/g	101	10.1	1.01	NA	NA	500	50	5.0	NA	NA	1.12
Uranium-Total	mg/kg	NA	NA	NA	24	28	NA	NA	NA	172	28	3.4

[a]ILCR = incremental lifetime cancer risk.

[b]HI = hazard index.

[c]NA = not applicable.

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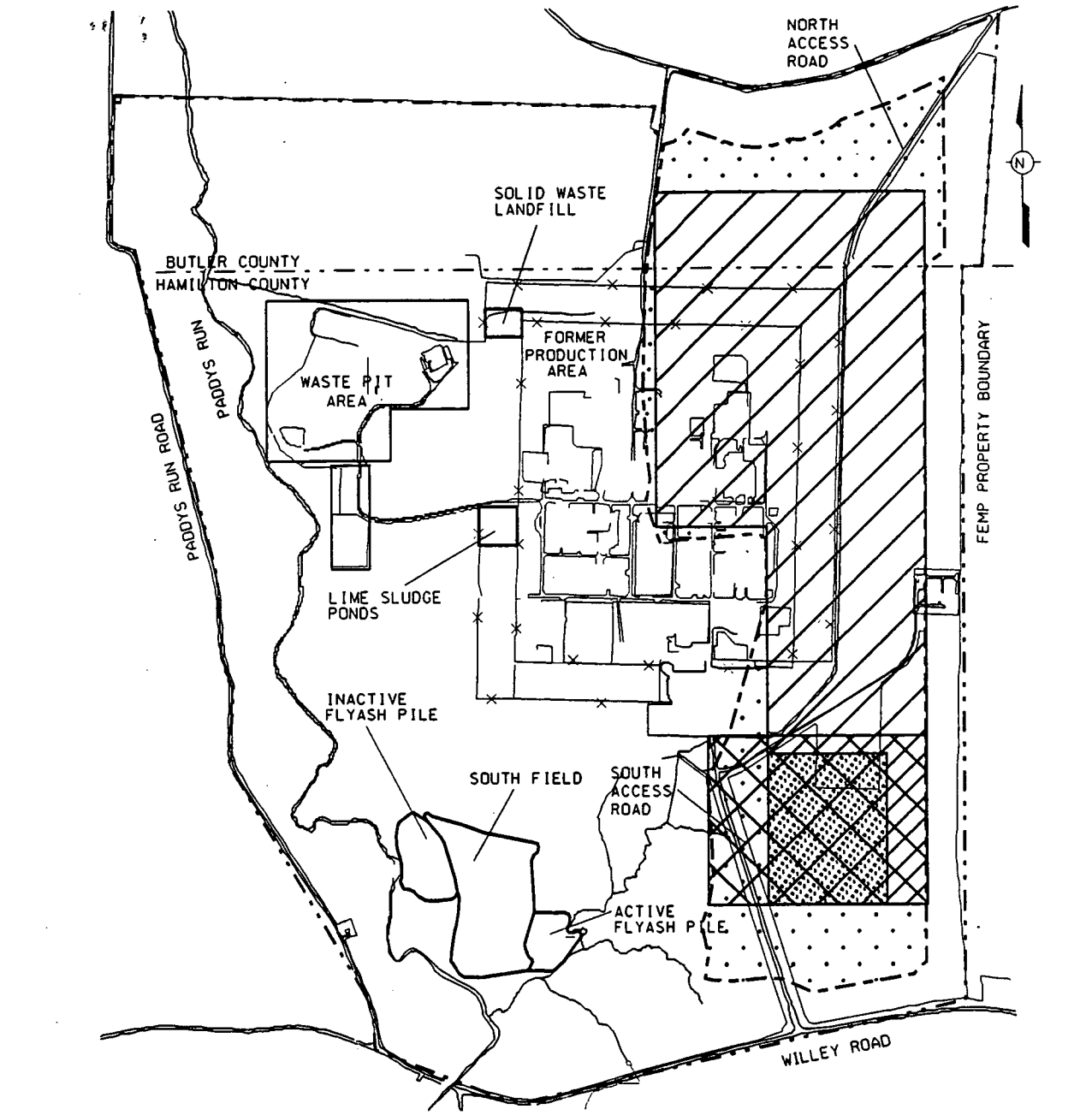

LEGEND

- ADDITIONAL AREA FOR 8,500,000 CU. YD. FEMP CELL
- PROPOSED OU2 DISPOSAL CELL LOCATION
- POTENTIALY ACCEPTABLE GEOLOGY
- AREA MODELED FOR WAC DEVELOPMENT
- FEMP BOUNDARY

SCALE

0 1200 2400 FEET

0 288 576 METER

FIGURE D.1-20
POTENTIALLY ACCEPTABLE LOCATIONS
FOR SITEWIDE ON-SITE DISPOSAL AND
MODELED AREA FOR WAC DEVELOPMENT

001504

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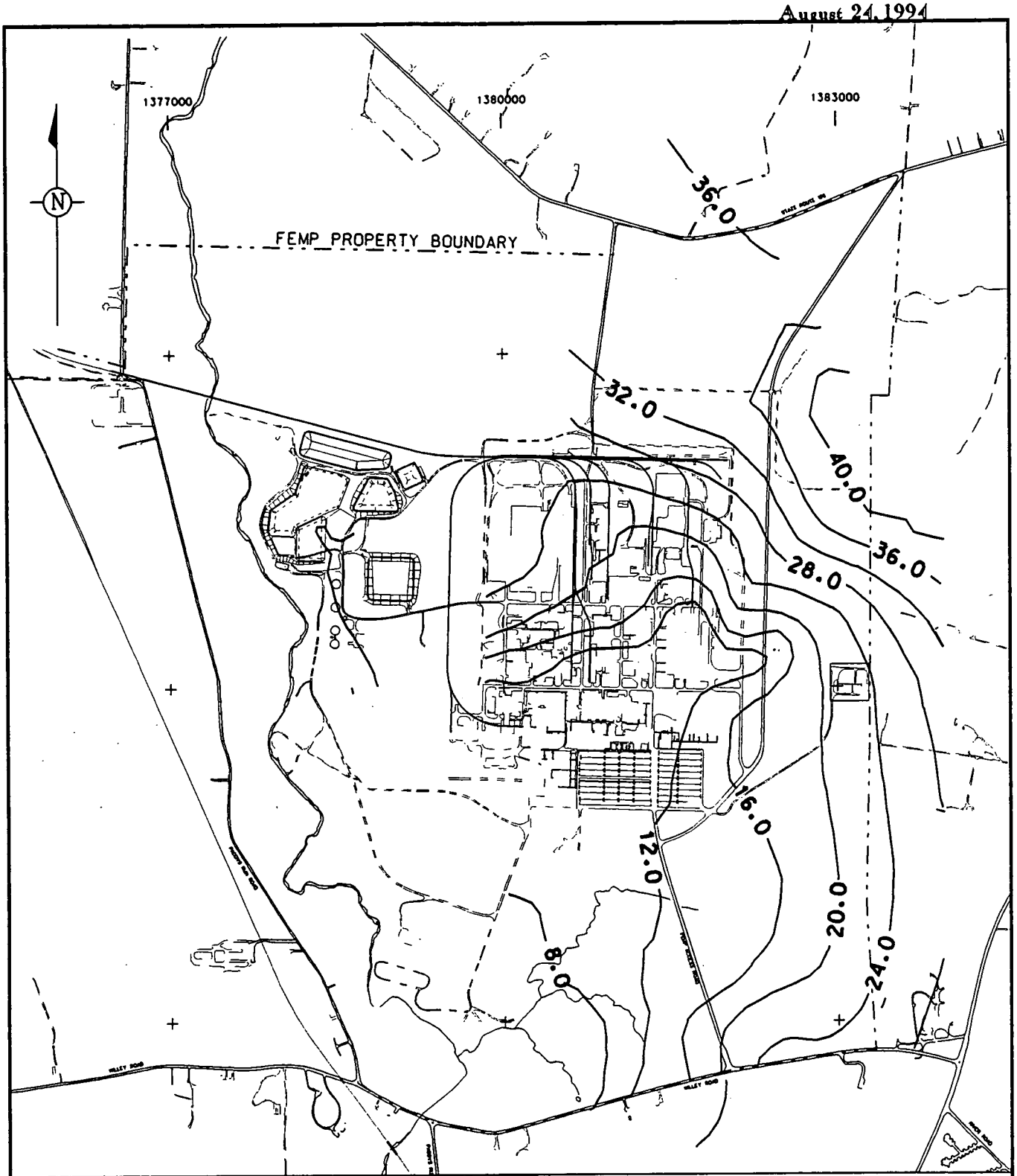

NOTE:

MAXIMUM THICKNESS
= 40.0 FT

LEGEND: 10.0 THICKNESS CONTOUR (FT)

SCALE
0 325 650 1300 FEET

0 78 156 312 METER

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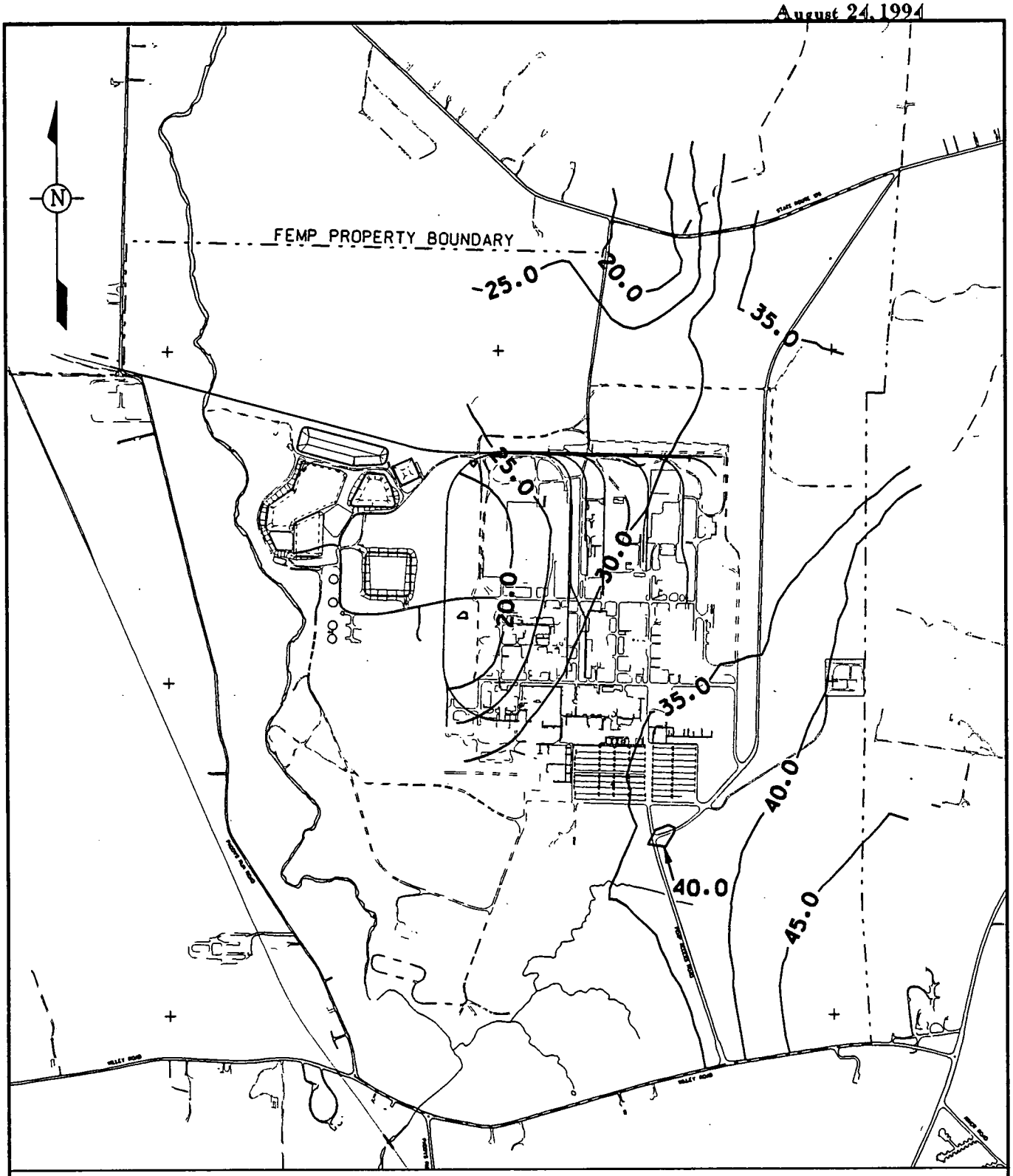
FIGURE D.1-21
GRAY TILL THICKNESS IN FEET FOR
DISPOSAL CELL AREA

001505



NOTE:

MAXIMUM THICKNESS
= 47.85 FT

LEGEND: 20.0 THICKNESS CONTOUR (FT)

SCALE
0 325 650 1300 FEET
0 78 156 312 METER

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FIGURE D.1-22
UNSATURATED GREAT MIAMI AQUIFER THICKNESS
INFEET FOR DISPOSAL CELL AREA

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The vadose zone model depicting flow in the subsurface soils at the disposal cell considers two layers. Layer 1 soils consist of gray tills with thickness ranging from 3.6 to 6.1 m (11.9 to 20 ft). Brown till and interbedded sand and gravel stringers within the glacial overburden were not considered as a barrier layer in the vadose zone pathway. Beneath the till layer is more than 10.7 m (35 ft) of unsaturated sand and gravel as Layer 2. Figures D.1-21 and D.1-22 show the thicknesses of the two layers used in the modeling. The HELP model was used to estimate infiltration through the composite cap. Outputs of the HELP model are included in Attachment D.1-I. Infiltration through the cap was estimated to be 3.1 cm/yr (1.2 in./yr). The seepage velocity in the gray till was 19.6 cm/yr (7.7 in./yr) and in the unsaturated Great Miami Aquifer was 77.5 cm/yr (30.5 in./yr).

Using a constant leachate concentration of 10 mg/L (3,360 pCi/L), the maximum concentration in the Great Miami Aquifer was predicted to be 0.93 pCi/L (2.78 μg/L). The maximum predicted fenceline concentration was 0.032 pCi/L. If uranium-238 leachate concentration is 71.38 mg/L (23,980 pCi/L), the maximum on-site concentration in the Great Miami Aquifer will be 20 μg/L of total uranium (19.85 μg/L uranium-238 or 6.67 pCi/L uranium-238) and the maximum FEMP fenceline concentration will be 0.23 pCi/L uranium-238. Thus, to be acceptable for on-site disposal, waste should not result in uranium-238 leachate concentrations exceeding 71.38 mg/L. The waste concentrations are a function of waste leachability, which can be quantified with use of the distribution coefficient for leaching (K_L). Table D.1-25 presents WAC as a function of K_L. The Operable Unit 2 waste with the lowest K_L is flyash (see Appendix D.3). For flyash, K_L is 37.5 mL/g; this results in a preliminary WAC of 2,677 mg/Kg uranium-238 or 900 pCi/g uranium-238. If K_L was 15 mL/g, the WAC would be 1,070 mg/Kg or 360 pCi/g uranium-238.

To confirm the protectiveness of the preliminary WAC, an alternate modeling approach was utilized. That modeling is presented in Attachment D.5-IV. That alternate approach ignores any contribution of the unsaturated Great Miami Aquifer to the retardation of uranium. However, it does include the contribution of a clay liner having a K_d of 24 mL/g. Also, the alternate approach uses a recalculated infiltration rate that accounts for all layers in the disposal cell cross-section except for geomembranes. This alternate approach results in an even lower loading to the Great Miami Aquifer than the original modeling simulates.

TABLE D.1-25

PRELIMINARY WASTE ACCEPTANCE CRITERIA PROTECTIVE OF THE GREAT MIAMI AQUIFER FOR ON-SITE DISPOSAL OF OPERABLE UNIT 2 MATERIALS

Desorption Distribution Coefficient (mL/g)	Preliminary WAC Concentration[a]	
	Uranium-238 (pCi/g)	Total Uranium (ppm)
15	360	1070
37.5[b]	900	2680
75[c]	1800	5360
177[d]	4250	12600
200[e]	4800	14300

[a]Preliminary WACs are based on leachate concentration of 71.38 mg/L uranium-238, which results in a GMA concentration of 20 μg/L under the disposal cell and is below 10^{-6} ILCR levels at the fenceline.

[b]Desorption distribution coefficient for Inactive Flyash and Active Flyash waste.

[c]Desorption distribution coefficient for the Solid Waste Landfill waste.

[d]Desorption distribution coefficient for the South Field waste.

[e]Desorption distribution coefficient for the Lime Sludge Ponds and berms material.

001508

D.1.7 SENSITIVITY TO THE DISTRIBUTION COEFFICIENT

Distribution coefficient (K_d) is the most important parameter in PRG and preliminary WAC development. Distribution coefficients developed from different tests/studies for the glacial overburden indicate that the K_d for this layer may vary from about 3.1 mL/g to more than 200 mL/g. All of the PRGs developed in this appendix are based on a K_d of 24 mL/g for the glacial till. If the K_d for the glacial till is set at 200 mL/g, the PRGs for all areas with more than 2.1 m (7 ft) of gray till would be more than the maximum source concentrations in the Operable Unit 2 subunits. On the other hand, if a K_d of 3.1 mL/g is selected, the PRGs would decrease significantly. Table D.1-26 shows the sensitivity of the PRGs (at 10^{-6} ILCR) to the glacial till K_d values. Table D.1-26 also shows that at the disposal cell the preliminary WAC would increase to a large number for a glacial till K_d of 24 mL/g and higher. This would be due to no breakthrough of the uranium-238 from the soil layers beneath the disposal cell.

TABLE D.1-26

SENSITIVITY OF PRGs TO THE GLACIAL TILL DISTRIBUTION COEFFICIENT OPERABLE UNIT 2

Subunit/Source Area	Receptor	Modified Soil PRGs for Uranium-238 at 10^{-6} ILCR in pCi/g		
		K_d = 3.1 mL/g	K_d = 24 mL/g	K_d = 200 mL/g
Solid Waste Landfill without a cap	Off-property resident farmer	40.5	40.5	> 100,000
	On-property resident farmer	1.25	1.25	> 100,000
Solid Waste Landfill with a cap	Off-property resident farmer	2,430	> 100,000	> 100,000
Lime Sludge Ponds without a cap	Off-property resident farmer	106	127	> 100,000
	On-property resident farmer	4.06	4.66	> 100,000
Inactive Flyash Pile/South Field - Clean perched water without any controls (Most of flow is directly through the unsaturated Great Miami Aquifer.)	Off-property resident farmer	2.5	2.5	2.5
	On-property resident farmer	0.89	0.89	0.89
Inactive Flyash Pile/South Field - Source control for lateral migration of perched water, source on the top of the terrace	Off-property resident farmer	60	70	> 100,000
Inactive Flyash Pile/South Field/Active Flyash Pile - Consolidation and capping, and controls for lateral migration of perched water	Off-property resident farmer	171	> 10,000	> 100,000

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APPENDIX D.1

ATTACHMENT D.1-I

INFILTRATION CALCULATIONS FOR ODAST/SWIFT MODELING

D.1.I INFILTRATION CALCULATIONS FOR ODAST/SWIFT MODELING

MODELING APPROACH

Infiltration rates (seepage rates) through the waste to the Great Miami Aquifer for various conceptual models were calculated using the Hydraulic Evaluation of Landfill Performance (HELP) model. The HELP model is a quasi-two-dimensional hydrologic model of water movement across, into, through, and out of a waste unit. The model accepts climatologic, soil, and design data and simulates a number of hydraulic processes, including surface storage, runoff, infiltration, percolation, evapotranspiration, soil moisture storage, and lateral drainage. The systems that can be modeled by the HELP model include various combinations of vegetation, cover soils, waste cells, drainage layers, and relatively impermeable barrier soils.

The HELP model was run in 5-year steps using the climatologic data (precipitation and mean monthly temperatures) from 1974 to 1978 for Cincinnati, Ohio. These data were obtained from the HELP model database. The HELP model was run to "steady state," that is, until successive simulations showed less than 0.005 change between initial- and final-year soil moisture content in any of the layers. A successive substitution procedure was used to reach steady-state conditions.

Physical properties of waste, glacial till, and the Great Miami Aquifer soils were the same as properties used in the Operable Unit 2 RI fate and transport modeling (Appendix A.2 of the RI Report). These values were defined based upon RI sampling activities, or literature values for similar soil types.

Figure D.1-I-1 shows a typical section for the composite cap and liner. Design data for conceptual models available up to July 12, 1994, were used for infiltration calculations. Topsoil, vegetative soil support, sand filter, cobbles, pea gravel, bentonite geocomposite, clay liner with bentonite, and compacted structural fill were simulated as HELP soil texture number 6, 5, 2, 1, 1, 18, 18, and 17, respectively. HELP default hydraulic conductivities were modified to match the design. Hydraulic conductivities for these layers were 1×10^{-3}, 5×10^{-4}, 1×10^{-3}, 10.0, 1×10^{-2}, 1×10^{-8}, 1×10^{-7}, and 2.6×10^{-5} cm/sec, respectively. Grass cover was assumed to be fair, and the evaporative zone depth was conservatively estimated to be 18 inches.

The bentonite geocomposite was assumed to be 0.6 cm (0.25 in.) thick, with properties of recompacted clay. The high density polyethylene (HDPE) geomembrane was assumed to have deteriorated, and the drainage layer in the liner was assumed to be ineffective. The bentonite geocomposite (a barrier layer) is on top of clay soil liner with a bentonite layer (another barrier layer). However, the HELP model cannot simulate two barrier layers next to each other. Therefore, a vertical percolation (sand) layer with hydraulic conductivity of 10.0 cm/sec was inserted between the two barrier layers.

For conceptual models with a cap, the HELP model simulation showed that the infiltration rate is not sensitive to the thicknesses of waste, glacial overburden, or the unsaturated Great Miami Aquifer. This may be because infiltration through these caps is very small and is within the transmissive capability of the glacial overburden under gravity drainage.

The remaining conceptual models were simulated with typical thicknesses of waste, glacial till, and unsaturated Great Miami Aquifer obtained during field activities for the RI and were modified to account for any source removal considered. It was assumed that 30.5 cm (12 in.) of soil fill material will be added on top of all areas from which wastes are removed. Sand/gravel layers within the Glacial Overburden and weathered till were ignored while calculating glacial till thickness. An attempt was made to estimate worst-case infiltration rates.

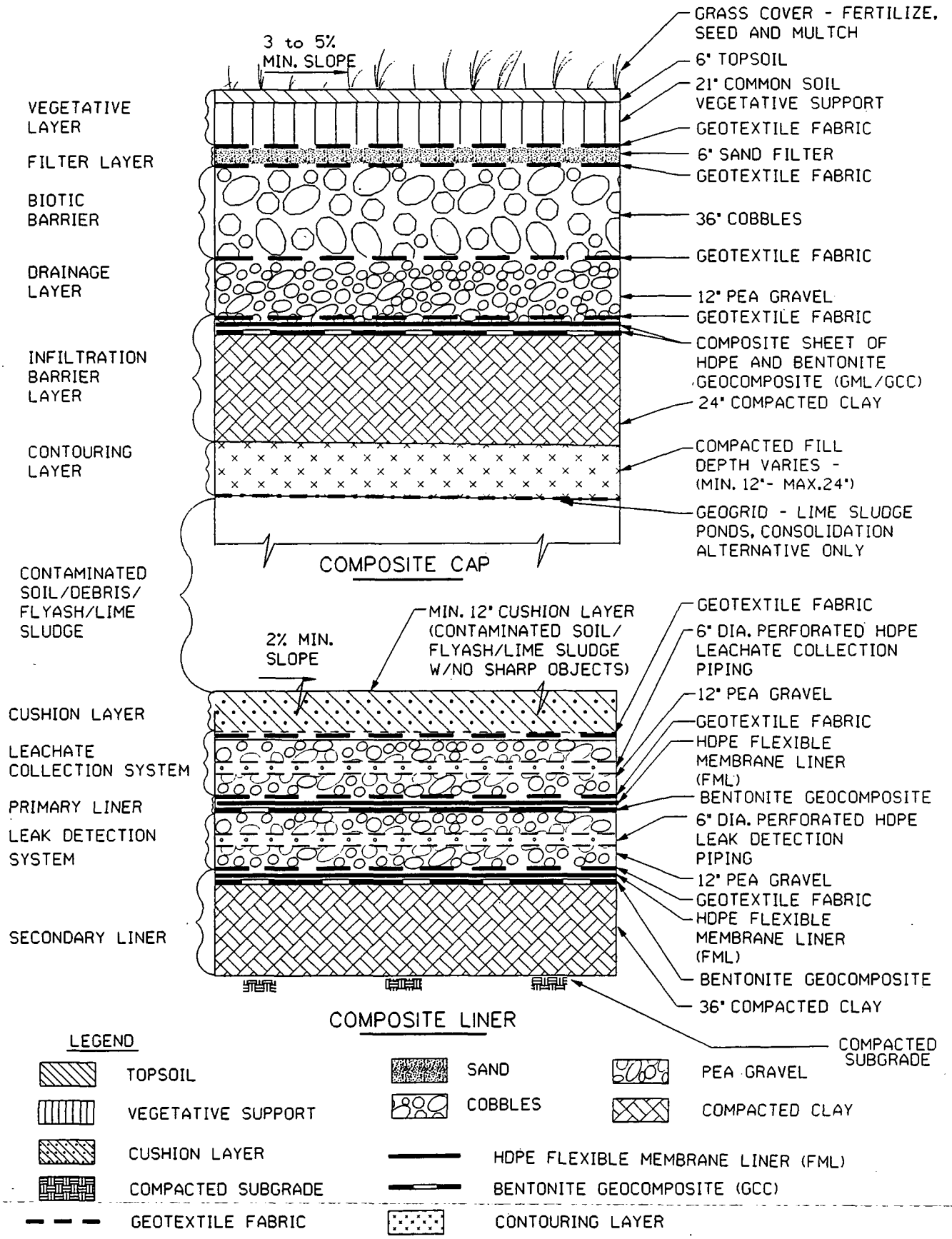

FIGURE D.1.I-1
TYPICAL DETAIL
COMPOSITE CAP AND LINER
(NOT TO SCALE)

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LOW LEVEL RADIOACTIVE WASTE DISPOSAL FACILITY FOR OPERABLE UNIT 2
GEOCOMPOSITE CAP AND LINER - NO HDPE LINER AND FAILED LEACHATE COLLECTION SY
MINIMUM WASTE THICKNESS                                  February 28, 1994

*************************************************************************
*************************************************************************

                          FAIR GRASS

                          LAYER  1
                          --------

                   VERTICAL PERCOLATION LAYER
THICKNESS                              =      6.00 INCHES
POROSITY                               =      0.4530 VOL/VOL
FIELD CAPACITY                         =      0.1901 VOL/VOL
WILTING POINT                          =      0.0848 VOL/VOL
INITIAL SOIL WATER CONTENT             =      0.3243 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY       =      0.001000000047 CM/SEC


                          LAYER  2
                          --------

                   VERTICAL PERCOLATION LAYER
THICKNESS                              =     21.00 INCHES
POROSITY                               =      0.4570 VOL/VOL
FIELD CAPACITY                         =      0.1309 VOL/VOL
WILTING POINT                          =      0.0580 VOL/VOL
INITIAL SOIL WATER CONTENT             =      0.2440 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY       =      0.000500000024 CM/SEC


                          LAYER  3
                          --------

                   VERTICAL PERCOLATION LAYER
THICKNESS                              =      6.00 INCHES
POROSITY                               =      0.4370 VOL/VOL
FIELD CAPACITY                         =      0.0624 VOL/VOL
WILTING POINT                          =      0.0245 VOL/VOL
INITIAL SOIL WATER CONTENT             =      0.1581 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY       =      0.001000000047 CM/SEC
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LAYER 4

VERTICAL PERCOLATION LAYER

THICKNESS	=	36.00 INCHES
POROSITY	=	0.4170 VOL/VOL
FIELD CAPACITY	=	0.0454 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0454 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	10.000000000000 CM/SEC

LAYER 5

LATERAL DRAINAGE LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4170 VOL/VOL
FIELD CAPACITY	=	0.0454 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4170 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.009999999776 CM/SEC
SLOPE	=	4.00 PERCENT
DRAINAGE LENGTH	=	800.0 FEET

LAYER 6

BARRIER SOIL LINER

THICKNESS	=	0.25 INCHES
POROSITY	=	0.4000 VOL/VOL
FIELD CAPACITY	=	0.3560 VOL/VOL
WILTING POINT	=	0.2899 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4000 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000010000 CM/SEC

LAYER 7

VERTICAL PERCOLATION LAYER

THICKNESS	=	2.00 INCHES
POROSITY	=	0.4170 VOL/VOL
FIELD CAPACITY	=	0.0454 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0564 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	10.000000000000 CM/SEC

001516

LAYER 8

BARRIER SOIL LINER

THICKNESS	=	24.00 INCHES
POROSITY	=	0.4300 VOL/VOL
FIELD CAPACITY	=	0.3663 VOL/VOL
WILTING POINT	=	0.2802 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000100000 CM/SEC

LAYER 9

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.3808 VOL/VOL
FIELD CAPACITY	=	0.1924 VOL/VOL
WILTING POINT	=	0.1043 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2523 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000026000000 CM/SEC

LAYER 10

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2794 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 11

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.4170 VOL/VOL
FIELD CAPACITY	=	0.0454 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0454 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.009999999776 CM/SEC

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LAYER 12

BARRIER SOIL LINER

THICKNESS	=	60.00 INCHES
POROSITY	=	0.4300 VOL/VOL
FIELD CAPACITY	=	0.3663 VOL/VOL
WILTING POINT	=	0.2802 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4300 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000100000 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	68.00
TOTAL AREA OF COVER	=	1102500. SQ FT
EVAPORATIVE ZONE DEPTH	=	12.00 INCHES
UPPER LIMIT VEG. STORAGE	=	5.4600 INCHES
INITIAL VEG. STORAGE	=	3.4098 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	58.2148 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR CINCINNATI OHIO

MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	133
END OF GROWING SEASON (JULIAN DATE)	=	300

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.90	32.10	41.80	53.50	63.00	71.40
75.40	74.10	67.50	55.30	43.40	33.80

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****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	1.59	3.86	3.11	3.36	4.79
	3.54	4.80	2.89	3.33	2.69	3.36
STD. DEVIATIONS	0.56	1.34	1.71	0.63	1.78	1.24
	2.04	1.04	2.17	1.37	1.35	1.99
RUNOFF						
TOTALS	0.000	0.004	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.001	0.000	0.005
STD. DEVIATIONS	0.000	0.009	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.002	0.000	0.011
EVAPOTRANSPIRATION						
TOTALS	0.853	1.535	2.424	2.871	2.814	4.791
	3.826	4.116	2.198	1.959	1.683	0.905
STD. DEVIATIONS	0.188	0.312	0.120	0.265	1.712	1.202
	1.451	0.997	1.704	0.567	0.120	0.179
LATERAL DRAINAGE FROM LAYER 5						
TOTALS	1.3155	1.4678	1.1784	0.9902	0.6175	0.5255
	0.5178	0.4965	0.6843	0.4741	0.4245	0.7490
STD. DEVIATIONS	0.6603	1.2556	1.1494	0.6790	0.1245	0.0628
	0.0694	0.0626	0.4737	0.1049	0.1121	0.7123
PERCOLATION FROM LAYER 6						
TOTALS	0.1141	0.1071	0.1175	0.1157	0.1173	0.1063
	0.1024	0.0937	0.0851	0.0842	0.0811	0.0921
STD. DEVIATIONS	0.0405	0.0405	0.0441	0.0333	0.0261	0.0272
	0.0269	0.0232	0.0273	0.0336	0.0341	0.0355

001519

5860

PERCOLATION FROM LAYER 8

TOTALS	0.1077	0.0983	0.1082	0.1048	0.1084	0.0978
	0.1012	0.1018	0.0970	0.0983	0.0918	0.1010
STD. DEVIATIONS	0.0025	0.0034	0.0023	0.0024	0.0026	0.0179
	0.0184	0.0169	0.0194	0.0236	0.0257	0.0161

PERCOLATION FROM LAYER 12

TOTALS	0.1050	0.0919	0.0998	0.0975	0.1018	0.0994
	0.1035	0.1042	0.1013	0.1050	0.1017	0.1051
STD. DEVIATIONS	0.0016	0.0088	0.0120	0.0100	0.0084	0.0064
	0.0050	0.0036	0.0024	0.0017	0.0013	0.0014

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	40.64	(6.929)	3733984.	100.00
RUNOFF	0.010	(0.014)	920.	0.02
EVAPOTRANSPIRATION	29.974	(2.728)	2753890.	73.75
LATERAL DRAINAGE FROM LAYER 5	9.4411	(3.7889)	867399.	23.23
PERCOLATION FROM LAYER 6	1.2163	(0.3337)	111743.	2.99
PERCOLATION FROM LAYER 8	1.2162	(0.1433)	111743.	2.99
PERCOLATION FROM LAYER 12	1.2162	(0.0607)	111741.	2.99
CHANGE IN WATER STORAGE	0.000	(3.907)	34.	0.00

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001520

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	2.40	220500.0
RUNOFF	0.025	2269.9
LATERAL DRAINAGE FROM LAYER 5	0.5774	53045.4
PERCOLATION FROM LAYER 6	0.0045	415.1
HEAD ON LAYER 6	12.2	
PERCOLATION FROM LAYER 8	0.0036	331.4
HEAD ON LAYER 8	1.4	
PERCOLATION FROM LAYER 12	0.0034	314.4
HEAD ON LAYER 12	0.4	
SNOW WATER	1.18	108843.8

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3497

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0711

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001521

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FINAL WATER STORAGE AT END OF YEAR 78 **5860**

LAYER	(INCHES)	(VOL/VOL)
1	1.95	0.3243
2	5.12	0.2440
3	0.95	0.1581
4	1.64	0.0454
5	5.00	0.4170
6	0.40	0.4000
7	0.11	0.0564
8	10.32	0.4300
9	3.03	0.2523
10	3.35	0.2794
11	0.55	0.0454
12	25.80	0.4300
SNOW WATER	0.00	

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001522

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GRAY TILL ONLY
SOLID WASTE LANDFILL

July 12, 1994

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3970 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	99.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3140 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

001523

5860

LAYER 3

BARRIER SOIL LINER

THICKNESS	=	155.00 INCHES
POROSITY	=	0.4100 VOL/VOL
FIELD CAPACITY	=	0.3710 VOL/VOL
WILTING POINT	=	0.2510 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4100 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000001900000 CM/SEC

LAYER 4

VERTICAL PERCOLATION LAYER

THICKNESS	=	384.00 INCHES
POROSITY	=	0.3900 VOL/VOL
FIELD CAPACITY	=	0.0454 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0762 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.015900000930 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	68.00
TOTAL AREA OF COVER	=	46000. SQ FT
EVAPORATIVE ZONE DEPTH	=	12.00 INCHES
UPPER LIMIT VEG. STORAGE	=	6.2400 INCHES
INITIAL VEG. STORAGE	=	4.7640 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	128.6608 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

001524

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CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR CINCINNATI OHIO

MAXIMUM LEAF AREA INDEX = 2.00
START OF GROWING SEASON (JULIAN DATE) = 133
END OF GROWING SEASON (JULIAN DATE) = 300

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.90	32.10	41.80	53.50	63.00	71.40
75.40	74.10	67.50	55.30	43.40	33.80

001525

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	1.59	3.86	3.11	3.36	4.79
	3.54	4.80	2.89	3.33	2.69	3.36
STD. DEVIATIONS	0.56	1.34	1.71	0.63	1.78	1.24
	2.04	1.04	2.17	1.37	1.35	1.99
RUNOFF						
TOTALS	0.000	0.020	0.000	0.019	0.000	0.027
	0.022	0.043	0.008	0.027	0.000	0.016
STD. DEVIATIONS	0.000	0.044	0.000	0.042	0.000	0.061
	0.048	0.096	0.014	0.046	0.000	0.036
EVAPOTRANSPIRATION						
TOTALS	0.848	1.534	2.470	2.879	3.165	4.809
	4.073	4.272	2.250	1.983	1.672	0.892
STD. DEVIATIONS	0.189	0.311	0.128	0.331	1.635	1.381
	1.402	1.207	1.767	0.526	0.138	0.170
PERCOLATION FROM LAYER 3						
TOTALS	1.6208	1.6289	1.5251	1.1168	0.5161	0.2535
	0.1939	0.0844	0.3983	0.5914	0.3213	1.3635
STD. DEVIATIONS	0.8551	0.6425	0.5794	1.0308	0.9119	0.4921
	0.4335	0.1746	0.8906	0.6639	0.4839	0.8907
PERCOLATION FROM LAYER 4						
TOTALS	0.7604	0.8614	1.1076	1.1059	1.0855	0.9203
	0.7868	0.6540	0.5747	0.5912	0.5591	0.6059
STD. DEVIATIONS	0.3140	0.3531	0.4679	0.4935	0.5676	0.5443
	0.3844	0.2586	0.2095	0.2819	0.2379	0.2442

001526

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	40.64	(6.929)	155794.	100.00
RUNOFF	0.181	(0.096)	694.	0.45
EVAPOTRANSPIRATION	30.847	(2.971)	118246.	75.90
PERCOLATION FROM LAYER 3	9.6141	(3.8484)	36854.	23.66
PERCOLATION FROM LAYER 4	9.6128	(3.9916)	36849.	23.65
CHANGE IN WATER STORAGE	0.001	(4.532)	5.	0.00

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	2.40	9200.0
RUNOFF	0.214	819.0
PERCOLATION FROM LAYER 3	0.0719	275.7
HEAD ON LAYER 3	17.5	
PERCOLATION FROM LAYER 4	0.0613	234.8
SNOW WATER	1.18	4541.3

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4811

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1391

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001527

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	4.76	0.3970
2	31.09	0.3140
3	63.55	0.4100
4	29.27	0.0762
SNOW WATER	0.00	

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GRAY TILL ONLY
LIME SLUDGE PONDS

July 12, 1994

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3970 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	102.00 INCHES
POROSITY	=	0.5500 VOL/VOL
FIELD CAPACITY	=	0.3782 VOL/VOL
WILTING POINT	=	0.2650 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3969 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.001000000047 CM/SEC

5860

LAYER 3

BARRIER SOIL LINER

THICKNESS	=	139.00 INCHES
POROSITY	=	0.4100 VOL/VOL
FIELD CAPACITY	=	0.3710 VOL/VOL
WILTING POINT	=	0.2510 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4100 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000001900000 CM/SEC

LAYER 4

VERTICAL PERCOLATION LAYER

THICKNESS	=	283.00 INCHES
POROSITY	=	0.3900 VOL/VOL
FIELD CAPACITY	=	0.0454 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0775 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.015900000930 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	68.00
TOTAL AREA OF COVER	=	46000. SQ FT
EVAPORATIVE ZONE DEPTH	=	12.00 INCHES
UPPER LIMIT VEG. STORAGE	=	6.2400 INCHES
INITIAL VEG. STORAGE	=	4.7640 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	124.1703 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND SOLAR RADIATION FOR CINCINNATI OHIO

MAXIMUM LEAF AREA INDEX = 2.00

001530

START OF GROWING SEASON (JULIAN DATE) = 133
END OF GROWING SEASON (JULIAN DATE) = 300

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.90	32.10	41.80	53.50	63.00	71.40
75.40	74.10	67.50	55.30	43.40	33.80

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	1.59	3.86	3.11	3.36	4.79
	3.54	4.80	2.89	3.33	2.69	3.36
STD. DEVIATIONS	0.56	1.34	1.71	0.63	1.78	1.24
	2.04	1.04	2.17	1.37	1.35	1.99
RUNOFF						
TOTALS	0.000	0.020	0.000	0.019	0.000	0.027
	0.022	0.043	0.008	0.027	0.000	0.016
STD. DEVIATIONS	0.000	0.044	0.000	0.042	0.000	0.061
	0.048	0.096	0.014	0.046	0.000	0.036
EVAPOTRANSPIRATION						
TOTALS	0.848	1.534	2.470	2.879	3.165	4.809
	4.073	4.272	2.250	1.983	1.672	0.892
STD. DEVIATIONS	0.189	0.311	0.128	0.331	1.635	1.381
	1.402	1.207	1.767	0.526	0.138	0.170
PERCOLATION FROM LAYER 3						
TOTALS	1.6514	1.6575	1.4936	1.1343	0.4894	0.2146
	0.1939	0.0844	0.4052	0.5871	0.3187	1.3832
STD. DEVIATIONS	0.8784	0.6590	0.6206	1.0523	0.9363	0.4053
	0.4334	0.1746	0.9060	0.6559	0.4785	0.9085

001531

PERCOLATION FROM LAYER 4

TOTALS	0.7951	0.9575	1.2453	1.1995	1.1204	0.8924
	0.7153	0.5712	0.5005	0.5331	0.5077	0.5752
STD. DEVIATIONS	0.3698	0.4286	0.5697	0.5952	0.6519	0.5845
	0.3538	0.2145	0.1782	0.2985	0.2409	0.2645

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	40.64	(6.929)	155794.	100.00
RUNOFF	0.181	(0.096)	694.	0.45
EVAPOTRANSPIRATION	30.847	(2.971)	118246.	75.90
PERCOLATION FROM LAYER 3	9.6133	(3.8256)	36851.	23.65
PERCOLATION FROM LAYER 4	9.6132	(4.2193)	36851.	23.65
CHANGE IN WATER STORAGE	0.001	(4.424)	3.	0.00

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	2.40	9200.0
RUNOFF	0.214	819.0
PERCOLATION FROM LAYER 3	0.0751	287.9
HEAD ON LAYER 3	22.5	
PERCOLATION FROM LAYER 4	0.0659	252.4
SNOW WATER	1.18	4541.3

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4811

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1391

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	4.76	0.3970
2	40.49	0.3969
3	56.99	0.4100
4	21.93	0.0775
SNOW WATER	0.00	

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001533

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REMOVE FILL TO 5 PCI/G ON TERRACE SLOPE
SOUTH FIELD AND INACTIVE FLYASH PILE
ZONE 1                                          June 8, 1994

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3970 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	32.40 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3472 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

0582

LAYER 3

VERTICAL PERCOLATION LAYER

THICKNESS	=	249.00 INCHES
POROSITY	=	0.3900 VOL/VOL
FIELD CAPACITY	=	0.0454 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0795 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.015900000930 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	68.00
TOTAL AREA OF COVER	=	46000. SQ FT
EVAPORATIVE ZONE DEPTH	=	12.00 INCHES
UPPER LIMIT VEG. STORAGE	=	6.2400 INCHES
INITIAL VEG. STORAGE	=	4.7640 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	35.8088 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND SOLAR RADIATION FOR CINCINNATI OHIO

MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	133
END OF GROWING SEASON (JULIAN DATE)	=	300

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.90	32.10	41.80	53.50	63.00	71.40
75.40	74.10	67.50	55.30	43.40	33.80

001535

5860

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	1.59	3.86	3.11	3.36	4.79
	3.54	4.80	2.89	3.33	2.69	3.36
STD. DEVIATIONS	0.56	1.34	1.71	0.63	1.78	1.24
	2.04	1.04	2.17	1.37	1.35	1.99
RUNOFF						
TOTALS	0.000	0.020	0.000	0.019	0.000	0.027
	0.022	0.043	0.008	0.027	0.000	0.016
STD. DEVIATIONS	0.000	0.044	0.000	0.042	0.000	0.061
	0.048	0.096	0.014	0.046	0.000	0.036
EVAPOTRANSPIRATION						
TOTALS	0.848	1.534	2.470	2.879	3.165	4.809
	4.073	4.272	2.250	1.983	1.672	0.893
STD. DEVIATIONS	0.189	0.311	0.129	0.331	1.635	1.381
	1.402	1.207	1.767	0.526	0.138	0.170
PERCOLATION FROM LAYER 3						
TOTALS	0.8069	1.0173	1.2504	1.2871	1.0878	0.8236
	0.6931	0.5819	0.5128	0.5267	0.4737	0.5507
STD. DEVIATIONS	0.3686	0.4689	0.6940	0.9485	0.6910	0.4383
	0.3016	0.2016	0.1713	0.2508	0.2071	0.2316

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001536

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	40.64	(6.929)	155794.	100.00
RUNOFF	0.181	(0.096)	694.	0.45
EVAPOTRANSPIRATION	30.847	(2.970)	118246.	75.90
PERCOLATION FROM LAYER 3	9.6120	(4.3781)	36846.	23.65
CHANGE IN WATER STORAGE	0.002	(4.529)	9.	0.01

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	2.40	9200.0
RUNOFF	0.214	819.0
PERCOLATION FROM LAYER 3	0.1002	384.0
SNOW WATER	1.18	4541.3

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4810

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1391

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	4.76	0.3970
2	11.25	0.3472
3	19.81	0.0795
SNOW WATER	0.00	

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REMOVE FILL TO 5 PCI/G ON TERRACE SLOPE
SOUTH FIELD AND INACTIVE FLYASH PILE
ZONE 2                                          June 8, 1994

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3970 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	202.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3348 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 3

VERTICAL PERCOLATION LAYER

THICKNESS	=	228.00 INCHES
POROSITY	=	0.3900 VOL/VOL
FIELD CAPACITY	=	0.0454 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0733 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.015900000930 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	68.00
TOTAL AREA OF COVER	=	46000. SQ FT
EVAPORATIVE ZONE DEPTH	=	12.00 INCHES
UPPER LIMIT VEG. STORAGE	=	6.2400 INCHES
INITIAL VEG. STORAGE	=	4.7640 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	89.1060 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR CINCINNATI OHIO

MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	133
END OF GROWING SEASON (JULIAN DATE)	=	300

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.90	32.10	41.80	53.50	63.00	71.40
75.40	74.10	67.50	55.30	43.40	33.80

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	1.59	3.86	3.11	3.36	4.79
	3.54	4.80	2.89	3.33	2.69	3.36
STD. DEVIATIONS	0.56	1.34	1.71	0.63	1.78	1.24
	2.04	1.04	2.17	1.37	1.35	1.99
RUNOFF						
TOTALS	0.000	0.020	0.000	0.019	0.000	0.027
	0.022	0.043	0.008	0.027	0.000	0.016
STD. DEVIATIONS	0.000	0.044	0.000	0.042	0.000	0.061
	0.048	0.096	0.014	0.046	0.000	0.036
EVAPOTRANSPIRATION						
TOTALS	0.848	1.534	2.470	2.879	3.165	4.809
	4.073	4.272	2.250	1.984	1.672	0.892
STD. DEVIATIONS	0.189	0.311	0.128	0.332	1.635	1.381
	1.402	1.207	1.767	0.527	0.138	0.170
PERCOLATION FROM LAYER 3						
TOTALS	0.6935	0.7015	0.8605	0.9339	1.0061	0.9334
	0.8931	0.8170	0.7321	0.7192	0.6619	0.6623
STD. DEVIATIONS	0.2001	0.2161	0.3007	0.4161	0.4980	0.4525
	0.4011	0.3302	0.2673	0.2518	0.2221	0.2052

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	40.64	(6.929)	155794.	100.00
RUNOFF	0.181	(0.096)	694.	0.45
EVAPOTRANSPIRATION	30.847	(2.971)	118248.	75.90
PERCOLATION FROM LAYER 3	9.6146	(3.6066)	36856.	23.66
CHANGE IN WATER STORAGE	-0.001	(4.935)	-3.	0.00

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	2.40	9200.0
RUNOFF	0.214	819.0
PERCOLATION FROM LAYER 3	0.0570	218.4
SNOW WATER	1.18	4541.3

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4811

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1391

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001542

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	4.76	0.3970
2	67.64	0.3348
3	16.70	0.0733
SNOW WATER	0.00	

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REMOVE FILL TO 5 PCI/G ON TERRACE SLOPE
SOUTH FIELD AND INACTIVE FLYASH PILE
ZONE 3                                        June 8, 1994

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                          FAIR GRASS

                          LAYER  1
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                   VERTICAL PERCOLATION LAYER
THICKNESS                          =     12.00 INCHES
POROSITY                           =      0.5200 VOL/VOL
FIELD CAPACITY                     =      0.2942 VOL/VOL
WILTING POINT                      =      0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT         =      0.5200 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY   =      0.000199999995 CM/SEC


                          LAYER  2
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                     BARRIER SOIL LINER
THICKNESS                          =     19.00 INCHES
POROSITY                           =      0.4100 VOL/VOL
FIELD CAPACITY                     =      0.3710 VOL/VOL
WILTING POINT                      =      0.2510 VOL/VOL
INITIAL SOIL WATER CONTENT         =      0.4100 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY   =      0.000000140000 CM/SEC
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001544

LAYER 3

VERTICAL PERCOLATION LAYER

THICKNESS	=	317.00 INCHES
POROSITY	=	0.3900 VOL/VOL
FIELD CAPACITY	=	0.0454 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0595 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.015900000930 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	68.00
TOTAL AREA OF COVER	=	46000. SQ FT
EVAPORATIVE ZONE DEPTH	=	12.00 INCHES
UPPER LIMIT VEG. STORAGE	=	6.2400 INCHES
INITIAL VEG. STORAGE	=	6.2400 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	32.8915 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR CINCINNATI OHIO

MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	133
END OF GROWING SEASON (JULIAN DATE)	=	300

NORMAL MEAN MONTHLY TEMPERATURES. DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.90	32.10	41.80	53.50	63.00	71.40
75.40	74.10	67.50	55.30	43.40	33.80

001545

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	1.59	3.86	3.11	3.36	4.79
	3.54	4.80	2.89	3.33	2.69	3.36
STD. DEVIATIONS	0.56	1.34	1.71	0.63	1.78	1.24
	2.04	1.04	2.17	1.37	1.35	1.99
RUNOFF						
TOTALS	1.804	0.747	1.072	0.427	0.000	0.201
	0.020	0.043	0.239	0.026	0.000	1.651
STD. DEVIATIONS	1.121	1.656	1.655	0.513	0.000	0.421
	0.045	0.097	0.517	0.046	0.000	1.630
EVAPOTRANSPIRATION						
TOTALS	0.848	1.533	2.471	2.865	3.121	5.061
	5.631	4.307	2.301	1.986	1.659	0.901
STD. DEVIATIONS	0.186	0.308	0.124	0.279	1.675	1.216
	1.340	1.247	1.772	0.496	0.157	0.169
PERCOLATION FROM LAYER 2						
TOTALS	0.1990	0.1969	0.2109	0.1995	0.1966	0.1843
	0.1071	0.0186	0.0402	0.0716	0.1238	0.1786
STD. DEVIATIONS	0.0879	0.0274	0.0242	0.0098	0.0076	0.0148
	0.0297	0.0324	0.0898	0.0785	0.0898	0.1004
PERCOLATION FROM LAYER 3						
TOTALS	0.1407	0.1316	0.1483	0.1470	0.1547	0.1518
	0.1574	0.1502	0.1389	0.1383	0.1322	0.1377
STD. DEVIATIONS	0.0198	0.0200	0.0213	0.0203	0.0203	0.0189
	0.0183	0.0163	0.0143	0.0154	0.0164	0.0183

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001546

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	40.64	(6.929)	155794.	100.00
RUNOFF	6.231	(3.526)	23887.	15.33
EVAPOTRANSPIRATION	32.684	(3.084)	125288.	80.42
PERCOLATION FROM LAYER 2	1.7270	(0.3920)	6620.	4.25
PERCOLATION FROM LAYER 3	1.7288	(0.2070)	6627.	4.25
CHANGE IN WATER STORAGE	-0.002	(2.820)	-7.	0.00

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	2.40	9200.0
RUNOFF	2.237	8575.0
PERCOLATION FROM LAYER 2	0.0078	30.0
HEAD ON LAYER 2	12.5	
PERCOLATION FROM LAYER 3	0.0058	22.4
SNOW WATER	1.18	4541.3

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.5200

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1391

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	6.24	0.5200
2	7.79	0.4100
3	18.85	0.0595
SNOW WATER	0.00	

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 REMOVE FILL TO 5 PCI/G ON TERRACE SLOPE
 SOUTH FIELD AND INACTIVE FLYASH PILE
 ZONE 3 - Lateral Drainage                    June 8, 1994

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3970 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	24.00 INCHES
POROSITY	=	0.4100 VOL/VOL
FIELD CAPACITY	=	0.3710 VOL/VOL
WILTING POINT	=	0.2510 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3463 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000036000001 CM/SEC

LAYER 3

LATERAL DRAINAGE LAYER

THICKNESS	=	11.00 INCHES
POROSITY	=	0.3900 VOL/VOL
FIELD CAPACITY	=	0.0454 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2535 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.004000000190 CM/SEC
SLOPE	=	10.00 PERCENT
DRAINAGE LENGTH	=	125.0 FEET

LAYER 4

BARRIER SOIL LINER

THICKNESS	=	102.00 INCHES
POROSITY	=	0.4100 VOL/VOL
FIELD CAPACITY	=	0.3710 VOL/VOL
WILTING POINT	=	0.2510 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4100 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000140000 CM/SEC

LAYER 5

VERTICAL PERCOLATION LAYER

THICKNESS	=	361.00 INCHES
POROSITY	=	0.3900 VOL/VOL
FIELD CAPACITY	=	0.0454 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0588 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.015900000930 CM/SEC

001550

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	68.00
TOTAL AREA OF COVER	=	46000. SQ FT
EVAPORATIVE ZONE DEPTH	=	12.00 INCHES
UPPER LIMIT VEG. STORAGE	=	6.2400 INCHES
INITIAL VEG. STORAGE	=	4.7640 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	78.9105 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND SOLAR RADIATION FOR CINCINNATI OHIO

MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	133
END OF GROWING SEASON (JULIAN DATE)	=	300

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.90	32.10	41.80	53.50	63.00	71.40
75.40	74.10	67.50	55.30	43.40	33.80

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	1.59	3.86	3.11	3.36	4.79
	3.54	4.80	2.89	3.33	2.69	3.36
STD. DEVIATIONS	0.56	1.34	1.71	0.63	1.78	1.24
	2.04	1.04	2.17	1.37	1.35	1.99

RUNOFF

TOTALS	0.000	0.020	0.000	0.019	0.000	0.027
	0.022	0.043	0.008	0.027	0.000	0.016
STD. DEVIATIONS	0.000	0.044	0.000	0.042	0.000	0.061
	0.048	0.096	0.014	0.046	0.000	0.036

EVAPOTRANSPIRATION

TOTALS	0.848	1.534	2.470	2.879	3.165	4.809
	4.073	4.272	2.250	1.983	1.672	0.893
STD. DEVIATIONS	0.189	0.311	0.129	0.331	1.635	1.381
	1.402	1.207	1.767	0.526	0.138	0.170

LATERAL DRAINAGE FROM LAYER 3

TOTALS	1.5655	1.4884	1.1401	1.1149	0.7642	0.2630
	0.1454	0.0605	0.2601	0.2950	0.2205	0.7765
STD. DEVIATIONS	1.0236	0.8340	0.8940	1.0176	0.8788	0.3571
	0.1792	0.1084	0.5448	0.5054	0.3177	0.7719

PERCOLATION FROM LAYER 4

TOTALS	0.1311	0.1359	0.1517	0.1472	0.1497	0.1245
	0.1183	0.1113	0.1104	0.1030	0.1089	0.1284
STD. DEVIATIONS	0.0499	0.0101	0.0044	0.0057	0.0036	0.0271
	0.0411	0.0362	0.0399	0.0398	0.0491	0.0477

PERCOLATION FROM LAYER 5

TOTALS	0.1272	0.1163	0.1288	0.1256	0.1308	0.1270
	0.1308	0.1300	0.1251	0.1282	0.1232	0.1270
STD. DEVIATIONS	0.0087	0.0098	0.0092	0.0087	0.0087	0.0081
	0.0079	0.0077	0.0065	0.0060	0.0064	0.0077

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001552

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	40.64	(6.929)	155794.	100.00
RUNOFF	0.181	(0.096)	694.	0.45
EVAPOTRANSPIRATION	30.847	(2.970)	118245.	75.90
LATERAL DRAINAGE FROM LAYER 3	8.0941	(3.5454)	31027.	19.92
PERCOLATION FROM LAYER 4	1.5204	(0.2203)	5828.	3.74
PERCOLATION FROM LAYER 5	1.5200	(0.0848)	5827.	3.74
CHANGE IN WATER STORAGE	0.000	(3.739)	1.	0.00

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	2.40	9200.0
RUNOFF	0.214	819.0
LATERAL DRAINAGE FROM LAYER 3	0.1007	386.0
PERCOLATION FROM LAYER 4	0.0054	20.7
HEAD ON LAYER 4	14.3	
PERCOLATION FROM LAYER 5	0.0045	17.3
SNOW WATER	1.18	4541.3

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4810

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1391

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001553

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	4.76	0.3970
2	8.31	0.3463
3	2.79	0.2535
4	41.82	0.4100
5	21.23	0.0588
SNOW WATER	0.00	

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REMOVE FILL TO 5 PCI/G ON TERRACE SLOPE
SOUTH FIELD AND INACTIVE FLYASH PILE
ZONE 4                                          June 8, 1994

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.5200 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	92.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.5200 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 3

BARRIER SOIL LINER

THICKNESS	=	73.00 INCHES
POROSITY	=	0.4100 VOL/VOL
FIELD CAPACITY	=	0.3710 VOL/VOL
WILTING POINT	=	0.2510 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4100 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000140000 CM/SEC

LAYER 4

VERTICAL PERCOLATION LAYER

THICKNESS	=	358.00 INCHES
POROSITY	=	0.3900 VOL/VOL
FIELD CAPACITY	=	0.0454 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0670 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.015900000930 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	68.00
TOTAL AREA OF COVER	=	46000. SQ FT
EVAPORATIVE ZONE DEPTH	=	12.00 INCHES
UPPER LIMIT VEG. STORAGE	=	6.2400 INCHES
INITIAL VEG. STORAGE	=	6.2400 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	107.9960 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR CINCINNATI OHIO

001556

MAXIMUM LEAF AREA INDEX = 2.00
START OF GROWING SEASON (JULIAN DATE) = 133
END OF GROWING SEASON (JULIAN DATE) = 300

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.90	32.10	41.80	53.50	63.00	71.40
75.40	74.10	67.50	55.30	43.40	33.80

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	1.59	3.86	3.11	3.36	4.79
	3.54	4.80	2.89	3.33	2.69	3.36
STD. DEVIATIONS	0.56	1.34	1.71	0.63	1.78	1.24
	2.04	1.04	2.17	1.37	1.35	1.99
RUNOFF						
TOTALS	1.664	0.724	1.008	0.339	0.000	0.027
	0.021	0.043	0.136	0.027	0.000	0.810
STD. DEVIATIONS	1.042	1.620	1.588	0.487	0.000	0.061
	0.047	0.097	0.286	0.046	0.000	1.453
EVAPOTRANSPIRATION						
TOTALS	0.849	1.535	2.473	2.866	3.169	5.001
	4.867	4.268	2.252	2.000	1.671	0.901
STD. DEVIATIONS	0.186	0.307	0.123	0.279	1.636	1.320
	1.184	1.201	1.766	0.497	0.153	0.173
PERCOLATION FROM LAYER 3						
TOTALS	0.3483	0.3159	0.3449	0.3330	0.3418	0.3283
	0.3342	0.3307	0.3213	0.3305	0.3207	0.3414
STD. DEVIATIONS	0.0178	0.0171	0.0155	0.0083	0.0067	0.0078
	0.0020	0.0007	0.0082	0.0081	0.0107	0.0161
PERCOLATION FROM LAYER 4						
TOTALS	0.3376	0.3081	0.3394	0.3289	0.3402	0.3292
	0.3399	0.3391	0.3274	0.3376	0.3261	0.3369
STD. DEVIATIONS	0.0051	0.0081	0.0064	0.0066	0.0068	0.0066
	0.0066	0.0060	0.0054	0.0053	0.0050	0.0051

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001558

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	40.64	(6.929)	155794.	100.00
RUNOFF	4.800	(3.566)	18398.	11.81
EVAPOTRANSPIRATION	31.851	(3.432)	122097.	78.37
PERCOLATION FROM LAYER 3	3.9910	(0.0871)	15299.	9.82
PERCOLATION FROM LAYER 4	3.9904	(0.0687)	15297.	9.82
CHANGE IN WATER STORAGE	0.001	(3.872)	2.	0.00

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	2.40	9200.0
RUNOFF	2.194	8411.9
PERCOLATION FROM LAYER 3	0.0116	44.3
HEAD ON LAYER 3	104.6	
PERCOLATION FROM LAYER 4	0.0112	43.0
SNOW WATER	1.18	4541.3

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.5200

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1391

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	6.24	0.5200
2	47.84	0.5200
3	29.93	0.4100
4	23.99	0.0670
SNOW WATER	0.00	

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 REMOVE FILL TO 5 PCI/G ON TERRACE SLOPE
 SOUTH FIELD AND INACTIVE FLYASH PILE
 ZONE 4 - Lateral Drainage                    June 8, 1994

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3970 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	33.60 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4969 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 3

LATERAL DRAINAGE LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.5200 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC
SLOPE	=	10.00 PERCENT
DRAINAGE LENGTH	=	125.0 FEET

LAYER 4

BARRIER SOIL LINER

THICKNESS	=	73.00 INCHES
POROSITY	=	0.4100 VOL/VOL
FIELD CAPACITY	=	0.3710 VOL/VOL
WILTING POINT	=	0.2510 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4100 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000140000 CM/SEC

LAYER 5

VERTICAL PERCOLATION LAYER

THICKNESS	=	358.00 INCHES
POROSITY	=	0.3900 VOL/VOL
FIELD CAPACITY	=	0.0454 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0628 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.015900000930 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	68.00
TOTAL AREA OF COVER	=	46000. SQ FT
EVAPORATIVE ZONE DEPTH	=	12.00 INCHES
UPPER LIMIT VEG. STORAGE	=	6.2400 INCHES
INITIAL VEG. STORAGE	=	4.7640 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	80.1122 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR CINCINNATI OHIO

MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	133
END OF GROWING SEASON (JULIAN DATE)	=	300

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.90	32.10	41.80	53.50	63.00	71.40
75.40	74.10	67.50	55.30	43.40	33.80

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	1.59	3.86	3.11	3.36	4.79
	3.54	4.80	2.89	3.33	2.69	3.36
STD. DEVIATIONS	0.56	1.34	1.71	0.63	1.78	1.24
	2.04	1.04	2.17	1.37	1.35	1.99
RUNOFF						
TOTALS	0.000	0.361	0.567	0.074	0.000	0.027
	0.022	0.043	0.008	0.027	0.000	0.016
STD. DEVIATIONS	0.000	0.808	1.268	0.119	0.000	0.061
	0.048	0.096	0.014	0.046	0.000	0.036
EVAPOTRANSPIRATION						
TOTALS	0.850	1.538	2.477	2.855	3.167	4.813
	4.138	4.272	2.250	2.018	1.687	0.901
STD. DEVIATIONS	0.187	0.307	0.121	0.281	1.634	1.383
	1.353	1.207	1.767	0.510	0.160	0.180
LATERAL DRAINAGE FROM LAYER 3						
TOTALS	0.5551	0.5675	0.6161	0.5775	0.5557	0.5014
	0.4824	0.4356	0.4147	0.4097	0.3785	0.4533
STD. DEVIATIONS	0.1867	0.2036	0.2313	0.1856	0.1797	0.1767
	0.1518	0.1312	0.1613	0.1669	0.1434	0.1471
PERCOLATION FROM LAYER 4						
TOTALS	0.2249	0.2138	0.2332	0.2241	0.2265	0.2140
	0.2164	0.2108	0.2031	0.2071	0.1982	0.2127
STD. DEVIATIONS	0.0235	0.0275	0.0298	0.0240	0.0232	0.0221
	0.0184	0.0165	0.0207	0.0210	0.0187	0.0184

PERCOLATION FROM LAYER 5

TOTALS	0.2178	0.1990	0.2197	0.2135	0.2212	0.2143
	0.2212	0.2207	0.2128	0.2191	0.2112	0.2175
STD. DEVIATIONS	0.0114	0.0125	0.0113	0.0112	0.0118	0.0117
	0.0123	0.0124	0.0120	0.0125	0.0121	0.0122

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	40.64	(6.929)	155794.	100.00
RUNOFF	1.144	(2.032)	4387.	2.82
EVAPOTRANSPIRATION	30.965	(3.096)	118700.	76.19
LATERAL DRAINAGE FROM LAYER 3	5.9475	(1.8922)	22799.	14.63
PERCOLATION FROM LAYER 4	2.5848	(0.2420)	9908.	6.36
PERCOLATION FROM LAYER 5	2.5881	(0.1346)	9921.	6.37
CHANGE IN WATER STORAGE	-0.003	(4.369)	-11.	-0.01

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78 .

	(INCHES)	(CU. FT.)
PRECIPITATION	2.40	9200.0
RUNOFF	1.806	6923.3
LATERAL DRAINAGE FROM LAYER 3	0.0279	107.1
PERCOLATION FROM LAYER 4	0.0085	32.7
HEAD ON LAYER 4	58.0	
PERCOLATION FROM LAYER 5	0.0076	29.1
SNOW WATER	1.18	4541.3
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.5200	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1391	

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	4.76	0.3970
2	16.70	0.4969
3	6.24	0.5200
4	29.93	0.4100
5	22.47	0.0628
SNOW WATER	0.00	

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 REMOVE FILL TO 5 PCI/G ON TERRACE SLOPE
 SOUTH FIELD AND INACTIVE FLYASH PILE
 ZONE 5 - Lateral Drainage                    June 8, 1994

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3970 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	62.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4129 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 3

LATERAL DRAINAGE LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.5200 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC
SLOPE	=	10.00 PERCENT
DRAINAGE LENGTH	=	125.0 FEET

LAYER 4

BARRIER SOIL LINER

THICKNESS	=	153.00 INCHES
POROSITY	=	0.4100 VOL/VOL
FIELD CAPACITY	=	0.3710 VOL/VOL
WILTING POINT	=	0.2510 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4100 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000140000 CM/SEC

LAYER 5

VERTICAL PERCOLATION LAYER

THICKNESS	=	381.00 INCHES
POROSITY	=	0.3900 VOL/VOL
FIELD CAPACITY	=	0.0454 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0616 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.015900000930 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	68.00
TOTAL AREA OF COVER	=	46000. SQ FT
EVAPORATIVE ZONE DEPTH	=	12.00 INCHES
UPPER LIMIT VEG. STORAGE	=	6.2400 INCHES
INITIAL VEG. STORAGE	=	4.7640 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	122.8034 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR CINCINNATI OHIO

MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	133
END OF GROWING SEASON (JULIAN DATE)	=	300

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.90	32.10	41.80	53.50	63.00	71.40
75.40	74.10	67.50	55.30	43.40	33.80

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	1.59	3.86	3.11	3.36	4.79
	3.54	4.80	2.89	3.33	2.69	3.36
STD. DEVIATIONS	0.56	1.34	1.71	0.63	1.78	1.24
	2.04	1.04	2.17	1.37	1.35	1.99
RUNOFF						
TOTALS	0.000	0.020	0.000	0.019	0.000	0.027
	0.022	0.043	0.008	0.027	0.000	0.016
STD. DEVIATIONS	0.000	0.044	0.000	0.042	0.000	0.061
	0.048	0.096	0.014	0.046	0.000	0.036
EVAPOTRANSPIRATION						
TOTALS	0.848	1.534	2.470	2.879	3.165	4.809
	4.073	4.272	2.250	1.983	1.672	0.892
STD. DEVIATIONS	0.189	0.311	0.128	0.331	1.635	1.381
	1.402	1.207	1.767	0.526	0.138	0.170
LATERAL DRAINAGE FROM LAYER 3						
TOTALS	0.6474	0.6642	0.7522	0.7653	0.7356	0.6404
	0.6080	0.5484	0.5174	0.5112	0.4693	0.5420
STD. DEVIATIONS	0.2162	0.2375	0.3092	0.3478	0.3369	0.2899
	0.2508	0.2169	0.2122	0.2103	0.1820	0.1574
PERCOLATION FROM LAYER 4						
TOTALS	0.1888	0.1757	0.1939	0.1894	0.1930	0.1833
	0.1869	0.1839	0.1771	0.1817	0.1745	0.1837
STD. DEVIATIONS	0.0115	0.0138	0.0157	0.0165	0.0161	0.0145
	0.0128	0.0116	0.0117	0.0118	0.0106	0.0089

PERCOLATION FROM LAYER 5

TOTALS	0.1866	0.1700	0.1872	0.1816	0.1881	0.1822
	0.1883	0.1881	0.1817	0.1875	0.1811	0.1868
STD. DEVIATIONS	0.0062	0.0078	0.0058	0.0056	0.0058	0.0058
	0.0061	0.0063	0.0062	0.0064	0.0062	0.0062

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	40.64	(6.929)	155794.	100.00
RUNOFF	0.181	(0.096)	694.	0.45
EVAPOTRANSPIRATION	30.847	(2.971)	118246.	75.90
LATERAL DRAINAGE FROM LAYER 3	7.4015	(2.7185)	28372.	18.21
PERCOLATION FROM LAYER 4	2.2120	(0.1419)	8479.	5.44
PERCOLATION FROM LAYER 5	2.2092	(0.0686)	8469.	5.44
CHANGE IN WATER STORAGE	0.003	(4.792)	13.	0.01

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	2.40	9200.0
RUNOFF	0.214	819.0
LATERAL DRAINAGE FROM LAYER 3	0.0441	169.0
PERCOLATION FROM LAYER 4	0.0072	27.5
HEAD ON LAYER 4	77.4	
PERCOLATION FROM LAYER 5	0.0063	24.2
SNOW WATER	1.18	4541.3

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4811

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1391

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001573

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	4.76	0.3970
2	25.60	0.4129
3	6.24	0.5200
4	62.73	0.4100
5	23.48	0.0616
SNOW WATER	0.00	

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REMOVE FILL TO 60 PCI/G ON TERRACE SLOPE
SOUTH FIELD AND INACTIVE FLYASH PILE
ZONE 3                                          June 8, 1994

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.5200 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 2

BARRIER SOIL LINER

THICKNESS	=	40.80 INCHES
POROSITY	=	0.4100 VOL/VOL
FIELD CAPACITY	=	0.3710 VOL/VOL
WILTING POINT	=	0.2510 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4100 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000140000 CM/SEC

LAYER 3

VERTICAL PERCOLATION LAYER

THICKNESS	=	317.00 INCHES
POROSITY	=	0.3900 VOL/VOL
FIELD CAPACITY	=	0.0454 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0583 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.015900000930 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	68.00
TOTAL AREA OF COVER	=	46000. SQ FT
EVAPORATIVE ZONE DEPTH	=	12.00 INCHES
UPPER LIMIT VEG. STORAGE	=	6.2400 INCHES
INITIAL VEG. STORAGE	=	6.2400 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	41.4491 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR CINCINNATI OHIO

MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	133
END OF GROWING SEASON (JULIAN DATE)	=	300

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.90	32.10	41.80	53.50	63.00	71.40
75.40	74.10	67.50	55.30	43.40	33.80

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	1.59	3.86	3.11	3.36	4.79
	3.54	4.80	2.89	3.33	2.69	3.36
STD. DEVIATIONS	0.56	1.34	1.71	0.63	1.78	1.24
	2.04	1.04	2.17	1.37	1.35	1.99
RUNOFF						
TOTALS	1.835	0.761	1.096	0.451	0.000	0.218
	0.020	0.043	0.241	0.026	0.007	1.704
STD. DEVIATIONS	1.133	1.669	1.681	0.523	0.000	0.438
	0.045	0.097	0.523	0.046	0.016	1.647
EVAPOTRANSPIRATION						
TOTALS	0.848	1.533	2.471	2.865	3.121	5.021
	5.749	4.307	2.302	1.985	1.658	0.900
STD. DEVIATIONS	0.186	0.308	0.124	0.279	1.675	1.245
	1.414	1.246	1.771	0.496	0.157	0.169
PERCOLATION FROM LAYER 2						
TOTALS	0.1602	0.1637	0.1776	0.1696	0.1711	0.1630
	0.1017	0.0177	0.0340	0.0639	0.1103	0.1462
STD. DEVIATIONS	0.0662	0.0133	0.0112	0.0043	0.0034	0.0065
	0.0252	0.0312	0.0759	0.0698	0.0764	0.0812
PERCOLATION FROM LAYER 3						
TOTALS	0.1206	0.1121	0.1258	0.1242	0.1306	0.1283
	0.1336	0.1285	0.1195	0.1195	0.1145	0.1191
STD. DEVIATIONS	0.0143	0.0143	0.0147	0.0139	0.0139	0.0130
	0.0126	0.0112	0.0097	0.0106	0.0117	0.0133

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	40.64	(6.929)	155794.	100.00
RUNOFF	6.403	(3.594)	24545.	15.75
EVAPOTRANSPIRATION	32.760	(3.107)	125580.	80.61
PERCOLATION FROM LAYER 2	1.4789	(0.3159)	5669.	3.64
PERCOLATION FROM LAYER 3	1.4762	(0.1435)	5659.	3.63
CHANGE IN WATER STORAGE	0.003	(2.779)	10.	0.01

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	2.40	9200.0
RUNOFF	2.252	8631.3
PERCOLATION FROM LAYER 2	0.0062	23.7
HEAD ON LAYER 2	12.4	
PERCOLATION FROM LAYER 3	0.0048	18.5
SNOW WATER	1.18	4541.3

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.5200

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1391

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	6.24	0.5200
2	16.73	0.4100
3	18.49	0.0583
SNOW WATER	0.00	

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 REMOVE FILL TO 60 PCI/G ON TERRACE SLOPE
 SOUTH FIELD AND INACTIVE FLYASH PILE
 ZONE 4 - Lateral Drainage                    June 8, 1994

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3970 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	80.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3810 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 3

LATERAL DRAINAGE LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.5200 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC
SLOPE	=	10.00 PERCENT
DRAINAGE LENGTH	=	125.0 FEET

LAYER 4

BARRIER SOIL LINER

THICKNESS	=	73.00 INCHES
POROSITY	=	0.4100 VOL/VOL
FIELD CAPACITY	=	0.3710 VOL/VOL
WILTING POINT	=	0.2510 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4100 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000140000 CM/SEC

LAYER 5

VERTICAL PERCOLATION LAYER

THICKNESS	=	358.00 INCHES
POROSITY	=	0.3900 VOL/VOL
FIELD CAPACITY	=	0.0454 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0629 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.015900000930 CM/SEC

001581

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	68.00
TOTAL AREA OF COVER	=	46000. SQ FT
EVAPORATIVE ZONE DEPTH	=	12.00 INCHES
UPPER LIMIT VEG. STORAGE	=	6.2400 INCHES
INITIAL VEG. STORAGE	=	4.7640 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	93.9322 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND SOLAR RADIATION FOR CINCINNATI OHIO

MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	133
END OF GROWING SEASON (JULIAN DATE)	=	300

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.90	32.10	41.80	53.50	63.00	71.40
75.40	74.10	67.50	55.30	43.40	33.80

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	1.59	3.86	3.11	3.36	4.79
	3.54	4.80	2.89	3.33	2.69	3.36
STD. DEVIATIONS	0.56	1.34	1.71	0.63	1.78	1.24
	2.04	1.04	2.17	1.37	1.35	1.99
RUNOFF						
TOTALS	0.000	0.020	0.000	0.019	0.000	0.027
	0.022	0.043	0.008	0.027	0.000	0.016
STD. DEVIATIONS	0.000	0.044	0.000	0.042	0.000	0.061
	0.048	0.096	0.014	0.046	0.000	0.036
EVAPOTRANSPIRATION						
TOTALS	0.848	1.534	2.470	2.879	3.165	4.809
	4.073	4.272	2.250	1.983	1.672	0.892
STD. DEVIATIONS	0.189	0.311	0.128	0.331	1.635	1.381
	1.402	1.207	1.767	0.526	0.138	0.170
LATERAL DRAINAGE FROM LAYER 3						
TOTALS	0.6089	0.6270	0.7105	0.7246	0.6933	0.6011
	0.5686	0.5107	0.4816	0.4751	0.4288	0.5054
STD. DEVIATIONS	0.2086	0.2293	0.2991	0.3389	0.3255	0.2792
	0.2405	0.2072	0.2033	0.2016	0.1842	0.1521
PERCOLATION FROM LAYER 4						
TOTALS	0.2300	0.2171	0.2403	0.2360	0.2383	0.2234
	0.2256	0.2192	0.2104	0.2148	0.2040	0.2190
STD. DEVIATIONS	0.0242	0.0273	0.0326	0.0340	0.0335	0.0300
	0.0265	0.0238	0.0242	0.0244	0.0235	0.0186

PERCOLATION FROM LAYER 5

TOTALS	0.2251	0.2055	0.2267	0.2205	0.2288	0.2218
	0.2292	0.2287	0.2206	0.2271	0.2188	0.2252
STD. DEVIATIONS	0.0145	0.0157	0.0139	0.0135	0.0143	0.0143
	0.0152	0.0155	0.0151	0.0157	0.0151	0.0152

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	40.64	(6.929)	155794.	100.00
RUNOFF	0.181	(0.096)	694.	0.45
EVAPOTRANSPIRATION	30.847	(2.971)	118246.	75.90
LATERAL DRAINAGE FROM LAYER 3	6.9354	(2.6264)	26586.	17.06
PERCOLATION FROM LAYER 4	2.6783	(0.2955)	10267.	6.59
PERCOLATION FROM LAYER 5	2.6778	(0.1651)	10265.	6.59
CHANGE IN WATER STORAGE	0.001	(4.812)	3.	0.00

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	2.40	9200.0
RUNOFF	0.214	819.0
LATERAL DRAINAGE FROM LAYER 3	0.0422	161.7
PERCOLATION FROM LAYER 4	0.0096	36.6
HEAD ON LAYER 4	73.5	
PERCOLATION FROM LAYER 5	0.0080	30.6
SNOW WATER	1.18	4541.3

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4811

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1391

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	4.76	0.3970
2	30.48	0.3810
3	6.24	0.5200
4	29.93	0.4100
5	22.52	0.0629
SNOW WATER	0.00	

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 REMOVE FILL TO 60 PCI/G ON TERRACE SLOPE
 SOUTH FIELD AND INACTIVE FLYASH PILE
 ZONE 5 - Lateral Drainage                    June 8, 1994

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3970 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	47.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4491 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 3

LATERAL DRAINAGE LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.5200 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC
SLOPE	=	10.00 PERCENT
DRAINAGE LENGTH	=	125.0 FEET

LAYER 4

BARRIER SOIL LINER

THICKNESS	=	141.00 INCHES
POROSITY	=	0.4100 VOL/VOL
FIELD CAPACITY	=	0.3710 VOL/VOL
WILTING POINT	=	0.2510 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4100 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000140000 CM/SEC

LAYER 5

VERTICAL PERCOLATION LAYER

THICKNESS	=	372.00 INCHES
POROSITY	=	0.3900 VOL/VOL
FIELD CAPACITY	=	0.0454 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0617 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.015900000930 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	68.00
TOTAL AREA OF COVER	=	46000. SQ FT
EVAPORATIVE ZONE DEPTH	=	12.00 INCHES
UPPER LIMIT VEG. STORAGE	=	6.2400 INCHES
INITIAL VEG. STORAGE	=	4.7640 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	112.8741 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND SOLAR RADIATION FOR CINCINNATI OHIO

MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	133
END OF GROWING SEASON (JULIAN DATE)	=	300

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.90	32.10	41.80	53.50	63.00	71.40
75.40	74.10	67.50	55.30	43.40	33.80

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	1.59	3.86	3.11	3.36	4.79
	3.54	4.80	2.89	3.33	2.69	3.36
STD. DEVIATIONS	0.56	1.34	1.71	0.63	1.78	1.24
	2.04	1.04	2.17	1.37	1.35	1.99
RUNOFF						
TOTALS	0.000	0.020	0.395	0.019	0.000	0.027
	0.022	0.043	0.008	0.027	0.000	0.016
STD. DEVIATIONS	0.000	0.044	0.884	0.042	0.000	0.061
	0.048	0.096	0.014	0.046	0.000	0.036
EVAPOTRANSPIRATION						
TOTALS	0.848	1.534	2.470	2.879	3.165	4.809
	4.074	4.272	2.250	1.983	1.672	0.892
STD. DEVIATIONS	0.189	0.311	0.128	0.331	1.635	1.381
	1.400	1.207	1.767	0.526	0.138	0.170
LATERAL DRAINAGE FROM LAYER 3						
TOTALS	0.6245	0.6447	0.7270	0.6962	0.6725	0.5962
	0.5702	0.5152	0.4890	0.4849	0.4461	0.5196
STD. DEVIATIONS	0.2054	0.2303	0.3006	0.2631	0.2592	0.2401
	0.2096	0.1816	0.1930	0.1978	0.1701	0.1539
PERCOLATION FROM LAYER 4						
TOTALS	0.1911	0.1782	0.1971	0.1905	0.1942	0.1846
	0.1883	0.1851	0.1784	0.1831	0.1758	0.1855
STD. DEVIATIONS	0.0122	0.0146	0.0177	0.0151	0.0149	0.0137
	0.0121	0.0109	0.0118	0.0122	0.0109	0.0096
PERCOLATION FROM LAYER 5						
TOTALS	0.1885	0.1718	0.1892	0.1836	0.1901	0.1841
	0.1902	0.1900	0.1835	0.1893	0.1828	0.1885
STD. DEVIATIONS	0.0062	0.0078	0.0059	0.0058	0.0061	0.0060
	0.0064	0.0065	0.0064	0.0066	0.0064	0.0065

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	40.64	(6.929)	155794.	100.00
RUNOFF	0.576	(0.919)	2209.	1.42
EVAPOTRANSPIRATION	30.848	(2.971)	118251.	75.90
LATERAL DRAINAGE FROM LAYER 3	6.9860	(2.3927)	26780.	17.19
PERCOLATION FROM LAYER 4	2.2319	(0.1426)	8556.	5.49
PERCOLATION FROM LAYER 5	2.2314	(0.0710)	8554.	5.49
CHANGE IN WATER STORAGE	0.000	(4.600)	1.	0.00

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	2.40	9200.0
RUNOFF	0.601	2303.7
LATERAL DRAINAGE FROM LAYER 3	0.0378	145.0
PERCOLATION FROM LAYER 4	0.0072	27.4
HEAD ON LAYER 4	71.0	
PERCOLATION FROM LAYER 5	0.0064	24.4
SNOW WATER	1.18	4541.3

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.5200

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1391

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001591

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	4.76	0.3970
2	21.11	0.4491
3	6.24	0.5200
4	57.81	0.4100
5	22.96	0.0617
SNOW WATER	0.00	

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 REMOVE FILL TO 900 PCI/G ON TERRACE SLOPE
 SOUTH FIELD AND INACTIVE FLYASH PILE
 ZONE 1                                        July 7, 1994

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3970 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	166.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3374 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 3

VERTICAL PERCOLATION LAYER

THICKNESS	=	262.00 INCHES
POROSITY	=	0.3900 VOL/VOL
FIELD CAPACITY	=	0.0454 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0733 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.015900000930 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	68.00
TOTAL AREA OF COVER	=	46000. SQ FT
EVAPORATIVE ZONE DEPTH	=	12.00 INCHES
UPPER LIMIT VEG. STORAGE	=	6.2400 INCHES
INITIAL VEG. STORAGE	=	4.7640 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	79.9770 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR CINCINNATI OHIO

MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	133
END OF GROWING SEASON (JULIAN DATE)	=	300

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.90	32.10	41.80	53.50	63.00	71.40
75.40	74.10	67.50	55.30	43.40	33.80

001594

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	1.59	3.86	3.11	3.36	4.79
	3.54	4.80	2.89	3.33	2.69	3.36
STD. DEVIATIONS	0.56	1.34	1.71	0.63	1.78	1.24
	2.04	1.04	2.17	1.37	1.35	1.99
RUNOFF						
TOTALS	0.000	0.020	0.000	0.019	0.000	0.027
	0.022	0.043	0.008	0.027	0.000	0.016
STD. DEVIATIONS	0.000	0.044	0.000	0.042	0.000	0.061
	0.048	0.096	0.014	0.046	0.000	0.036
EVAPOTRANSPIRATION						
TOTALS	0.848	1.534	2.470	2.879	3.165	4.809
	4.073	4.272	2.250	1.984	1.672	0.892
STD. DEVIATIONS	0.189	0.311	0.128	0.332	1.635	1.381
	1.402	1.207	1.767	0.527	0.138	0.170
PERCOLATION FROM LAYER 3						
TOTALS	0.6834	0.6988	0.8672	0.9518	1.0246	0.9432
	0.8952	0.8131	0.7246	0.7095	0.6508	0.6504
STD. DEVIATIONS	0.2029	0.2207	0.3159	0.4493	0.5347	0.4778
	0.4174	0.3395	0.2724	0.2563	0.2253	0.2075

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	40.64	(6.929)	155794.	100.00
RUNOFF	0.181	(0.096)	694.	0.45
EVAPOTRANSPIRATION	30.847	(2.971)	118247.	75.90
PERCOLATION FROM LAYER 3	9.6125	(3.7688)	36848.	23.65
CHANGE IN WATER STORAGE	0.001	(4.903)	5.	0.00

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	2.40	9200.0
RUNOFF	0.214	819.0
PERCOLATION FROM LAYER 3	0.0593	227.5
SNOW WATER	1.18	4541.3

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4811

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1391

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001596

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	4.76	0.3970
2	56.01	0.3374
3	19.21	0.0733
SNOW WATER	0.00	

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REMOVE FILL TO 900 PCI/G ON TERRACE SLOPE
SOUTH FIELD AND INACTIVE FLYASH PILE
ZONE 2                                        July 7, 1994

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.5200 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	104.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.5200 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 3

BARRIER SOIL LINER

THICKNESS	=	76.00 INCHES
POROSITY	=	0.4100 VOL/VOL
FIELD CAPACITY	=	0.3710 VOL/VOL
WILTING POINT	=	0.2510 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4100 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000140000 CM/SEC

LAYER 4

VERTICAL PERCOLATION LAYER

THICKNESS	=	355.00 INCHES
POROSITY	=	0.3900 VOL/VOL
FIELD CAPACITY	=	0.0454 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0674 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.015900000930 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	68.00
TOTAL AREA OF COVER	=	46000. SQ FT
EVAPORATIVE ZONE DEPTH	=	12.00 INCHES
UPPER LIMIT VEG. STORAGE	=	6.2400 INCHES
INITIAL VEG. STORAGE	=	6.2400 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	115.4070 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR CINCINNATI OHIO

MAXIMUM LEAF AREA INDEX = 2.00
START OF GROWING SEASON (JULIAN DATE) = 133
END OF GROWING SEASON (JULIAN DATE) = 300

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.90	32.10	41.80	53.50	63.00	71.40
75.40	74.10	67.50	55.30	43.40	33.80

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	1.59	3.86	3.11	3.36	4.79
	3.54	4.80	2.89	3.33	2.69	3.36
STD. DEVIATIONS	0.56	1.34	1.71	0.63	1.78	1.24
	2.04	1.04	2.17	1.37	1.35	1.99
RUNOFF						
TOTALS	1.610	0.722	1.001	0.333	0.000	0.027
	0.021	0.043	0.123	0.027	0.000	0.774
STD. DEVIATIONS	0.995	1.615	1.580	0.481	0.000	0.061
	0.047	0.097	0.259	0.046	0.000	1.397
EVAPOTRANSPIRATION						
TOTALS	0.849	1.535	2.474	2.866	3.169	5.001
	4.801	4.269	2.252	2.001	1.672	0.901
STD. DEVIATIONS	0.186	0.307	0.123	0.279	1.637	1.320
	1.183	1.201	1.766	0.498	0.152	0.173
PERCOLATION FROM LAYER 3						
TOTALS	0.3633	0.3296	0.3601	0.3476	0.3569	0.3430
	0.3497	0.3464	0.3363	0.3461	0.3356	0.3564
STD. DEVIATIONS	0.0175	0.0171	0.0154	0.0085	0.0071	0.0080
	0.0021	0.0007	0.0080	0.0079	0.0103	0.0158
PERCOLATION FROM LAYER 4						
TOTALS	0.3529	0.3220	0.3546	0.3437	0.3555	0.3440
	0.3551	0.3544	0.3422	0.3529	0.3409	0.3521
STD. DEVIATIONS	0.0052	0.0084	0.0065	0.0068	0.0070	0.0068
	0.0068	0.0061	0.0055	0.0054	0.0051	0.0052

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	40.64	(6.929)	155794.	100.00
RUNOFF	4.682	(3.527)	17947.	11.52
EVAPOTRANSPIRATION	31.789	(3.486)	121859.	78.22
PERCOLATION FROM LAYER 3	4.1710	(0.0879)	15989.	10.26
PERCOLATION FROM LAYER 4	4.1702	(0.0701)	15986.	10.26
CHANGE IN WATER STORAGE	0.001	(3.890)	3.	0.00

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	2.40	9200.0
RUNOFF	2.189	8391.5
PERCOLATION FROM LAYER 3	0.0121	46.2
HEAD ON LAYER 3	116.6	
PERCOLATION FROM LAYER 4	0.0117	44.9
SNOW WATER	1.18	4541.3

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.5200

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1391

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001602

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	6.24	0.5200
2	54.08	0.5200
3	31.16	0.4100
4	23.93	0.0674
SNOW WATER	0.00	

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 REMOVE FILL TO 900 PCI/G ON TERRACE SLOPE
 SOUTH FIELD AND INACTIVE FLYASH PILE
 ZONE 2 - Lateral Drainage                    July 7, 1994

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3970 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	92.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3702 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 3

LATERAL DRAINAGE LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.5200 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC
SLOPE	=	10.00 PERCENT
DRAINAGE LENGTH	=	125.0 FEET

LAYER 4

BARRIER SOIL LINER

THICKNESS	=	76.00 INCHES
POROSITY	=	0.4100 VOL/VOL
FIELD CAPACITY	=	0.3710 VOL/VOL
WILTING POINT	=	0.2510 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4100 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000140000 CM/SEC

LAYER 5

VERTICAL PERCOLATION LAYER

THICKNESS	=	355.00 INCHES
POROSITY	=	0.3900 VOL/VOL
FIELD CAPACITY	=	0.0454 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0628 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.015900000930 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	68.00
TOTAL AREA OF COVER	=	46000. SQ FT
EVAPORATIVE ZONE DEPTH	=	12.00 INCHES
UPPER LIMIT VEG. STORAGE	=	6.2400 INCHES
INITIAL VEG. STORAGE	=	4.7640 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	98.5164 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR CINCINNATI OHIO

MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	133
END OF GROWING SEASON (JULIAN DATE)	=	300

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.90	32.10	41.80	53.50	63.00	71.40
75.40	74.10	67.50	55.30	43.40	33.80

001606

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	1.59	3.86	3.11	3.36	4.79
	3.54	4.80	2.89	3.33	2.69	3.36
STD. DEVIATIONS	0.56	1.34	1.71	0.63	1.78	1.24
	2.04	1.04	2.17	1.37	1.35	1.99
RUNOFF						
TOTALS	0.000	0.020	0.000	0.019	0.000	0.027
	0.022	0.043	0.008	0.027	0.000	0.016
STD. DEVIATIONS	0.000	0.044	0.000	0.042	0.000	0.061
	0.048	0.096	0.014	0.046	0.000	0.036
EVAPOTRANSPIRATION						
TOTALS	0.848	1.534	2.470	2.879	3.165	4.809
	4.073	4.272	2.250	1.983	1.672	0.892
STD. DEVIATIONS	0.189	0.311	0.128	0.331	1.635	1.381
	1.402	1.207	1.767	0.526	0.138	0.170
LATERAL DRAINAGE FROM LAYER 3						
TOTALS	0.6127	0.6307	0.7144	0.7285	0.6971	0.6045
	0.5720	0.5139	0.4846	0.4737	0.4287	0.5083
STD. DEVIATIONS	0.2090	0.2298	0.2997	0.3395	0.3261	0.2798
	0.2410	0.2077	0.2039	0.2083	0.1897	0.1530
PERCOLATION FROM LAYER 4						
TOTALS	0.2272	0.2142	0.2370	0.2327	0.2351	0.2206
	0.2229	0.2167	0.2081	0.2118	0.2015	0.2165
STD. DEVIATIONS	0.0232	0.0263	0.0314	0.0327	0.0321	0.0288
	0.0254	0.0229	0.0232	0.0245	0.0234	0.0179

PERCOLATION FROM LAYER 5

TOTALS	0.2222	0.2028	0.2237	0.2176	0.2258	0.2189
	0.2262	0.2257	0.2177	0.2242	0.2160	0.2223
STD. DEVIATIONS	0.0141	0.0152	0.0134	0.0131	0.0138	0.0138
	0.0146	0.0149	0.0146	0.0151	0.0145	0.0147

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	40.64	(6.929)	155794.	100.00
RUNOFF	0.181	(0.096)	694.	0.45
EVAPOTRANSPIRATION	30.847	(2.971)	118246.	75.90
LATERAL DRAINAGE FROM LAYER 3	6.9692	(2.6448)	26715.	17.15
PERCOLATION FROM LAYER 4	2.6445	(0.2858)	10137.	6.51
PERCOLATION FROM LAYER 5	2.6432	(0.1592)	10132.	6.50
CHANGE IN WATER STORAGE	0.002	(4.813)	6.	0.00

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	2.40	9200.0
RUNOFF	0.214	819.0
LATERAL DRAINAGE FROM LAYER 3	0.0423	162.3
PERCOLATION FROM LAYER 4	0.0094	36.0
HEAD ON LAYER 4	73.7	
PERCOLATION FROM LAYER 5	0.0079	30.1
SNOW WATER	1.18	4541.3

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4811

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1391

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	4.76	0.3970
2	34.06	0.3702
3	6.24	0.5200
4	31.16	0.4100
5	22.30	0.0628
SNOW WATER	0.00	

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REMOVE FILL TO 900 PCI/G ON TERRACE SLOPE
SOUTH FIELD AND INACTIVE FLYASH PILE
ZONE 3 - Lateral Drainage                    July 7, 1994

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3970 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	82.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3836 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 3

LATERAL DRAINAGE LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.5200 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC
SLOPE	=	10.00 PERCENT
DRAINAGE LENGTH	=	125.0 FEET

LAYER 4

BARRIER SOIL LINER

THICKNESS	=	141.00 INCHES
POROSITY	=	0.4100 VOL/VOL
FIELD CAPACITY	=	0.3710 VOL/VOL
WILTING POINT	=	0.2510 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4100 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000140000 CM/SEC

LAYER 5

VERTICAL PERCOLATION LAYER

THICKNESS	=	362.00 INCHES
POROSITY	=	0.3900 VOL/VOL
FIELD CAPACITY	=	0.0454 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0617 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.015900000930 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	68.00
TOTAL AREA OF COVER	=	46000. SQ FT
EVAPORATIVE ZONE DEPTH	=	12.00 INCHES
UPPER LIMIT VEG. STORAGE	=	6.2400 INCHES
INITIAL VEG. STORAGE	=	4.7640 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	122.6046 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND SOLAR RADIATION FOR CINCINNATI OHIO

MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	133
END OF GROWING SEASON (JULIAN DATE)	=	300

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.90	32.10	41.80	53.50	63.00	71.40
75.40	74.10	67.50	55.30	43.40	33.80

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	1.59	3.86	3.11	3.36	4.79
	3.54	4.80	2.89	3.33	2.69	3.36
STD. DEVIATIONS	0.56	1.34	1.71	0.63	1.78	1.24
	2.04	1.04	2.17	1.37	1.35	1.99
RUNOFF						
TOTALS	0.000	0.020	0.000	0.019	0.000	0.027
	0.022	0.043	0.008	0.027	0.000	0.016
STD. DEVIATIONS	0.000	0.044	0.000	0.042	0.000	0.061
	0.048	0.096	0.014	0.046	0.000	0.036
EVAPOTRANSPIRATION						
TOTALS	0.848	1.534	2.470	2.879	3.165	4.809
	4.073	4.272	2.250	1.983	1.672	0.892
STD. DEVIATIONS	0.189	0.311	0.128	0.331	1.635	1.381
	1.402	1.207	1.767	0.526	0.138	0.170
LATERAL DRAINAGE FROM LAYER 3						
TOTALS	0.6443	0.6612	0.7488	0.7630	0.7321	0.6372
	0.6047	0.5452	0.5145	0.5082	0.4665	0.5390
STD. DEVIATIONS	0.2156	0.2368	0.3084	0.3490	0.3359	0.2890
	0.2499	0.2160	0.2115	0.2097	0.1814	0.1569
PERCOLATION FROM LAYER 4						
TOTALS	0.1921	0.1790	0.1976	0.1931	0.1967	0.1866
	0.1901	0.1868	0.1799	0.1845	0.1771	0.1866
STD. DEVIATIONS	0.0125	0.0149	0.0170	0.0177	0.0175	0.0157
	0.0139	0.0125	0.0127	0.0128	0.0115	0.0096
PERCOLATION FROM LAYER 5						
TOTALS	0.1897	0.1729	0.1904	0.1848	0.1914	0.1854
	0.1916	0.1914	0.1849	0.1907	0.1841	0.1899
STD. DEVIATIONS	0.0070	0.0086	0.0066	0.0064	0.0067	0.0066
	0.0070	0.0072	0.0070	0.0073	0.0070	0.0071

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	40.64	(6.929)	155794.	100.00
RUNOFF	0.181	(0.096)	694.	0.45
EVAPOTRANSPIRATION	30.847	(2.971)	118246.	75.90
LATERAL DRAINAGE FROM LAYER 3	7.3647	(2.7123)	28231.	18.12
PERCOLATION FROM LAYER 4	2.2500	(0.1538)	8625.	5.54
PERCOLATION FROM LAYER 5	2.2471	(0.0778)	8614.	5.53
CHANGE IN WATER STORAGE	0.002	(4.794)	9.	0.01

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	2.40	9200.0
RUNOFF	0.214	819.0
LATERAL DRAINAGE FROM LAYER 3	0.0440	168.5
PERCOLATION FROM LAYER 4	0.0073	28.0
HEAD ON LAYER 4	75.6	
PERCOLATION FROM LAYER 5	0.0065	24.8
SNOW WATER	1.18	4541.3

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4811

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1391

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	4.76	0.3970
2	31.45	0.3836
3	6.24	0.5200
4	57.81	0.4100
5	22.35	0.0617
SNOW WATER	0.00	

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001616

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TOP OF THE TERRACE - TILL PRG DEVELOPMENT - 70 pCi/g
SOUTH FIELD
ZONE 1                                        July 12, 1994

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.5200 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	47.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.5200 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 3

BARRIER SOIL LINER

THICKNESS	=	110.00 INCHES
POROSITY	=	0.4100 VOL/VOL
FIELD CAPACITY	=	0.3710 VOL/VOL
WILTING POINT	=	0.2510 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4100 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000140000 CM/SEC

LAYER 4

VERTICAL PERCOLATION LAYER

THICKNESS	=	374.00 INCHES
POROSITY	=	0.3900 VOL/VOL
FIELD CAPACITY	=	0.0454 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0631 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.015900000930 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	68.00
TOTAL AREA OF COVER	=	46000. SQ FT
EVAPORATIVE ZONE DEPTH	=	12.00 INCHES
UPPER LIMIT VEG. STORAGE	=	6.2400 INCHES
INITIAL VEG. STORAGE	=	6.2400 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	99.3794 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

001618

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR CINCINNATI OHIO

MAXIMUM LEAF AREA INDEX = 2.00
START OF GROWING SEASON (JULIAN DATE) = 133
END OF GROWING SEASON (JULIAN DATE) = 300

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.90	32.10	41.80	53.50	63.00	71.40
75.40	74.10	67.50	55.30	43.40	33.80

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	1.59	3.86	3.11	3.36	4.79
	3.54	4.80	2.89	3.33	2.69	3.36
STD. DEVIATIONS	0.56	1.34	1.71	0.63	1.78	1.24
	2.04	1.04	2.17	1.37	1.35	1.99
RUNOFF						
TOTALS	1.814	0.750	1.075	0.381	0.000	0.034
	0.020	0.043	0.186	0.027	0.000	1.292
STD. DEVIATIONS	1.125	1.660	1.659	0.535	0.000	0.061
	0.045	0.097	0.399	0.046	0.000	1.597
EVAPOTRANSPIRATION						
TOTALS	0.848	1.533	2.472	2.865	3.167	5.021
	5.485	4.291	2.263	1.965	1.662	0.901
STD. DEVIATIONS	0.186	0.308	0.123	0.279	1.634	1.285
	1.280	1.228	1.781	0.509	0.155	0.169

PERCOLATION FROM LAYER 3

TOTALS	0.2215	0.2010	0.2198	0.2126	0.2182	0.2098
	0.2129	0.2098	0.2043	0.2108	0.2054	0.2185
STD. DEVIATIONS	0.0098	0.0093	0.0079	0.0029	0.0026	0.0036
	0.0013	0.0004	0.0051	0.0049	0.0069	0.0091

PERCOLATION FROM LAYER 4

TOTALS	0.2157	0.1966	0.2164	0.2096	0.2167	0.2098
	0.2167	0.2163	0.2089	0.2156	0.2084	0.2153
STD. DEVIATIONS	0.0022	0.0044	0.0027	0.0027	0.0028	0.0027
	0.0026	0.0025	0.0023	0.0023	0.0021	0.0022

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	40.64	(6.929)	155794.	100.00
RUNOFF	5.623	(3.794)	21557.	13.84
EVAPOTRANSPIRATION	32.474	(3.083)	124483.	79.90
PERCOLATION FROM LAYER 3	2.5447	(0.0433)	9755.	6.26
PERCOLATION FROM LAYER 4	2.5460	(0.0292)	9759.	6.26
CHANGE IN WATER STORAGE	-0.001	(3.438)	-5.	0.00

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	2.40	9200.0
RUNOFF	2.241	8590.7
PERCOLATION FROM LAYER 3	0.0073	28.1
HEAD ON LAYER 3	59.4	
PERCOLATION FROM LAYER 4	0.0071	27.2
SNOW WATER	1.18	4541.3

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.5200

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1391

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	6.24	0.5200
2	24.44	0.5200
3	45.10	0.4100
4	23.59	0.0631
SNOW WATER	0.00	

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001622

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 TOP OF THE TERRACE - TILL PRG DEVELOPMENT - 70 pCi/g
 SOUTH FIELD
 ZONE 2                                          July 12, 1994

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.5200 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	75.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.5200 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 3

BARRIER SOIL LINER

THICKNESS	=	104.00 INCHES
POROSITY	=	0.4100 VOL/VOL
FIELD CAPACITY	=	0.3710 VOL/VOL
WILTING POINT	=	0.2510 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4100 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000140000 CM/SEC

LAYER 4

VERTICAL PERCOLATION LAYER

THICKNESS	=	375.00 INCHES
POROSITY	=	0.3900 VOL/VOL
FIELD CAPACITY	=	0.0454 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0646 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.015900000930 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	68.00
TOTAL AREA OF COVER	=	46000. SQ FT
EVAPORATIVE ZONE DEPTH	=	12.00 INCHES
UPPER LIMIT VEG. STORAGE	=	6.2400 INCHES
INITIAL VEG. STORAGE	=	6.2400 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	112.1050 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR CINCINNATI OHIO

MAXIMUM LEAF AREA INDEX = 2.00
START OF GROWING SEASON (JULIAN DATE) = 133
END OF GROWING SEASON (JULIAN DATE) = 300

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.90	32.10	41.80	53.50	63.00	71.40
75.40	74.10	67.50	55.30	43.40	33.80

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	1.59	3.86	3.11	3.36	4.79
	3.54	4.80	2.89	3.33	2.69	3.36
STD. DEVIATIONS	0.56	1.34	1.71	0.63	1.78	1.24
	2.04	1.04	2.17	1.37	1.35	1.99
RUNOFF						
TOTALS	1.779	0.737	1.052	0.367	0.000	0.028
	0.021	0.043	0.170	0.027	0.000	1.127
STD. DEVIATIONS	1.107	1.649	1.634	0.519	0.000	0.062
	0.046	0.097	0.364	0.046	0.000	1.573
EVAPOTRANSPIRATION						
TOTALS	0.849	1.534	2.473	2.865	3.168	5.021
	5.252	4.280	2.263	1.967	1.666	0.902
STD. DEVIATIONS	0.186	0.307	0.123	0.279	1.636	1.285
	1.202	1.215	1.781	0.510	0.154	0.169
PERCOLATION FROM LAYER 3						
TOTALS	0.2650	0.2406	0.2631	0.2543	0.2613	0.2513
	0.2558	0.2528	0.2458	0.2535	0.2465	0.2614
STD. DEVIATIONS	0.0111	0.0109	0.0093	0.0041	0.0035	0.0045
	0.0012	0.0005	0.0055	0.0054	0.0075	0.0103
PERCOLATION FROM LAYER 4						
TOTALS	0.2582	0.2354	0.2591	0.2510	0.2596	0.2513
	0.2595	0.2591	0.2503	0.2583	0.2496	0.2579
STD. DEVIATIONS	0.0026	0.0054	0.0032	0.0033	0.0034	0.0033
	0.0033	0.0030	0.0027	0.0027	0.0026	0.0026

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001626

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	40.64	(6.929)	155794.	100.00
RUNOFF	5.351	(3.694)	20513.	13.17
EVAPOTRANSPIRATION	32.239	(3.193)	123584.	79.33
PERCOLATION FROM LAYER 3	3.0514	(0.0513)	11697.	7.51
PERCOLATION FROM LAYER 4	3.0493	(0.0351)	11689.	7.50
CHANGE IN WATER STORAGE	0.002	(3.625)	8.	0.01

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	2.40	9200.0
RUNOFF	2.225	8530.3
PERCOLATION FROM LAYER 3	0.0088	33.6
HEAD ON LAYER 3	87.5	
PERCOLATION FROM LAYER 4	0.0085	32.6
SNOW WATER	1.18	4541.3

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.5200

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1391

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	6.24	0.5200
2	39.00	0.5200
3	42.64	0.4100
4	24.24	0.0646
SNOW WATER	0.00	

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TOP OF THE TERRACE - TILL PRG DEVELOPMENT - 70 pCi/g
SOUTH FIELD
ZONE 3 July 12, 1994

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.5200 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	114.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.5200 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 3

BARRIER SOIL LINER

THICKNESS	=	105.00 INCHES
POROSITY	=	0.4100 VOL/VOL
FIELD CAPACITY	=	0.3710 VOL/VOL
WILTING POINT	=	0.2510 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4100 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000140000 CM/SEC

LAYER 4

VERTICAL PERCOLATION LAYER

THICKNESS	=	372.00 INCHES
POROSITY	=	0.3900 VOL/VOL
FIELD CAPACITY	=	0.0454 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0663 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.015900000930 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	68.00
TOTAL AREA OF COVER	=	46000. SQ FT
EVAPORATIVE ZONE DEPTH	=	12.00 INCHES
UPPER LIMIT VEG. STORAGE	=	6.2400 INCHES
INITIAL VEG. STORAGE	=	6.2400 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	133.2336 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

001630

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR CINCINNATI OHIO

MAXIMUM LEAF AREA INDEX = 2.00
START OF GROWING SEASON (JULIAN DATE) = 133
END OF GROWING SEASON (JULIAN DATE) = 300

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.90	32.10	41.80	53.50	63.00	71.40
75.40	74.10	67.50	55.30	43.40	33.80

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	1.59	3.86	3.11	3.36	4.79
	3.54	4.80	2.89	3.33	2.69	3.36
STD. DEVIATIONS	0.56	1.34	1.71	0.63	1.78	1.24
	2.04	1.04	2.17	1.37	1.35	1.99
RUNOFF						
TOTALS	1.728	0.729	1.025	0.349	0.000	0.028
	0.021	0.043	0.150	0.027	0.000	0.913
STD. DEVIATIONS	1.081	1.631	1.605	0.499	0.000	0.062
	0.047	0.097	0.320	0.046	0.000	1.534
EVAPOTRANSPIRATION						
TOTALS	0.849	1.534	2.473	2.866	3.169	5.006
	4.984	4.268	2.262	1.971	1.670	0.903
STD. DEVIATIONS	0.186	0.307	0.123	0.279	1.636	1.311
	1.170	1.201	1.782	0.512	0.153	0.170

PERCOLATION FROM LAYER 3

TOTALS	0.3181	0.2889	0.3161	0.3055	0.3141	0.3023
	0.3087	0.3061	0.2972	0.3063	0.2973	0.3139
STD. DEVIATIONS	0.0119	0.0121	0.0103	0.0052	0.0043	0.0051
	0.0013	0.0006	0.0056	0.0057	0.0077	0.0109

PERCOLATION FROM LAYER 4

TOTALS	0.3116	0.2840	0.3126	0.3028	0.3131	0.3030
	0.3129	0.3123	0.3018	0.3114	0.3009	0.3109
STD. DEVIATIONS	0.0035	0.0064	0.0042	0.0044	0.0045	0.0043
	0.0043	0.0040	0.0036	0.0036	0.0034	0.0035

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001632

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	40.64	(6.929)	155794.	100.00
RUNOFF	5.013	(3.604)	19216.	12.33
EVAPOTRANSPIRATION	31.955	(3.330)	122492.	78.62
PERCOLATION FROM LAYER 3	3.6746	(0.0578)	14086.	9.04
PERCOLATION FROM LAYER 4	3.6771	(0.0461)	14096.	9.05
CHANGE IN WATER STORAGE	-0.003	(3.842)	-10.	-0.01

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	2.40	9200.0
RUNOFF	2.206	8456.9
PERCOLATION FROM LAYER 3	0.0105	40.2
HEAD ON LAYER 3	126.5	
PERCOLATION FROM LAYER 4	0.0103	39.3
SNOW WATER	1.18	4541.3

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.5200

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1391

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	6.24	0.5200
2	59.28	0.5200
3	43.05	0.4100
4	24.65	0.0663
SNOW WATER	0.00	

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REMOVE FILL TO 90 PCI/G ON TOP OF TERRACE - CLEAN PERCHED WATER
SOUTH FIELD AND INACTIVE FLYASH PILE
ZONE 1 June 13, 1994

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.5200 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	80.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.5200 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 3

BARRIER SOIL LINER

THICKNESS	=	54.00 INCHES
POROSITY	=	0.4100 VOL/VOL
FIELD CAPACITY	=	0.3710 VOL/VOL
WILTING POINT	=	0.2510 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4100 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000140000 CM/SEC

LAYER 4

VERTICAL PERCOLATION LAYER

THICKNESS	=	384.00 INCHES
POROSITY	=	0.3900 VOL/VOL
FIELD CAPACITY	=	0.0454 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0678 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.015900000930 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	68.00
TOTAL AREA OF COVER	=	46000. SQ FT
EVAPORATIVE ZONE DEPTH	=	12.00 INCHES
UPPER LIMIT VEG. STORAGE	=	6.2400 INCHES
INITIAL VEG. STORAGE	=	6.2400 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	96.0152 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

001636

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR CINCINNATI OHIO

MAXIMUM LEAF AREA INDEX = 2.00
START OF GROWING SEASON (JULIAN DATE) = 133
END OF GROWING SEASON (JULIAN DATE) = 300

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.90	32.10	41.80	53.50	63.00	71.40
75.40	74.10	67.50	55.30	43.40	33.80

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	1.59	3.86	3.11	3.36	4.79
	3.54	4.80	2.89	3.33	2.69	3.36
STD. DEVIATIONS	0.56	1.34	1.71	0.63	1.78	1.24
	2.04	1.04	2.17	1.37	1.35	1.99
RUNOFF						
TOTALS	1.519	0.718	0.988	0.325	0.000	0.027
	0.021	0.043	0.109	0.027	0.000	0.729
STD. DEVIATIONS	0.910	1.606	1.566	0.472	0.000	0.061
	0.047	0.097	0.228	0.046	0.000	1.331
EVAPOTRANSPIRATION						
TOTALS	0.849	1.535	2.474	2.866	3.169	5.001
	4.768	4.269	2.252	2.001	1.673	0.901
STD. DEVIATIONS	0.186	0.307	0.123	0.279	1.637	1.320
	1.179	1.202	1.766	0.498	0.152	0.173

PERCOLATION FROM LAYER 3

TOTALS	0.3854	0.3491	0.3804	0.3668	0.3757	0.3600
	0.3655	0.3606	0.3505	0.3600	0.3491	0.3745
STD. DEVIATIONS	0.0255	0.0237	0.0225	0.0128	0.0108	0.0120
	0.0035	0.0018	0.0118	0.0118	0.0149	0.0227

PERCOLATION FROM LAYER 4

TOTALS	0.3696	0.3377	0.3722	0.3609	0.3734	0.3614
	0.3730	0.3719	0.3589	0.3699	0.3571	0.3687
STD. DEVIATIONS	0.0076	0.0107	0.0092	0.0096	0.0099	0.0096
	0.0097	0.0089	0.0080	0.0080	0.0075	0.0077

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	40.64	(6.929)	155794.	100.00
RUNOFF	4.507	(3.460)	17276.	11.09
EVAPOTRANSPIRATION	31.757	(3.473)	121737.	78.14
PERCOLATION FROM LAYER 3	4.3777	(0.1342)	16781.	10.77
PERCOLATION FROM LAYER 4	4.3746	(0.1004)	16769.	10.76
CHANGE IN WATER STORAGE	0.003	(3.881)	12.	0.01

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	2.40	9200.0
RUNOFF	2.180	8356.3
PERCOLATION FROM LAYER 3	0.0129	49.5
HEAD ON LAYER 3	92.7	
PERCOLATION FROM LAYER 4	0.0124	47.5
SNOW WATER	1.18	4541.3

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.5200

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1391

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	6.24	0.5200
2	41.60	0.5200
3	22.14	0.4100
4	26.05	0.0678
SNOW WATER	0.00	

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REMOVE FILL TO 90 PCI/G ON TOP OF TERRACE - CLEAN PERCHED WATER
SOUTH FIELD AND INACTIVE FLYASH PILE
ZONE 2 June 13, 1994

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.5200 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	26.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.5200 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 3

BARRIER SOIL LINER

THICKNESS	=	112.00 INCHES
POROSITY	=	0.4100 VOL/VOL
FIELD CAPACITY	=	0.3710 VOL/VOL
WILTING POINT	=	0.2510 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4100 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000140000 CM/SEC

LAYER 4

VERTICAL PERCOLATION LAYER

THICKNESS	=	271.00 INCHES
POROSITY	=	0.3900 VOL/VOL
FIELD CAPACITY	=	0.0454 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0619 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.015900000930 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	68.00
TOTAL AREA OF COVER	=	46000. SQ FT
EVAPORATIVE ZONE DEPTH	=	12.00 INCHES
UPPER LIMIT VEG. STORAGE	=	6.2400 INCHES
INITIAL VEG. STORAGE	=	6.2400 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	82.4549 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

001642

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR CINCINNATI OHIO

MAXIMUM LEAF AREA INDEX = 2.00
START OF GROWING SEASON (JULIAN DATE) = 133
END OF GROWING SEASON (JULIAN DATE) = 300

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.90	32.10	41.80	53.50	63.00	71.40
75.40	74.10	67.50	55.30	43.40	33.80

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	1.59	3.86	3.11	3.36	4.79
	3.54	4.80	2.89	3.33	2.69	3.36
STD. DEVIATIONS	0.56	1.34	1.71	0.63	1.78	1.24
	2.04	1.04	2.17	1.37	1.35	1.99
RUNOFF						
TOTALS	1.832	0.759	1.091	0.390	0.000	0.041
	0.020	0.043	0.196	0.026	0.000	1.402
STD. DEVIATIONS	1.131	1.668	1.676	0.545	0.000	0.062
	0.045	0.097	0.421	0.046	0.000	1.618
EVAPOTRANSPIRATION						
TOTALS	0.848	1.533	2.471	2.865	3.167	4.981
	5.682	4.299	2.263	1.963	1.659	0.900
STD. DEVIATIONS	0.186	0.308	0.124	0.279	1.634	1.311
	1.407	1.237	1.781	0.509	0.157	0.169

PERCOLATION FROM LAYER 3

TOTALS	0.1928	0.1749	0.1912	0.1849	0.1897	0.1824
	0.1846	0.1812	0.1767	0.1824	0.1781	0.1901
STD. DEVIATIONS	0.0092	0.0085	0.0072	0.0024	0.0023	0.0031
	0.0015	0.0004	0.0049	0.0046	0.0067	0.0086

PERCOLATION FROM LAYER 4

TOTALS	0.1868	0.1704	0.1876	0.1819	0.1881	0.1821
	0.1881	0.1876	0.1811	0.1868	0.1805	0.1865
STD. DEVIATIONS	0.0022	0.0041	0.0028	0.0028	0.0028	0.0027
	0.0026	0.0024	0.0021	0.0022	0.0021	0.0022

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001644

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	40.64	(6.929)	155794.	100.00
RUNOFF	5.802	(3.865)	22239.	14.27
EVAPOTRANSPIRATION	32.632	(3.013)	125087.	80.29
PERCOLATION FROM LAYER 3	2.2090	(0.0396)	8468.	5.44
PERCOLATION FROM LAYER 4	2.2075	(0.0286)	8462.	5.43
CHANGE IN WATER STORAGE	0.001	(3.326)	6.	0.00

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	2.40	9200.0
RUNOFF	2.251	8630.5
PERCOLATION FROM LAYER 3	0.0064	24.5
HEAD ON LAYER 3	38.4	
PERCOLATION FROM LAYER 4	0.0062	23.7
SNOW WATER	1.18	4541.3

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.5200

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1391

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	6.24	0.5200
2	13.52	0.5200
3	45.92	0.4100
4	16.78	0.0619
SNOW WATER	0.00	

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001646

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REMOVE FILL TO 90 PCI/G ON TOP OF TERRACE - CLEAN PERCHED WATER
SOUTH FIELD AND INACTIVE FLYASH PILE
ZONE 3                                        June 13, 1994

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.5200 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 2

VERTICAL PERCOLATION LAYER

THICKNESS	=	53.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.5200 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 3

BARRIER SOIL LINER

THICKNESS	=	96.00 INCHES
POROSITY	=	0.4100 VOL/VOL
FIELD CAPACITY	=	0.3710 VOL/VOL
WILTING POINT	=	0.2510 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4100 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000140000 CM/SEC

LAYER 4

VERTICAL PERCOLATION LAYER

THICKNESS	=	260.00 INCHES
POROSITY	=	0.3900 VOL/VOL
FIELD CAPACITY	=	0.0454 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0638 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.015900000930 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	68.00
TOTAL AREA OF COVER	=	46000. SQ FT
EVAPORATIVE ZONE DEPTH	=	12.00 INCHES
UPPER LIMIT VEG. STORAGE	=	6.2400 INCHES
INITIAL VEG. STORAGE	=	6.2400 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	89.7480 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND
SOLAR RADIATION FOR CINCINNATI OHIO

MAXIMUM LEAF AREA INDEX = 2.00
START OF GROWING SEASON (JULIAN DATE) = 133
END OF GROWING SEASON (JULIAN DATE) = 300

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.90	32.10	41.80	53.50	63.00	71.40
75.40	74.10	67.50	55.30	43.40	33.80

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	1.59	3.86	3.11	3.36	4.79
	3.54	4.80	2.89	3.33	2.69	3.36
STD. DEVIATIONS	0.56	1.34	1.71	0.63	1.78	1.24
	2.04	1.04	2.17	1.37	1.35	1.99
RUNOFF						
TOTALS	1.798	0.744	1.064	0.375	0.000	0.029
	0.021	0.043	0.179	0.027	0.000	1.221
STD. DEVIATIONS	1.117	1.655	1.647	0.529	0.000	0.062
	0.046	0.097	0.384	0.046	0.000	1.584
EVAPOTRANSPIRATION						
TOTALS	0.849	1.533	2.472	2.865	3.168	5.021
	5.385	4.287	2.263	1.966	1.664	0.902
STD. DEVIATIONS	0.186	0.307	0.123	0.279	1.635	1.285
	1.245	1.222	1.781	0.509	0.155	0.169

PERCOLATION FROM LAYER 3

TOTALS	0.2413	0.2189	0.2393	0.2314	0.2374	0.2281
	0.2313	0.2280	0.2220	0.2289	0.2230	0.2376
STD. DEVIATIONS	0.0116	0.0109	0.0094	0.0037	0.0033	0.0043
	0.0015	0.0005	0.0059	0.0057	0.0080	0.0107

PERCOLATION FROM LAYER 4

TOTALS	0.2341	0.2136	0.2353	0.2281	0.2360	0.2284
	0.2358	0.2351	0.2269	0.2339	0.2260	0.2335
STD. DEVIATIONS	0.0034	0.0055	0.0043	0.0043	0.0043	0.0041
	0.0040	0.0036	0.0032	0.0032	0.0031	0.0033

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	40.64	(6.929)	155794.	100.00
RUNOFF	5.501	(3.744)	21087.	13.54
EVAPOTRANSPIRATION	32.374	(3.128)	124099.	79.66
PERCOLATION FROM LAYER 3	2.7674	(0.0519)	10608.	6.81
PERCOLATION FROM LAYER 4	2.7669	(0.0430)	10606.	6.81
CHANGE IN WATER STORAGE	0.000	(3.518)	2.	0.00

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	2.40	9200.0
RUNOFF	2.234	8562.5
PERCOLATION FROM LAYER 3	0.0080	30.7
HEAD ON LAYER 3	65.5	
PERCOLATION FROM LAYER 4	0.0078	29.8
SNOW WATER	1.18	4541.3

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.5200

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1391

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	6.24	0.5200
2	27.56	0.5200
3	39.36	0.4100
4	16.59	0.0638
SNOW WATER	0.00	

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REMOVE FILL TO 90 PCI/G ON TOP OF TERRACE - CLEAN PERCHED WATER
SOUTH FIELD AND INACTIVE FLYASH PILE
ZONE 4                                          June 13, 1994

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FAIR GRASS

LAYER 1

VERTICAL PERCOLATION LAYER

THICKNESS	=	12.00 INCHES
POROSITY	=	0.5200 VOL/VOL
FIELD CAPACITY	=	0.2942 VOL/VOL
WILTING POINT	=	0.1400 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.5200 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000199999995 CM/SEC

LAYER 2

BARRIER SOIL LINER

THICKNESS	=	133.00 INCHES
POROSITY	=	0.4100 VOL/VOL
FIELD CAPACITY	=	0.3710 VOL/VOL
WILTING POINT	=	0.2510 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4100 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.000000140000 CM/SEC

LAYER 3

VERTICAL PERCOLATION LAYER

THICKNESS	=	265.00 INCHES
POROSITY	=	0.3900 VOL/VOL
FIELD CAPACITY	=	0.0454 VOL/VOL
WILTING POINT	=	0.0200 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0576 VOL/VOL
SATURATED HYDRAULIC CONDUCTIVITY	=	0.015900000930 CM/SEC

GENERAL SIMULATION DATA

SCS RUNOFF CURVE NUMBER	=	68.00
TOTAL AREA OF COVER	=	46000. SQ FT
EVAPORATIVE ZONE DEPTH	=	12.00 INCHES
UPPER LIMIT VEG. STORAGE	=	6.2400 INCHES
INITIAL VEG. STORAGE	=	6.2400 INCHES
INITIAL SNOW WATER CONTENT	=	0.0000 INCHES
INITIAL TOTAL WATER STORAGE IN SOIL AND WASTE LAYERS	=	76.0340 INCHES

SOIL WATER CONTENT INITIALIZED BY USER.

CLIMATOLOGICAL DATA

DEFAULT RAINFALL WITH SYNTHETIC DAILY TEMPERATURES AND SOLAR RADIATION FOR CINCINNATI OHIO

MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	133
END OF GROWING SEASON (JULIAN DATE)	=	300

NORMAL MEAN MONTHLY TEMPERATURES, DEGREES FAHRENHEIT

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.90	32.10	41.80	53.50	63.00	71.40
75.40	74.10	67.50	55.30	43.40	33.80

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 74 THROUGH 78

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.33	1.59	3.86	3.11	3.36	4.79
	3.54	4.80	2.89	3.33	2.69	3.36
STD. DEVIATIONS	0.56	1.34	1.71	0.63	1.78	1.24
	2.04	1.04	2.17	1.37	1.35	1.99
RUNOFF						
TOTALS	1.859	0.769	1.111	0.462	0.000	0.231
	0.020	0.043	0.243	0.026	0.013	1.732
STD. DEVIATIONS	1.145	1.677	1.697	0.530	0.000	0.456
	0.045	0.097	0.526	0.046	0.030	1.654
EVAPOTRANSPIRATION						
TOTALS	0.848	1.533	2.471	2.864	3.121	5.021
	5.797	4.307	2.302	1.985	1.657	0.900
STD. DEVIATIONS	0.186	0.308	0.124	0.279	1.675	1.245
	1.419	1.246	1.771	0.496	0.156	0.169
PERCOLATION FROM LAYER 2						
TOTALS	0.1366	0.1434	0.1569	0.1512	0.1550	0.1492
	0.0973	0.0174	0.0302	0.0591	0.1019	0.1264
STD. DEVIATIONS	0.0530	0.0050	0.0034	0.0013	0.0010	0.0019
	0.0226	0.0304	0.0675	0.0645	0.0685	0.0698
PERCOLATION FROM LAYER 3						
TOTALS	0.1083	0.1005	0.1129	0.1115	0.1175	0.1157
	0.1208	0.1159	0.1074	0.1071	0.1027	0.1069
STD. DEVIATIONS	0.0135	0.0132	0.0133	0.0124	0.0123	0.0115
	0.0111	0.0098	0.0084	0.0095	0.0109	0.0126

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 74 THROUGH 78

	(INCHES)		(CU. FT.)	PERCENT
PRECIPITATION	40.64	(6.929)	155794.	100.00
RUNOFF	6.511	(3.632)	24959.	16.02
EVAPOTRANSPIRATION	32.806	(3.122)	125758.	80.72
PERCOLATION FROM LAYER 2	1.3245	(0.2675)	5077.	3.26
PERCOLATION FROM LAYER 3	1.3271	(0.1290)	5087.	3.27
CHANGE IN WATER STORAGE	-0.003	(2.768)	-10.	-0.01

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PEAK DAILY VALUES FOR YEARS 74 THROUGH 78

	(INCHES)	(CU. FT.)
PRECIPITATION	2.40	9200.0
RUNOFF	2.253	8635.1
PERCOLATION FROM LAYER 2	0.0052	20.0
HEAD ON LAYER 2	12.4	
PERCOLATION FROM LAYER 3	0.0043	16.7
SNOW WATER	1.18	4541.3

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.5200

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1391

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FINAL WATER STORAGE AT END OF YEAR 78

LAYER	(INCHES)	(VOL/VOL)
1	6.24	0.5200
2	54.53	0.4100
3	15.25	0.0576
SNOW WATER	0.00	

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APPENDIX D.1

ATTACHMENT D.1-II

SOIL EROSION CALCULATIONS

D.1-II - SOIL EROSION CALCULATIONS

PURPOSE

To calculate the depth of erosion on the South Field for Operable Unit 2 for the proposed conditions.

PROCEDURE

Use the universal soil loss equation (D.1-II-1) to estimate the yearly amount of sediment released from the South Field. The amount will then be converted to a depth using the area and the soil bulk density. The 1,000-year depth will be calculated by multiplying the annual depth of soil lost by 1,000.

To account for distinct changes in slope, the amount of soil loss for each segment will be calculated using the average slope for that segment. Then the erosion depth will be developed. The maximum erosion amount for all the segments will be taken as the erosion amount for the South Field.

CALCULATION

The universal soil loss equation takes the following form (EPA 1985; EPA 1988; Maidment 1993):

$$M = R \times K \times LS \times C \times P \times A$$

where

M	=	annual soil loss (metric tons/year)
R	=	rainfall erosivity factor (100 m-tonne-cm/ha-hr)
K	=	soil erodability factor (metric tons/ha/R)
LS	=	slope length steepness factor (dimensionless)
C	=	cover factor (dimensionless)
P	=	erosion control practice factor (dimensionless)
A	=	subbasin area (Ha)

The depth of soil lost per year is given by

$$Depth = \frac{M}{100\ \rho A}$$

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where

M = annual soil loss (metric tons/year)
Depth = the depth of soil lost per year (cm)
ρ = soil bulk density (g/cm^3)

therefore

$$\text{Depth} = \frac{R \times K \times LS \times C \times P}{\rho \times 100} \qquad \text{(D.1-II-3)}$$

The values of the parameters are

R = 303.6 — From Figure III-10 of EPA (1985). Value of 175 converted to metric units with

$$1.735 \frac{(100 \text{ m-tonne-cm/ha-hr})}{(10 \text{ ft-ton-}\in\text{/ac-hr})}$$

K = 0.55 tonne/ha/R — Assume that cover soil is similar to natural soils around FEMP. Use Ho A (Henshaw) from USDA (1982) converted to metric with factor 1.29 (EPA 1988):

0.43 x 1.292 = 0.55 tonnes/ha/R

C = 0.003 — From Table 2-4 of EPA (1988), 95 percent ground cover, no appreciable canopy, surface covered with grass.

P = 1.0 — Assume no special erosion control practices. Use 1.0 for uncontrolled hazardous waste sites (EPA 1988, p. 22).

LS — Use following table based on Figure 2-6 of EPA (1988). Use steep slope. Do not average slope, since steep slope controls erosion.

Location*	Steep Slope Portion		LS
	Slope	Length (ft)	
A	9%	425	2.2
B	22%	125	6.0
C	11%	400	3.0

*See Figure D.1-II-1 for locations.

ρ = 1.30 g/cm^3 — See explanation for K factor.

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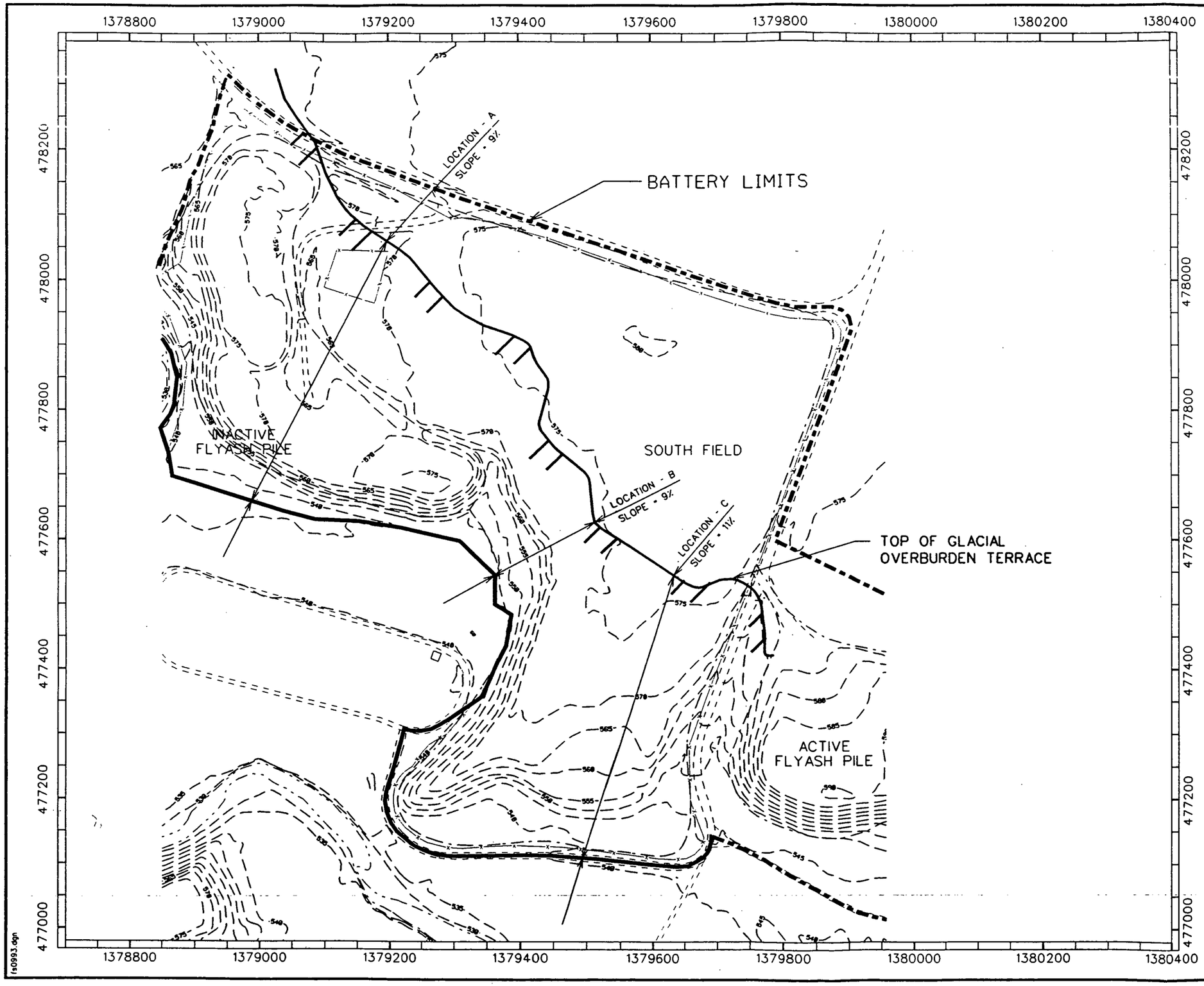

LEGEND

- 575 — ELEVATION CONTOURS
- ROADS
- STREAM
- FENCE
- TOP OF GLACIAL OVERBURDEN TERRACE

NOTE:
Coordinates are in State Planar NAD 1927.
Surface contours based on 1992 flyover.

SCALE (FT)
0 150 300

SCALE (METER)
0 36 72

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FIGURE D.1.II-1
SOUTH FIELD LOCATIONS AND SLOPES FOR SOIL EROSION CALCULATIONS

RESULTS

Results of soil erosion calculations are summarized in the following table.

SUMMARY OF SOIL EROSION CALCULATIONS

Area	R (100 m-tonne-cm/ ha-hr)	K (tonnes/ha/R)	LS	C	P	ρ (gm/cm^3)	Erosion Depth (cm/yr)	Erosion Depth (cm/1,000 yr)	Erosion Depth (in/1,000 yr)
A	303.6	0.55	2.2	0.003	1	1.3	8.48E-03	8.48	3.34
B	303.6	0.55	6	0.003	1	1.3	2.31E-02	23.12	9.10
C	303.6	0.55	3	0.003	1	1.3	1.16E-02	11.56	4.55

APPENDIX D.1

ATTACHMENT D.1-III

CALIBRATION OF FATE AND TRANSPORT MODEL AGAINST LYSIMETER DATA

D.1-III - CALIBRATION OF FATE AND TRANSPORT MODEL AGAINST LYSIMETER DATA

Three pairs of lysimeters were installed at the FEMP site by Operable Unit 5. At each location, one lysimeter was installed in the gray till and another in the unsaturated Great Miami Aquifer. Details of lysimeter installation and data collected from these lysimeters are reported in the Operable Unit 5 RI Report. Typically, lysimeters were installed 0.9 m (3 ft) above and 0.9 m (3 ft) below the contact between the gray till and the Great Miami Aquifer. Lysimeter pair 11130/11131 is in the area of the proposed disposal cell for Operable Unit 2. Lysimeter pair 11129/11234 is close to the South Field, and lysimeter pair 11132/11133 is located in the northeast part of the FEMP. Table D.1-III-1 shows the uranium concentrations measured in the water samples collected from the lysimeters. With one exception, this data show that the uranium concentration is higher in the lysimeter in the unsaturated Great Miami Aquifer than in the one in the gray till. Average uranium concentrations in the water samples collected from the unsaturated Great Miami Aquifer are approximately 4.8 times higher than water samples collected from the gray till. Typical barrier layer (i.e., gray clay) thickness is about 3 m (10 ft).

The ODAST model was used to simulate the fate and transport of uranium in the glacial overburden and unsaturated Great Miami Aquifer. Under similar conditions to what has occurred at the lysimeters. The model was first set up to simulate average hydrogeologic conditions for all 3 of the lysimeter sites. The infiltration rate was estimated to be 8.4 inch/year at the lysimeters (Operable Unit 5 RI Report). Soil properties shown in Table D.1-2 of Appendix D.1 were used. Seepage velocities, dispersion coefficients, and retardation factors were calculated as described in Section D.1.3.3. For example, the seepage velocity in the glacial till was calculated to be 52.8 in/yr. Large quantities of the soluble forms of uranium were dispersed and deposited over the site during the first 5 years of operations at the FEMP (see Appendix D.4). This was simulated by using a source term with constant loading for the initial 5 year period of the model. I was then run, and current measured concentrations were compared to the model predictions at 40 years. This is the approximate time period that has elapsed since the operations began at the FEMP and initial uranium release occurred.

Table D.1-III-2 shows model predictions based on the assumption that the distribution coefficient (K_d) is 3.1 mL/g for the gray till and 1.78 mL/g for the unsaturated Great Miami Aquifer. The ODAST model predicted that the ratio of uranium concentration between the unsaturated Great Miami Aquifer

lysimeter and gray till lysimeter is 5 at 40 years. This is considered a good agreement between model predictions and field measured data. Observed average concentration data were matched by assuming the leachate concentration at the source to be constant at 175 μg/L.

The model was also calibrated against data from a specific lysimeter pair instead of average data. Lysimeter pair 11129/11234 was selected for calibration because of good soil sample recovery during installation of lysimeters and clear indications of breaks in lithology. At this location, soil boring data indicate that gray till thickness is approximately 2.4 m (8 ft). Lysimeter 11234 was installed approximately 1.4 m (4.5 ft) into gray clay [approximately 1.1 m (3.5 ft) above the unsaturated Great Miami Aquifer and gray till interface]. Lysimeter 11129 was installed in the unsaturated Great Miami Aquifer approximately 0.96 m (3 ft) below gray till. Average uranium concentrations in the unsaturated Great Miami Aquifer were about 4.9 times that in the gray till at these lysimeters (Table D.1-III-1). Table D.1-III-3 shows model predictions based on the assumption that the distribution coefficient (K_d) is 4.3 mL/g for the gray till and 1.78 mL/g for the unsaturated Great Miami Aquifer. The ODAST model predicted that the ratio of uranium concentration between the unsaturated Great Maim Aquifer lysimeter and gray till lysimeter is 4.7 at 40 years. This is considered a good agreement between model predictions and field-measured data. Observed concentration data were matched by using 375 μg/L as the leachate concentration.

Model calculations indicate that lysimeter data can be explained by glacial till K_d values in the range of 3.1 to 4.3 mL/g and leachate concentrations in the range of 175 to 375 μg/L for first the 5 years of operations at the FEMP.

TABLE D.1-III-1

URANIUM CONCENTRATIONS MEASURED IN THE WATER SAMPLES COLLECTED FROM THE LYSIMETERS

	Southwest Lysimeters			Southeast Lysimeters			Northeast Lysimeters		
Date	Unsaturated GMA[a] Lysimeter 11129 (μg/L)	Gray Till Lysimeter 11234 (μg/L)	Ratio of Unsaturated GMA to Gray Till Concentration	Unsaturated GMA Lysimeter 11131 (μg/L)	Gray Till Lysimeter 11130 (μg/L)	Ratio of Unsaturated GMA to Gray Till Concentration	Unsaturated GMA Lysimeter 11133 (μg/L)	Gray Till Lysimeter 11132 (μg/L)	Ration of Unsaturated GMA to Gray Till Concentration
9/93	15.0	ND[b]	NA[c]	11.0	7.9	1.4	52.0	ND	NA
3/21/94	16.0	4.1	3.9	3.4	13.0	0.3	47.0	4.6	10.2
3/22/94	29.0	3.9	7.4	12.0	2.9	4.1	16.0	2.5	6.4
3/23/94	28.0	4.6 (4.2)	6.1	12.0 (12.0)	2.8	4.3	17.0 (14.0)	2.3	7.4
3/24/94	ND	4.9	NA	ND	2.8	NA	16.0	3.5	4.6
5/06/94	28.0	5.6	5.0	10.0	2.4	4.2	12.0	2.9	4.1
5/13/94	27.0	5.2	5.2	9.1	2.5	3.6	12.0	2.8	4.3
5/20/94	26.0	5.4	4.8	8.9	3.0	3.0	13.0	2.8	4.6
5/27/94	ND	5.1	NA	ND	2.4	NA	ND	2.6	NA
6/03/94	24.0	5.2	4.6	8.1	2.4	3.4	12.0	2.6	4.6
6/10/94	ND	5.4	NA	ND	2.4	NA	ND	2.6	NA
6/17/94	23.0	5.3	4.3	8.3	2.6	3.2	12.0	2.4	5.0
Average	24.0	4.9	4.9	9.5	3.9	2.4	20.3	2.9	7.1

Overall average unsaturated GMA concentration = 17.9 μg/L.
Overall average gray till concentration = 3.9 μg/L.
Overall average ratio = 4.8.

[a]GMA = Great Miami Aquifer
[b]ND = No data available
[c]NA = Not applicable

TABLE D.1-III-2

PREDICTED URANIUM CONCENTRATIONS FOR TYPICAL LYSIMETER INSTALLATION

Time (Years)	Predicted Uranium Concentrations		
	Unsaturated GMA[a] Lysimeter (μg/L)	Gray Till Lysimeter (μg/L)	Ration of Unsaturated GMA to Gray Till Concentration
5	0.0	0.0	0.0
10	0.0	0.0	0.0
15	0.0	1.6	0.0
20	0.0	31.0	0.0
25	0.0	71.3	0.0
30	0.1	49.6	0.0
35	3.1	17.0	0.2
40	18.9	3.8	5.0
45	50.3	0.1	584.8

[a]GMA = Great Miami Aquifer

TABLE D.1-III-3

PREDICTED URANIUM CONCENTRATIONS FOR SOUTHWEST LYSIMETER PAIR 11129/11234

Time (Years)	Predicted Uranium Concentrations		
	Unsaturated GMA[a] Lysimeter 11129 (μg/L)	Gray Till Lysimeter 11234 (μg/L)	Ration of Unsaturated GMA to Gray Till Concentration
5	0.0	0.0	0.0
10	0.0	0.4	0.0
15	0.0	32.6	0.0
20	0.0	128.3	0.0
25	0.0	126.9	0.0
30	0.2	60.9	0.0
35	3.6	19.6	0.2
40	23.3	5.0	4.7
45	63.8	1.1	59.4

[a]GMA = Great Miami Aquifer

ATTACHMENT D.1-IV

ALTERNATE MODELING APPROACH FOR PRELIMINARY WASTE ACCEPTANCE CRITERIA

ATTACHMENT D.1-IV

ALTERNATE MODELING APPROACH FOR PRELIMINARY WASTE ACCEPTANCE CRITERIA

In order to evaluate the protectiveness of the proposed waste acceptance criteria (WAC), additional modeling was performed using a conceptual model for the vadose zone that differed from the model used throughout the remainder of the groundwater modeling. The differences were as follows:

- The infiltration was recalculated using less conservative assumptions than those used in the original HELP modeling.
- The 3 feet thick disposal cell liner, which was not used in the original modeling, was included in the ODAST simulation.
- The unsaturated sand and gravel layer in the Great Miami Aquifer, which was used in the original modeling, was not included in the ODAST simulation.

Infiltration was calculated by the HELP model using the entire disposal cell cross section. The HELP model output indicates that the infiltration rate would be 0.89 in./yr which is lower than the original value of 1.22 in./yr. A summary of the HELP model input and output is presented in Table D.5-IV-1. In contrast to the original infiltration calculation, the current calculation includes the overburden waste material layer and the underlying natural material beneath the disposal cell. Also, while the original calculation included only a 1-foot lateral drainage layer with a hydraulic conductivity of 1 x 10^{-2} cm/s, which does not provide much lateral drainage, the updated HELP model simulation includes a 4.5-foot combined lateral drainage layer consisting of the sand filter (0.5 feet of sand), biotic barrier (3 feet of cobbles), and the drainage layer (1 foot of sand) functioning together as a unit. Together these layers are capable of sufficiently draining water above the infiltration barrier, thus preventing the buildup of excessive hydraulic head above the infiltration barrier. The hydraulic conductivity in this combined lateral drainage layer is estimated to be 1 x 10^{-1} cm/s. All of the layers utilized in the updated HELP run are present in the disposal cell cap cross section and can be accounted for in the simulation. However, conservatism is still maintained by omission of the geomembranes in the system.

The clay liner was set at 3 feet thick and assumed to consist of clay with a K_d value of 24 L/Kg. This K_d value, which is higher than that in the original modeling, was based on the assumption that the quality of clay from a borrow source would be controlled to ensure the higher value. The

TABLE D.1-IV-1
ALTERNATE MODELING APPROACH
INFILTRATION MODELING RESULTS

CRU2 Disposal Cell Area

Total Surface Area	15,625	square feet
Open or Closed Landfill	0	0 – Closed 1 – Open
Runoff Fraction	1	
AMC – II Runoff Curve Number	58.00	
Vegetative Cover Number	3.0	
Maximum Leaf Area Index	2.0	
Evaporative Zone Depth	21.0	inches
Initial Snow Water	0.0	inches
Liner Leakage Fraction	1	

RESULTS

Percolation Flux Rate	0.84	in/yr
Leak Detection Flux Rate	0.05	in/yr
Final Snow Water	0.00	in

HELP Layer Type

1 – Vertical Percolation Layer
2 – Lateral Drainage Layer
3 – Barrier Soil Layer
4 – Membrane

Grass Type	Vegetative Cover Number	Leaf Area Index	Evap. Zone Depth (in)
None	1.0	0.0	9.0
Poor	2.0	1.0	15.0
Fair	3.0	2.0	21.0
Good	4.0	3.3	30.0
Excellent	5.0	5.0	38.0

Climatological data is HELP default for Cincinnati, OH 1974 – 1978

HELP Layer #	Layer Description	HELP Layer Type	HELP Soil Type	Layer Thickness (ft)	Drain Length (ft)	Drain Slope (%)	Hydraulic Conductivity (cm/sec)	Porosity (%)	Field Capacity (%)	Wilting Point (%)	Initial Moist. (%)	Final Moist. (%)
1	Top Soil	1	10	2.25			1.20E – 04	0.398	0.244	0.136	0.32	0.32
2	Bio – Drain	2	99999	4.50	100	4	1.00E – 01	0.417	0.045	0.020	0.05	0.05
3	Sub – Barrier	3	16	2.00			1.00E – 07	0.430	0.366	0.280	0.43	0.43
4	Contaminated Soil	1	10	36.50			1.20E – 04	0.398	0.244	0.136	0.24	0.24
5	Leak Detection	2	99999	1.00	100	4	1.00E – 01	0.417	0.045	0.020	0.05	0.05
6	2 Sub – Barrier	3	16	3.00			1.00E – 07	0.430	0.366	0.280	0.43	0.43
7	Brown Clay / Sand	1	7	10			7.04E – 05	0.300	0.108	0.080	0.22	0.22
8	Gray Clay	1	14	15			7.23E – 07	0.200	0.165	0.148	0.19	0.19
9	Unsaturated GMA	1	1	30			1.59E – 02	0.300	0.108	0.015	0.04	0.04

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19 percent. Because of the updated infiltration rate and moisture content, the retardation factor is 31.2, higher than the original value of 14.99, which was based on the original, higher infiltration rate and moisture content.

The thickness of the unsaturated sand and gravel layer in the Great Miami Aquifer was assumed to be zero (compared to approximately 35 feet in the original modeling). Thus, any retardation in the sand and gravel is eliminated.

Using the updated layers, infiltration rate, and retardation factor, an ODAST/SWIFT modeling run was completed. The source leachate concentration was assumed to be 24,000 pCi/L. The simulated maximum uranium concentration in the Great Miami Aquifer in 1,000 years was about 1.4 ug/L, well below the target MCL value of 20 ug/L. The uranium plume at the end of the simulation is shown in the Figure D.5-IV-1. This result serves to support the current preliminary WAC proposed in this FS. Confirmation of the preliminary WAC by a different modeling approach also serves to demonstrate that the proposed criteria are robust.

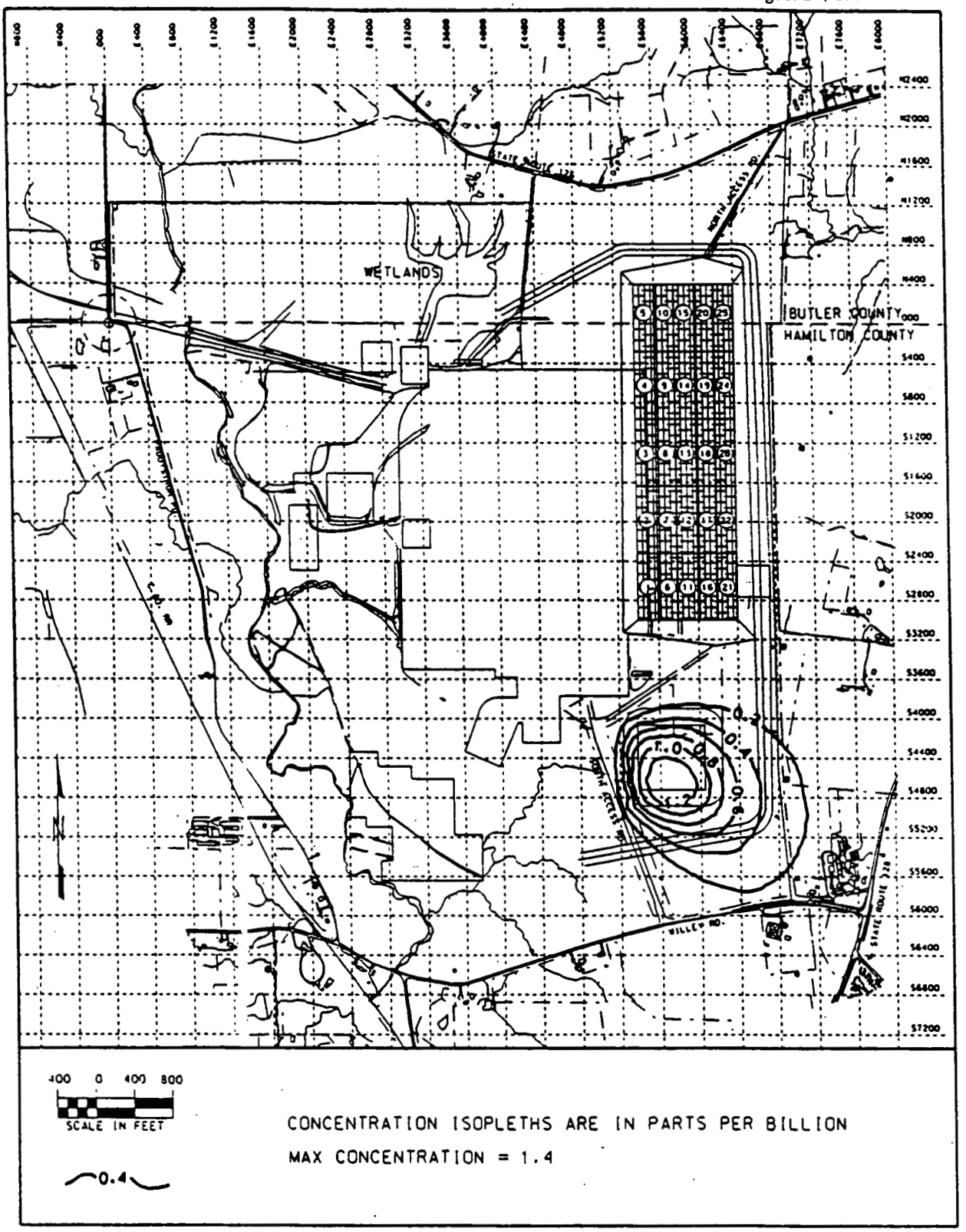

FIGURE D.1-IV-1
ALTERNATE MODELING APPROACH
PROJECTED INCREASE IN TOTAL URANIUM CONCENTRATIONS

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D.2

APPENDIX D.2

AIR TRANSPORT MODELING FOR LONG-TERM RESIDUAL RISK

D.2.0 AIR TRANSPORT MODELING FOR LONG-TERM RESIDUAL RISK

D.2.1 INTRODUCTION

This section presents the approach, methodology, and results of the long-term air transport analysis of the Operable Unit 2 remedial alternatives. The objective of this analysis was to determine the maximum on-property and off-property annual average air contaminant concentrations and deposition rates from the remediated Operable Unit 2 subunits. These concentrations were used for the residual risk assessment described in this FS. The discussion and results of the site-wide air transport analysis for all operable units is presented in the Operable Units 1 and 2 CRARE submitted with this FS.

The analysis was conducted in accordance with EPA guidance (EPA 1989a). Two emission models and an air dispersion model were used to estimate air emissions from each source and to calculate annual average concentrations and deposition rates at various receptor locations. One emission model predicted the quantity of exposed soil that would be resuspended by the wind, and the other emission model estimated the flux of radon-222 gas from soil containing radium-226. Particulate-phase contaminants examined include radionuclides and inorganic compounds, as well as semivolatile and nonvolatile organic compounds. The only gas-phase contaminant evaluated in this analysis was radon-222. VOCs were not analyzed, as they would be lost to the atmosphere prior to the start of the postremediation periods analyzed in the FS. The air dispersion model accounted for dispersion and dilution of the contaminants under defined meteorological conditions, such as wind speed and direction, atmospheric stability, and mixing height. The meteorological parameters used were collected from an on-property meteorological station, as well as from the National Weather Service (NWS) in Dayton, Ohio.

Five major steps were required to achieve the objective of this analysis:

1. Scenarios for the air transport analysis were defined.
2. Sources of air emissions and contaminants released were identified based on site-specific information.
3. The appropriate EPA regulatory air dispersion model was selected which best represented the site characteristics and the objective of the analysis.
4. Particulate or gaseous air emissions were estimated from site-specific soil contaminant concentrations, and additional inputs to the model, such as meteorological data and receptor locations, were determined.

5. Results of the air dispersion model were processed to determine the maximum on- and off-property annual average concentrations and deposition rates for residual risk calculations.

Figure D.2-1 presents the sequential block diagram of these steps and indicates the sections below that describe them.

Throughout the analysis, site-specific data were used where available. When such data were not available, conservative assumptions were made. Regulatory default options and values were used where applicable in the air emission and dispersion models. The intent of the assumptions was to make the results relevant to the site so that the risk associated with the air exposure pathway was realistic.

D.2.2 SOURCE TERM ASSUMPTIONS FOR AIR TRANSPORT ANALYSIS

The residual risks from remediated Operable Unit 2 subunits were evaluated for a number of exposure scenarios under two land-use assumptions: future with federal ownership and future with private ownership. The impact that the RME receptor was assumed to have on the generation of air emissions from the FEMP was different between these two scenarios. With federal ownership, the expanded trespasser was assumed to have little impact on the generation of fugitive particulate matter emissions. With private ownership, the on-property resident farmer was assumed to significantly contribute to the generation of fugitive particulate matter emissions, primarily from agricultural tilling. Therefore, separate sets of air emissions and concentration estimates were developed for each of the future land-use scenarios.

A detailed analysis of four remedial alternatives is presented in Section 5.0 of this FS. These alternatives include no action (Alternative 1), consolidation and capping (Alternative 2), excavation and off-site disposal (Alternative 3), and excavation and on-site disposal with off-site disposal of fraction exceeding the waste acceptance criteria (Alternative 6). Therefore, exposure point concentrations were required for Alternatives 2, 3, and 6 to complete the risk assessments for these alternatives. Exposure point concentrations were determined for Alternative 1 in the Operable Unit 2 RI Report Baseline Risk Assessment (DOE 1994). The assumptions regarding the air pathway impacts associated with the other three remedial alternatives are discussed in the following paragraphs.

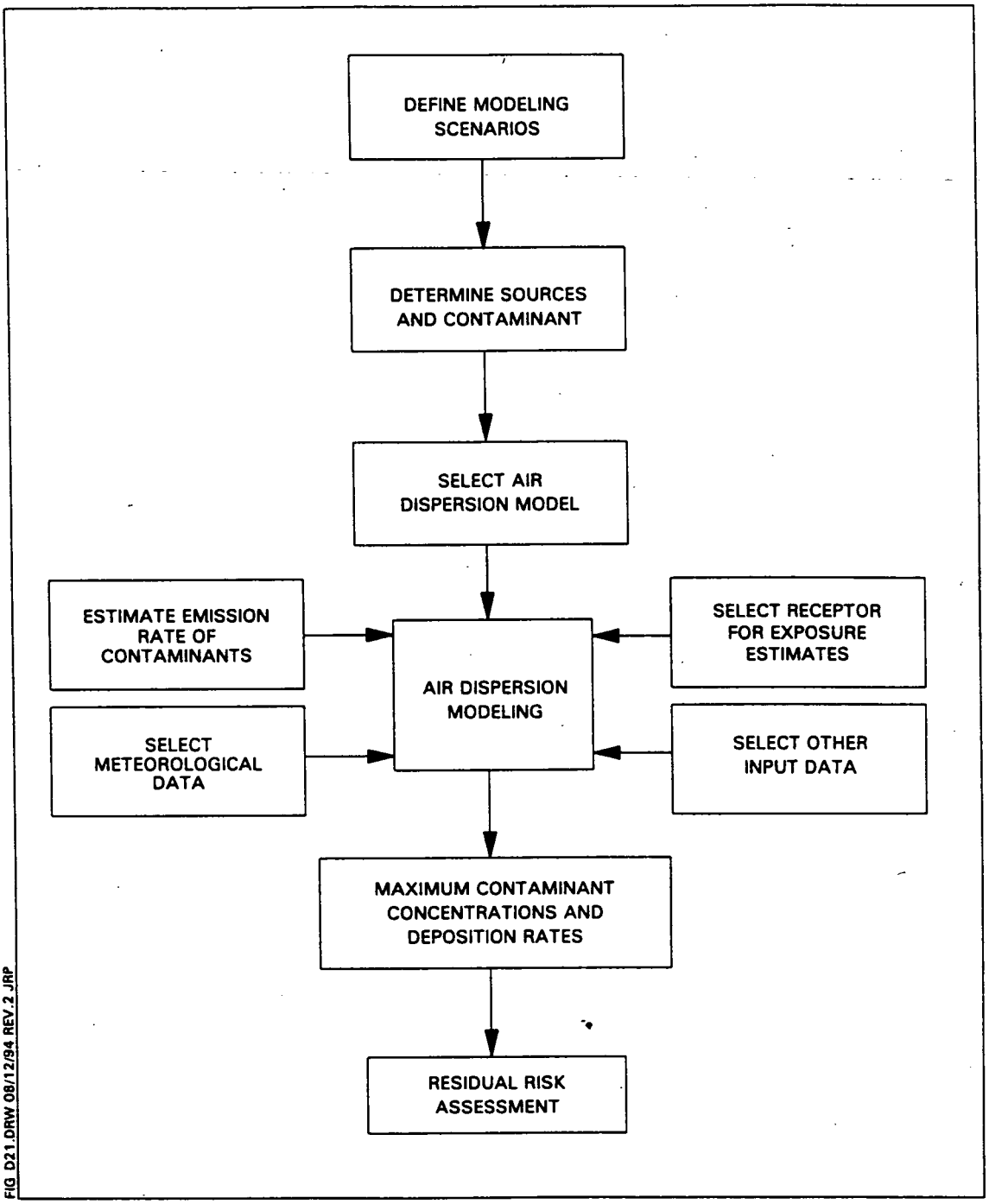

FIGURE D.2-1. SEQUENTIAL BLOCK DIAGRAM OF AIR TRANSPORT ANALYSIS

D.2.2.1 Alternative 2: Consolidation and Capping

This alternative involves excavation, consolidation, and capping within each Operable Unit 2 subunit. Air fate and transport analysis for this alternative was conducted only for the future land use with federal ownership. Therefore, the expanded trespasser and/or off-property resident farmer PRLs were assumed to set the upper limit on residual surface soil contamination levels.

The consolidation area for the South Field area (South Field, Active Flyash Pile, and Inactive Flyash Pile) will be located on the deep till in the northeast portion of the South Field and Active Flyash Pile. The contaminated material directly overlying the Great Miami Aquifer (GMA) and/or down surface from the old terrace face in the South Field area will be excavated and placed in the consolidation area. A multi-layer capping system, as shown in Appendix E, will be constructed over the consolidation area. The excavated areas may be backfilled or covered with clean material.

Several layers of South Field area soil containing residual contamination were assumed to be exposed to the atmosphere after completion of remedial activities for this analysis. The contaminant concentrations in the GMA soil (from Appendix A) were assumed for the areas excavated down to the GMA. The contaminant concentrations in the old terrace face (listed as "Other Till" in Appendix A) were assumed for the Inactive Flyash Pile area that was excavated to the old terrace. The contaminant concentrations in the impacted till below portions of the South Field and Active Flyash Pile were used for those areas where excavation was completed just below the fill or source material. Radon emissions were estimated from residual radium concentrations in the exposed soil. The multi-layer cap over the consolidation area will be constructed to last 1,000 years without exposure of contained material. Therefore, the consolidation area was not assumed to contribute particulate matter emissions. However, gaseous radon emissions through the cap were quantified and included in radon dispersion modeling.

Contaminated material in the Solid Waste Landfill with concentrations exceeding the expanded trespasser and off-property resident farmer PRLs will be consolidated within the landfill and a composite cap constructed over the material. The excavated areas will be backfilled with clean soil. The capped area was assumed to cover most of the surface area of the Solid Waste Landfill. Therefore, no significant contribution to particulate matter emissions was assumed for this subunit. Gaseous radon emissions through the cap were quantified and included in radon dispersion modeling.

The Lime Sludge Ponds will be capped in place with a multi-layered cap. No significant contribution to particulate matter emissions was assumed for this subunit. However, gaseous radon emissions through the cap were quantified and included in radon dispersion modeling.

D.2.2.2 Alternative 3: Offsite Disposal

This alternative involves excavation of all contaminated material, segregation, staging, size reduction, drying, packaging, and off-site disposal. Air fate and transport analysis for this alternative was conducted for both future land-use scenarios. With federal ownership, the expanded trespasser and/or off-property resident farmer PRLs were assumed to set the upper limit on residual surface soil contamination levels. With private ownership, the on-property resident farmer PRLs were assumed to set the upper limit on residual surface soil contamination levels.

As in Alternative 2, the contaminated material directly overlying the GMA and/or down surface from the old terrace face in the South Field area will be excavated. The contaminant concentrations in the GMA soil (from Appendix A) were assumed for the areas excavated down to the GMA. The contaminant concentrations in the old terrace face (listed as "Other Till" in Appendix A) were assumed for the areas that were excavated to the old terrace. The contaminant concentrations in the impacted till were used for those areas where excavation was completed just below the fill or source material. The contaminant concentrations in the surface soil in the northeast corner of the South Field and Active Flyash Pile were assumed to be at or below the appropriate PRL values for each land-use scenario. Radon emissions were estimated from residual radium concentrations in the exposed soil.

The material in the Solid Waste Landfill with contaminant concentrations which exceed the appropriate PRL values will be excavated. The excavated areas will be backfilled with clean soil. The residual soil concentrations were assumed to be at or below the PRL values. Radon emissions were estimated from residual radium concentrations in the surface soil.

The material in the Lime Sludge Ponds with contaminant concentrations which exceed the appropriate PRL values will be excavated. The excavated areas will be backfilled with clean soil. The residual soil concentrations were assumed to be at or below the PRL values. Radon emissions were estimated from residual radium concentrations in the surface soil.

D.2.2.3 Alternative 6: Excavation and On-Site Disposal with Offsite Disposal of Fraction Exceeding the WAC

This alternative involves excavation of contaminated material and transportation to an on-site disposal cell. Material with contamination exceeding the on-site disposal cell waste acceptance criteria (WAC) will be disposed off site at a permitted commercial facility. Air fate and transport analysis for this alternative was conducted for both future land-use scenarios. With federal ownership, the expanded trespasser and/or off-property resident farmer PRLs were assumed to set the upper limit on residual surface soil contamination levels. With private ownership, the on-property resident farmer PRLs were assumed to set the upper limit on residual surface soil contamination levels.

As in Alternatives 2 and 3, the contaminated material directly overlying the GMA and/or down surface from the old terrace face in the South Field Area will be excavated. The contaminant concentrations in the GMA soil (from Appendix A) were assumed for the areas excavated down to the GMA. The contaminant concentrations in the old terrace face (listed as "Other Till" in Appendix A) were assumed for the areas that were excavated to the old terrace. The contaminant concentrations in the impacted till were used for those areas where excavation was completed just below the fill or source material. The contaminant concentrations in the surface soil in the northeast corner of the South Field and Active Flyash Pile were assumed to be at or below the appropriate PRL values for each land use scenario. Radon emissions were estimated from residual radium concentrations in the exposed soil.

The material in the Solid Waste Landfill with contaminant concentrations which exceed the appropriate PRL values will be excavated. The excavated areas will be backfilled with clean soil. The residual soil concentrations were assumed to be at or below the PRL values. Radon emissions were estimated from residual radium concentrations in the surface soil.

The material in the Lime Sludge Ponds with contaminant concentrations which exceed the appropriate PRL values will be excavated. The excavated areas will be backfilled with clean soil. The residual soil concentrations were assumed to be at or below the PRL values. Radon emissions were estimated from residual radium concentrations in the surface soil.

The excavated material which meets the disposal cell WAC will be placed in the on-site disposal cell. This cell will be covered with a multi-layered cap designed to last 1,000 years. Therefore, the

disposal cell was not assumed to contribute particulate matter emissions. However, gaseous radon emissions through the cap were quantified and included in radon dispersion modeling.

To analyze the Operable Unit 2 subunits, a total of 373 area sources were used. These sources were combined into 13 source groups; each source group contained sources with identical emission rates. The eight major source groups in the South Field Area are presented on Figure D.2-2. The remaining five source groups included the Solid Waste Landfill, Lime Sludge Ponds, On-Site Disposal Cell, and the Consolidation Area (north end and south end).

D.2.3 AIR TRANSPORT MODELS

The annual average contaminant concentrations and deposition rates were determined using the ISCLT2 model (EPA 1992a). This model is recommended by EPA for air pathway analysis of Superfund sites (EPA 1989a). The annual average deposition rates were calculated by multiplying the contaminant concentrations in air by the particulate deposition velocity of 0.0018 m/s (DOE 1992).

The ISCLT2 model was designed by the EPA to assess the impact on air quality of emissions from a wide variety of sources. It incorporates a steady-state gaussian plume equation that is applicable in flat or gently rolling terrain, for multiple point, area, and volume sources. The ISCLT2 model calculates the annual average concentration due to airborne emissions at user-selected receptors, based on sector-averaged statistical wind summaries. Data required for input to the model include source emission rates, the locations and configurations of sources, statistical summaries of wind speed, wind direction, and atmospheric stability, and the locations of the selected receptors.

D.2.4 PARTICULATE CONTAMINANT EMISSION RATES

Radionuclide, inorganic, semivolatile organic, and nonvolatile organic contaminants were assumed to be present in the suspended particulate matter emitted from the site. The emission rate for each contaminant in this particulate matter was calculated from the concentration of the contaminant in the exposed soil and from the estimated average particulate matter emission rates from Operable Unit 2. For concentration calculations, the emission rate of particulate matter less than 10 micrometers in diameter (PM_{10}) was used. For deposition rate calculations, the emission rate of total suspended particulates (TSP) was used. The TSP emission rate was determined by assuming that PM_{10} represented 50 percent of the TSP value (EPA 1993).

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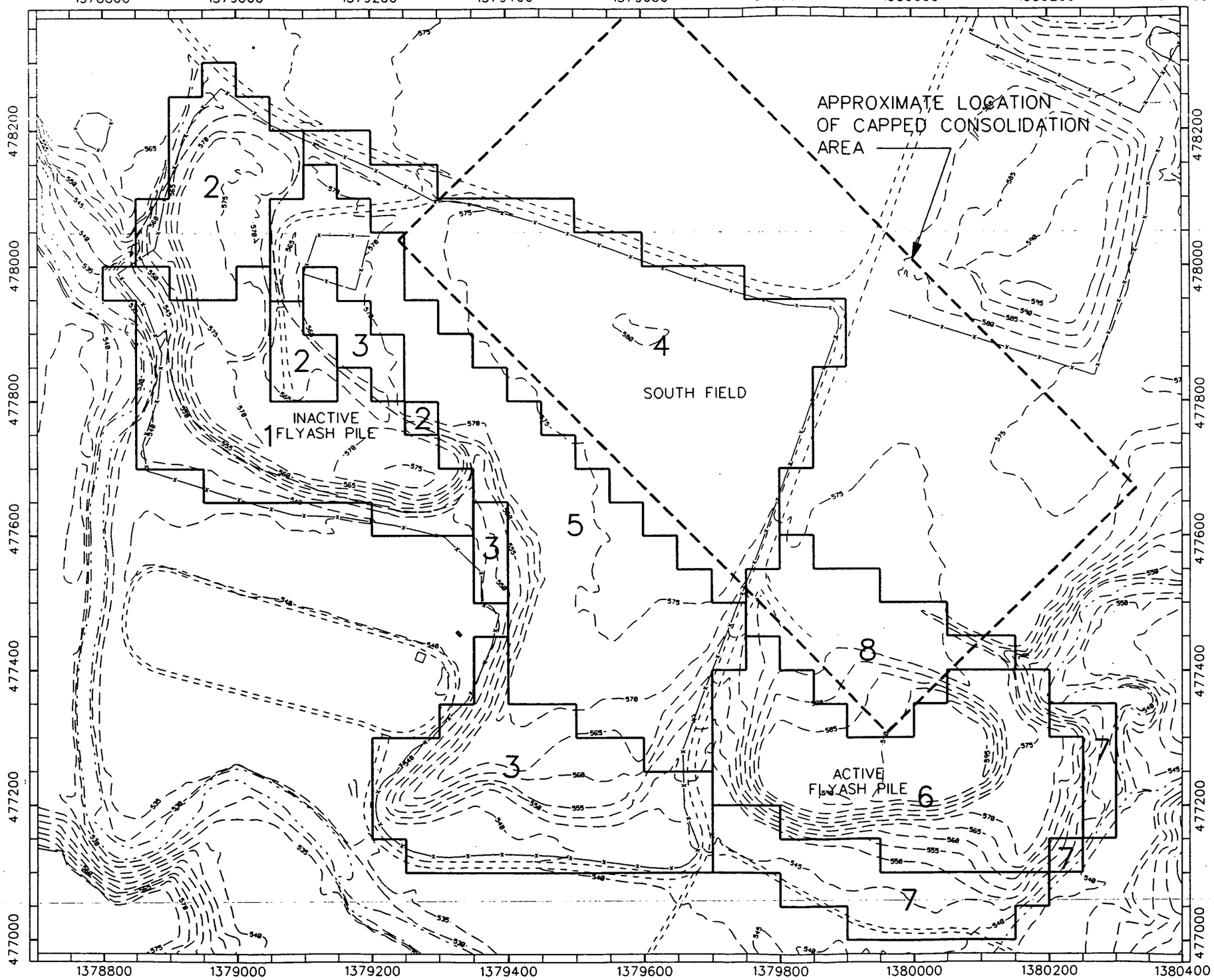

1 INACTIVE FLYASH PILE, EXPOSED GREAT MIAMI AQUIFER

2 INACTIVE FLYASH PILE, EXPOSED TILL

3 SOUTH FIELD, EXPOSED GREAT MIAMI AQUIFER

4 SOUTH FIELD, EXPOSED FILL (NOT USED FOR CONSOLIDATION AND CAPPING ALTERNATIVE)

5 SOUTH FIELD, EXPOSED TILL

6 ACTIVE FLYASH PILE, EXPOSED TILL

7 ACTIVE FLYASH PILE, EXPOSED GREAT MIAMI AQUIFER

8 ACTIVE FLYASH PILE, EXPOSED TILL (NOT USED FOR CONSOLIDATION AND CAPPING ALTERNATIVE)

LEGEND

575 ELEVATION CONTOURS

ROADS

STREAM

FENCE

NOTE:
Coordinates are in State Planar NAD 1927.
Surface contours based on 1992 flyover.

N

SCALE (FT)
0 150 300

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SCALE (METER)
0 36 72

FIGURE D.2-2
OPERABLE UNIT 2
SOURCE GROUPS FOR
RESIDUAL AIR MODELING

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D.2.4.1 Contaminated Soil Concentrations

The contaminant concentrations in soil used to develop of emission source terms are presented in Attachment D.2-I. The initial contaminant soil concentrations were selected from data in Appendix A of this FS.

Because this analysis assumed that the site has been remediated, any soil concentrations exceeding the expanded trespasser or on-property resident farmer PRLs identified in this FS were reset to the appropriate PRL value. For COCs which did not exceed the PRL value, the exposed soil concentration terms were used. These layers included the upper GMA and till in the Flyash Piles and South Field (all alternatives) as well as the fill in the South Field (Alternatives 3 and 6). This approach assumed that the residual contamination after remediation will not be worse than currently measured levels.

D.2.4.2 Suspended Particulate Emission Estimate

The method used to estimate PM_{10} emission rates for the FEMP is based on EPA guidance for estimating wind erosion rates from flat soil surfaces at hazardous waste sites (EPA 1985a). The EPA methodology assumes that a minimum wind speed is required for the suspension of respirable dust, and the emission rate is a nonlinear function of the "Threshold Friction Velocity" (TFV) and the erosion potential of the site, which depends on the particle size distribution of the soil. Very fine soils (those with small modal diameters) have low TFVs and high potential for erosion by wind.

In addition to modal diameter, other factors such as the amount of nonerodible elements [gravel and pebbles with diameters greater than approximately 1 cm (0.4 in.)], crustiness of the surface soil, and the amount of vegetative cover effect the quantity of soil that can be resuspended by the wind.

The on-property resident farmer receptor would be continuously breaking up the soil crust in the farmed area. Therefore, crustiness was not applied as a factor in determining the particulate emissions for this receptor. To conservatively estimate the emissions from an on-property farm, only the modal diameter was used to calculate the flux of particulate matter for determining risk under this scenario. For all other receptors/scenarios, the ability of the soil to form a crust, as well as moisture content and presence of nonerodible elements, was taken into account.

D.2.4.2.1 Emission Rates with Private Ownership

The modal diameter of Operable Unit 2 exposed soil was estimated from particle size distributions presented in the Operable Unit 2 RI Report (DOE 1994). From the data in that report, the modal diameter occurs in the silt fraction, which is between 0.002 and 0.075 mm (0.000001 and 0.00003 in.). The modal diameter selected was approximately 0.021 mm (0.00001 in.), which is in agreement with the typical 50 percent particle size diameter for the FEMP (Mulder 1993).

Using an exposed soil modal diameter of 0.021 mm, the TFV can be determined from the EPA guidance document (EPA 1985a, Figure 3-4). The relationship between the modal diameter and the TFV can be represented by the equation:

$$\log (TFV) = 1.812 + 0.4161 \log (d_p) \qquad \text{(D.2-1)}$$

where

TFV = threshold friction velocity (cm/s) near the soil surface, and
d_p = modal diameter of soil sample (mm).

The calculated TFV is approximately 13.0 cm/s (5 in./s) based on a modal diameter of 0.021 mm (0.00001 in.). The calculated TFV should be corrected based on the surface roughness, crustiness, and quantity of nonerodible elements. The ratio of the corrected TFV to the uncorrected TFV is a nonlinear function of the ratio of the silhouette area of the roughness elements to the total area of bare loose soil (EPA 1985a). For this FS, no correction was applied to the calculated TFV based on the assumption that the exposed surface would behave like dry, loose silt. This assumption is obviously conservative, since the site has enough clay in the soil to form a nonerodible crust, the surface contains nonerodible elements, and the vegetation present will significantly increase the TFV necessary to resuspend surface soil.

The calculated TFV is less than the 75 cm/s (30 in./s); therefore, the FEMP surface soil was considered to have an "unlimited" erosion potential (EPA 1985a). The equation for respirable particulate emissions of soils with unlimited erosion potential takes the following form:

$$E_{10} = 0.036 \times (1-V) \times [(u/u_t)^3] \times F(y) \qquad \text{(D.2-2)}$$

where

E_{10} = annual average PM_{10} emission rate per unit area of contaminated surface (g/hr/m^2),

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PM_{10} = particulate matter with a diameter $\leq$ 10 meters,

V = fraction of soil covered by vegetation,

u = mean annual wind speed (m/s),

u_t = TFV at the height of "u" (m/s),

y = $0.886 \times u_t / u$,

F(y) = 1.91 for $y < 0.5$,

F(y) = $0.18 \times (y^3 + 12y) \times EXP(-y^2)$ for $y > 2$, and

F(y) = See Figure 4-3, EPA 1985a, for $0.5 < y < 2$.

For the on-property resident farmer exposure scenarios, the farmed land will be periodically plowed and planted, harvested, plowed, and left fallow. Under these scenarios, the topsoil is assumed to be covered with vegetation for only 50 percent of the year.

The TFV must be corrected to the anemometer height [10 m (30 ft)] used to collect site wind speed data. The corrected TFV is calculated from the following equation (EPA 1985a):

$$U_t/TFV = (1/0.4) \ln (Z/Z_o) \qquad \text{(D.2-3)}$$

where

Z = anemometer height (m), and

Z_o = surface roughness height (m).

The surface at the FEMP will be covered with grass and other vegetation after completion of remedial actions. Using an approximated value of 0.03 m (0.1 ft) for grassland (EPA 1985a) as Z_o, the value of U_t was calculated to be 1.89 m/s (6 ft/s).

The methodology used to calculate the emissions for soil with unlimited erosion potential is based on multiplying the emission rate for a single mean annual wind speed value by an estimated annual wind speed probability distribution. This method allows for rapid calculation of annual PM_{10} emissions knowing only the mean annual wind speed. The highest annual average wind speed from the on-site meteorological data set was 2.28 m/s (DOE 1993c). Using this wind speed value in Equation D.2-2 provides an estimated PM_{10} emission flux of 1.59×10^{-5} g/sec/m^2.

The annual average contaminant emission rates from each subunit under each alternative is presented in Attachment D.2-II. Only those emission rates associated with soil concentrations which exceed background are included in the attachment.

D.2.4.2.2 Emission Rates with Administrative Controls

Observations of the surface soil at the FEMP indicate that the surface may have a limited erosion potential, based on comparison of the FEMP surface to photographs of limited erosion potential surfaces presented in the reference document (EPA 1985a). Therefore, the limited erosion potential equation, presented below, is used to estimate particulate emissions for the expanded trespasser/off-property farmer exposure scenarios:

$$E_{10} = 0.83 \times f \times P(u^+) \times (1 - V) / (PE/50)^2 \qquad \text{(D.2-4)}$$

where

E_{10} = annual average PM_{10} emission rate per unit area of contaminated surface ($g/hr/m^2$),

f = frequency of disturbance per month,

$P(u^+)$ = erosion potential, the quantity of erodible particles present on the surface prior to the onset of wind erosion (g/m^2),

u^+ = observed (or probable) fastest mile, of wind for the period between disturbances (m/s),

V = fraction of soil covered by vegetation, and

PE = Thornthwaite's Precipitation Index (a measure of average soil moisture content).

The erosion potential in Equation D.2-4 depends on the fastest mile as follows (EPA 1985a):

$$P(u^+) = 6.7 \times (u^+ - u_t), \text{ for } u^+ \geq u_t, \qquad \text{(D.2-5)}$$
$$= 0, \text{ for } u^+ < u_t.$$

A typical fastest mile for the region is 24 m/s (EPA 1985a) at 7 m above the ground. Correcting the threshold friction velocity previously determined for the unlimited erosion potential to 7 m above the ground (using Equation D.2-3) results in a value of 1.77 m/s for u_t. The calculated value for $P(u^+)$ is 148.93 g/m^2.

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Since the remediated site under scenarios other than the on-property resident farmer will be infrequently disturbed, the value of **f** was assumed to be 1. Thornthwaite's Precipitation Index (PE) for the southwest corner of Ohio is 103 (EPA 1985a).

Currently, the FEMP is 80 to 85 percent covered with vegetation. After remediation, each subunit will be planted with appropriate vegetation for erosion control and aesthetics. The region easily supports plant life, and a 100 percent vegetative cover is expected over the postremediated site, with or without continued maintenance. For this air transport analysis, the site was conservatively assumed to be 85 percent covered with vegetation. The 85 percent value is in line with EPA estimates of control efficiencies for vegetative covers (EPA 1987).

The limited erosion potential of PM_{10} for the FEMP is then calculated to be 1.21×10^{-6} g/s/m^2.

Note that the ISCLT2 model calculates dispersion for six wind speed categories (EPA 1992a). The use of a single emission rate for dispersion under all six wind speed categories will overestimate the concentrations for low wind speeds and underestimate concentrations for high wind speeds. The frequency of wind speeds in the lower wind speed categories is much greater than the frequency of wind speeds in the upper wind speed categories. Therefore, using a single emission rate for all wind speed categories in ISCLT2 will tend to overestimate the ground level PM_{10} concentrations. Evidence indicates (EPA 1985b) that no substantial fugitive particulate emissions occur for wind speeds less than 5 m/s (16.4 ft/s or 12 mph). These wind speeds include the lower three wind speed categories analyzed by ISCLT2.

The annual average contaminant emission rates from each subunit under each alternative is presented in Attachment D.2-II. Only those emission rates associated with soil concentrations which exceed background are included in the attachment.

D.2.5 GASEOUS CONTAMINANT EMISSION RATES

Emissions of radon-222 were estimated for exposed soil as well as from capped or covered areas. No other gaseous emissions were estimated. Volatile organics were assumed to have decayed to negligible levels prior to the time period studied by this analysis. Radionuclides, semivolatile and nonvolatile organics, and inorganics were assumed to be transported with the particulates emitted from the site.

Radon-222 emissions were determined from the radium-226 concentrations in the contaminated soil using the RAECOM model algorithms developed for the NRC (NRC 1984). The model accounts for the half-lives of radon and radium, as well as the density, porosity, moisture content, and depth of contaminated layers and cover layers in estimating radon-222 emission rates. The model converts radium-226 soil concentrations (in pCi/g) to radon-222 fluxes (in pCi/s/m^2). The basic equations are presented in the Risk Assessment Work Plan Addendum (DOE 1992). The RAECOM model input parameters and output are presented in Attachment D.2-III.

D.2.6 METEOROLOGICAL DATA

Meteorological data characterizing the transport and dispersion conditions of an area are needed as input to the ISCLT2 model. These data include wind speed, wind direction, atmospheric stability, ambient air temperature, and mixing height. Measurements for all of these meteorological parameters, except mixing height, have been recorded at the FEMP site as part of a comprehensive environmental monitoring program since August 1986.

Direct measurements of wind speed, wind direction, and ambient air temperature were taken at a height of 10 m (30 ft) above the ground. Atmospheric stability was derived from direct measurements of the standard deviation of the horizontal wind direction (σ_θ) during the day and the low-level temperature difference (ΔT) at night. Measurements of σ_θ were taken at a height of 60 m (180 ft) above the ground. The temperature difference was calculated from air temperature measurements taken at 60 and 10 m (180 and 30 ft) above the ground. Site-specific hourly measurements were obtained for 1987 through 1992, excluding 1990 due to poor data recovery. A 5-year composite joint frequency distribution of wind speed, wind direction, and atmospheric stability is presented in Attachment D.2-IV. The composite distribution was used in the ISCLT2 dispersion model.

Mixing heights were determined from twice-daily atmospheric soundings made by the NWS. The nearest NWS station is in Dayton, Ohio.

D.2.7 RECEPTOR LOCATIONS

As previously stated, the objective of the air transport analysis was to determine the maximum on- and off-property contaminant concentrations for risk assessment calculations. Two rectangular

receptor grid systems were used to determine the maximum on-property concentrations and approximate locations. The first grid consisted of 676 receptor points in a 121.9 x 121.9 m (400 x 400 ft) pattern which extended over the entire FEMP property. The 1927 State Planar coordinate system was used for origin and location. The second grid consisted of 360 receptor points, also in a 121.9 x 121.9 m (400 x 400 ft) pattern, located over the center of the FEMP. The second grid was offset 200 ft north and 200 ft east of the first grid, resulting in an effective 86.2 x 86.2 m (283 x 283 ft) pattern over the center of the FEMP.

Thirty-six fenceline receptor points located around the FEMP were included in the air transport analysis to identify the maximum off-property receptor. These fenceline receptor locations were determined from the intersection of the FEMP fenceline and imaginary lines extending in 36 directions at 10-degree intervals from a point located at 1,381,000 ft East and 480,000 ft North (1927 State Planar coordinates). The analysis results for the fenceline receptor with the highest air quality impacts are reported as the maximum off-property concentrations in Section D.2.10.

Figure D.2-3 shows the layout of the receptor grid considered in the air dispersion modeling. Because the concentrations were used primarily to estimate inhalation pathway risk for outdoor activities, the receptors were assumed to be 1.5 m (5 ft) above the ground to simulate a typical person's breathing height for outdoor activities (EPA 1989b). The variation of ground level concentration within 0 to 1.5 m (0 to 5 ft) is negligible.

D.2.8 DISPERSION COEFFICIENTS

The selection of rural or urban dispersion coefficients for use in the ISCLT2 model was based on a land-use typing procedure to determine whether the characteristics of the area around the FEMP are primarily rural or urban. The procedure involved classifying the land use within an area circumscribed by a 3 km (1.9 mi) radius about the site. Urban dispersion coefficients were recommended for use if land-use types of heavy industrial, light-to-moderate industrial, commercial, single-compact residential, and multi-compact residential account for 50 percent or more of the area. Otherwise, rural dispersion coefficients were recommended.

A review of U.S. Geological Survey (USGS) maps and a site survey of the area indicated that industrial, commercial, and compact residential land use comprise no more than 10 percent of the

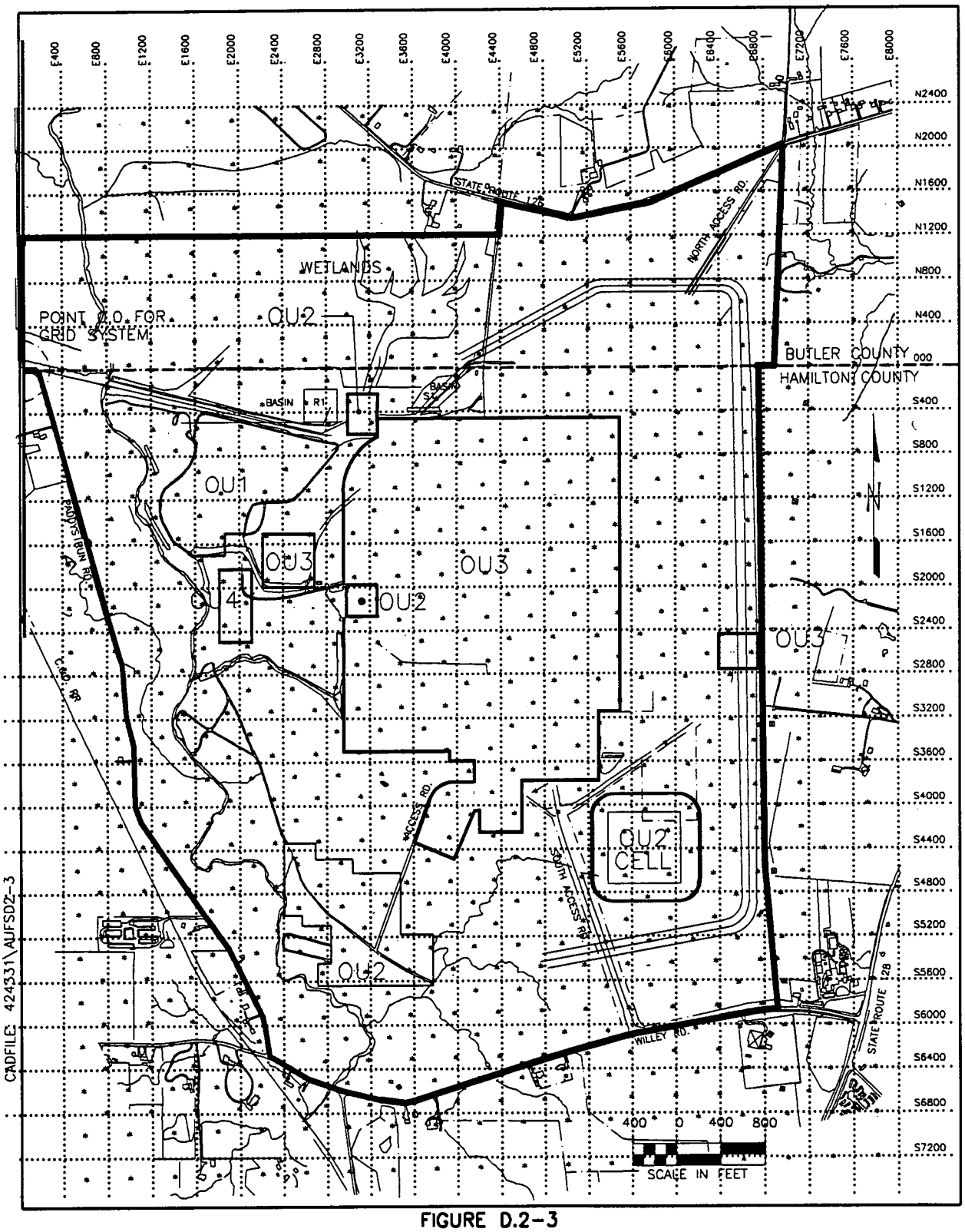

FIGURE D.2-3

RECEPTOR GRIDS FOR AIR DISPERSION MODELING

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area within a 3 km (1.9 mi) radius of the site. Therefore, the area was classified as rural for the purpose of air dispersion modeling, indicating the use of rural dispersion coefficients would be appropriate.

D.2.9 MODEL OUTPUT PROCESSING

The air dispersion modeling analysis was simplified by running the ISCLT2 model with an assumed emission rate of 1.0 g/s/m^2 or 1.0 pCi/s/m^2 for each area source. The source group and plot file options of the ISCLT2 program were used to group sources and write the grouped results to a plot file. The ISCLT2 source group results were multiplied by the contaminant emission rates listed in Attachments D.2-II and D.2-III to determine the contaminant-specific annual concentrations presented in Section D.2.10. Spreadsheets were used to calculate the contaminant-specific concentrations from the ISCLT2 model output and emissions data in Attachments D.2-I and D.2-II. The 373 area sources were combined into 13 source groups:

1. Active Flyash Pile - exposed GMA (26 sources)
2. Active Flyash Pile - exposed till, consolidation/capping alternatives (36 sources)
3. Active Flyash Pile - exposed till, additional sources for on-site disposal cell and off-site disposal alternatives (21 sources)
4. Inactive Flyash Pile - exposed GMA (32 sources)
5. Inactive Flyash Pile - exposed till (22 sources)
6. South Field - exposed GMA (40 sources)
7. South Field - exposed till (43 sources)
8. South Field - exposed fill, on-site disposal cell and off-site disposal alternatives (58 sources)
9. Consolidation Area - Inactive Flyash Pile and South Field end (49 sources for radon-222 emissions only)
10. Consolidation Area - Active Flyash Pile end (22 sources for radon-222 emissions only)
11. Solid Waste Landfill (4 sources)
12. Lime Sludge Ponds (4 sources)
13. On-site disposal cell (16 sources for radon-222 emissions only)

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D.2.10 RESULTS OF AIR DISPERSION MODELING

This section discusses the modeled air concentrations for each alternative. Values are presented for the maximum on-property and maximum off-property (fenceline) concentration or deposition rate for each contaminant in Attachment D.2-V.

D.2.10.1 Alternative 2 - Consolidation and Capping

The modeled maximum annual average contaminant concentrations (above background) under the consolidation and capping alternative are presented in Tables D.2-V-1 and D.2-V-9.

Gaseous radon-222 emissions resulted in the highest activity concentrations of any radionuclide analyzed by at least four orders of magnitude. The maximum on- and off-property (fenceline) concentrations of radon-222 were modeled at 1.55 and 0.080 pCi/m^3, respectively, from the South Field area. The exposed till in the South Field and Active Flyash Pile were the major contributors to the radon-222 impacts under this alternative. Radon-222 emissions from the capped areas are approximately five orders of magnitude below the emissions from exposed soil. Therefore, assuming that capped areas provide insignificant contribution to gas and particulate air emissions should be reasonable. The operable unit-wide radon-222 air concentrations are presented on Figure D.2-4.

The maximum radon-222 value is over three orders of magnitude below the EPA action level of 4,000 pCi/m^3 (4 pCi/l) for indoor radon concentrations. The maximum value is approximately three orders of magnitude below the annual average U.S. residential radon concentration of 1,250 pCi/m^3 (Marcinowski and Napolitano 1993).

Modeled concentrations of uranium-238 typically represented one of the more prevalent radionuclides in the particulate phase. The maximum on- and off-property concentrations of uranium-238 in PM_{10} were modeled at 9.47 x 10^{-5} and 4.55 x 10^{-6} pCi/m^3, respectively, for the South Field area. The maximum on- and off-property deposition rates of uranium-238 were modeled at 3.40 x 10^{-7} and 1.64 x 10^{-8} pCi/m^2/s, respectively, for the South Field area. The exposed till in the South Field was the major contributor to the uranium-238 impacts under this alternative. The operable unit-wide uranium-238 air concentrations are presented on Figure D.2-5.

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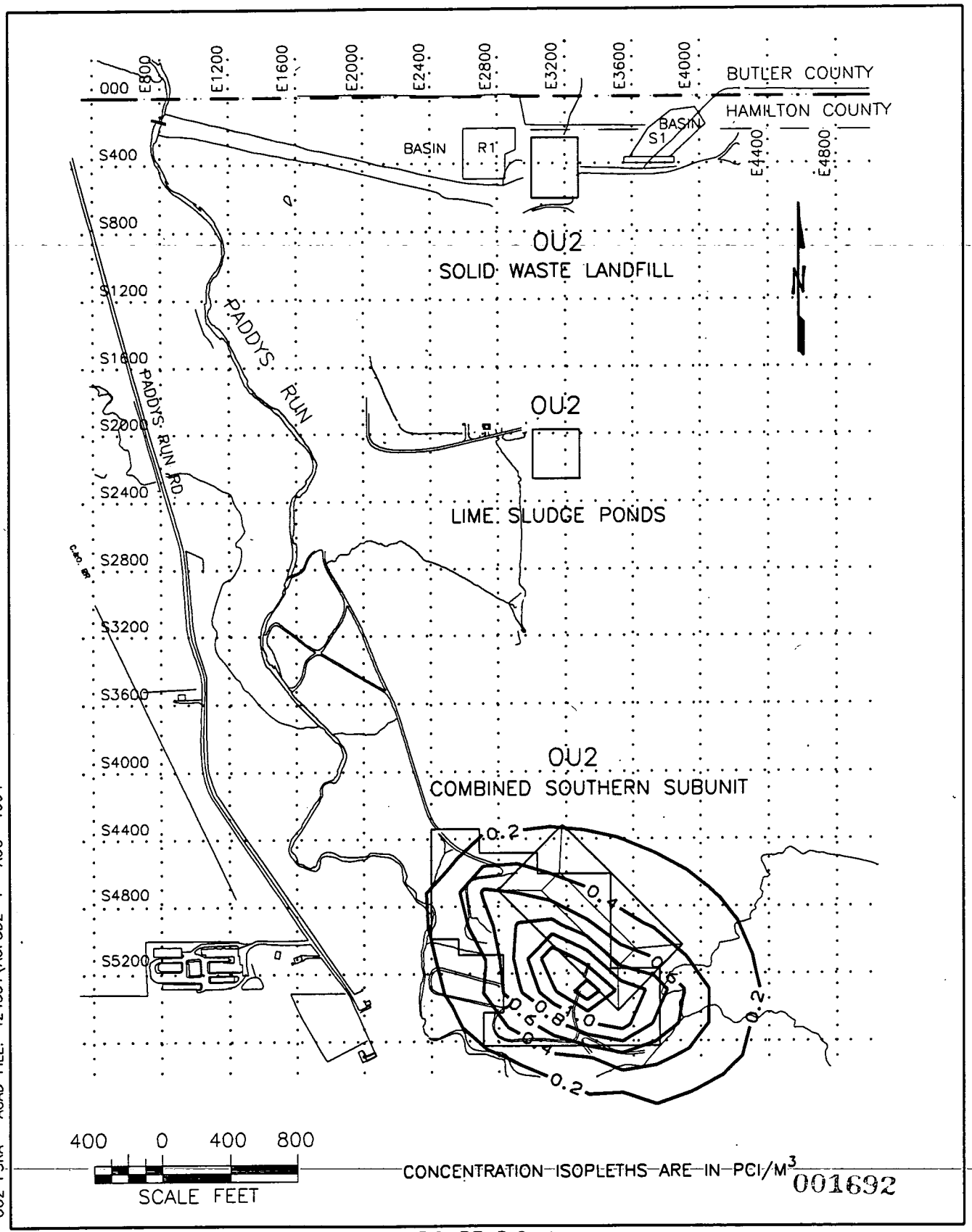

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FIGURE D.2-4

Rn-222 CONCENTRATION IN AIR FOR CONSOLIDATION AND CAPPING ALTERNATIVE
EXPANDED TRESPASSER (IMPACTS ABOVE BACKGROUND)

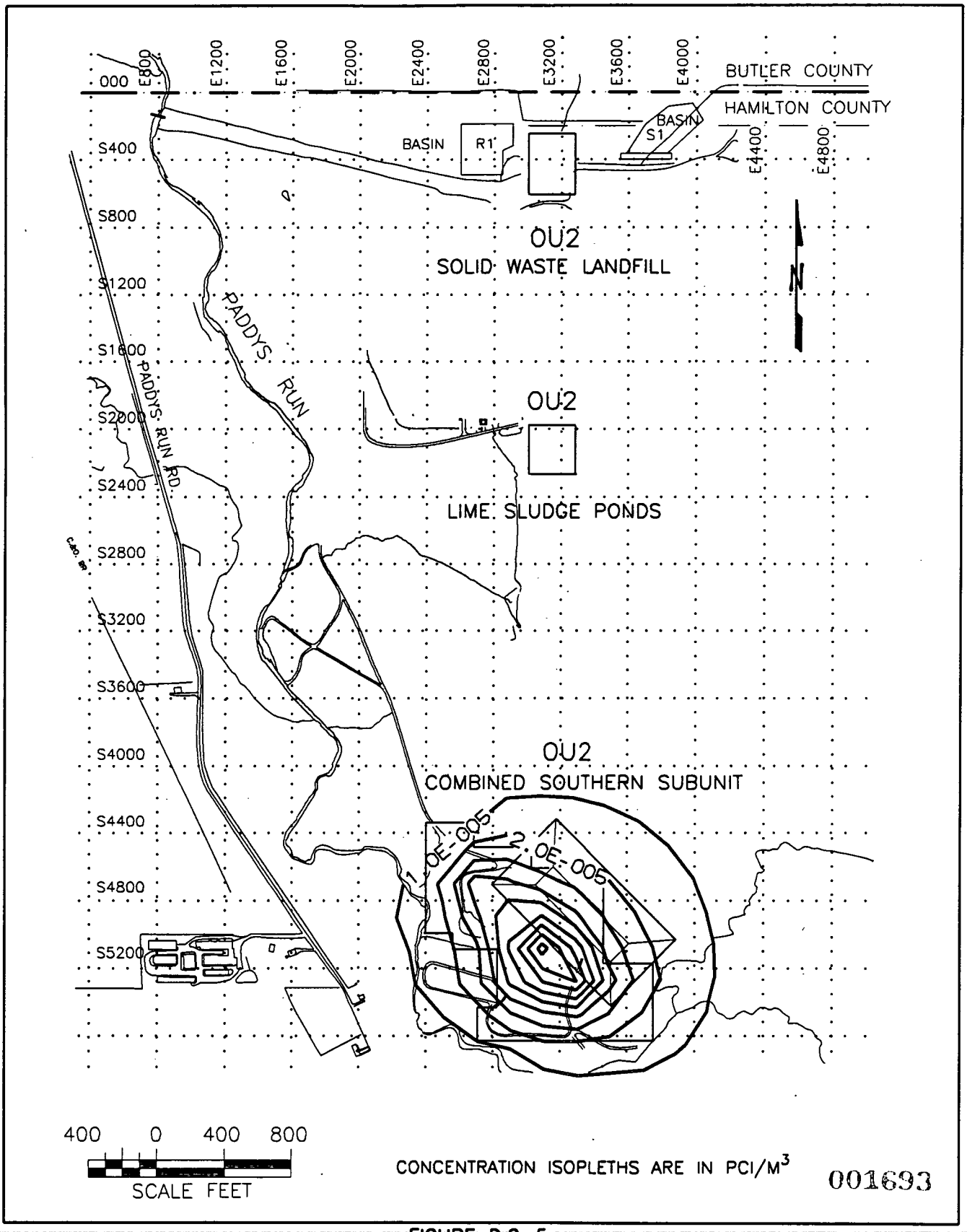

FIGURE D.2-5

U-238 CONCENTRATION IN AIR FOR CONSOLIDATION AND CAPPING ALTERNATIVE
EXPANDED TRESPASSER (IMPACTS ABOVE BACKGROUND)

D.2.10.2 Alternative 3 - Excavation and Off-site Disposal

The modeled maximum annual average contaminant concentrations under the off-site disposal alternative with federal ownership are presented in Tables D.2-V-2, D.2-V-3, D.2-V-4, and D.2-V-8. The modeled maximum annual average contaminant concentrations under the off-site disposal alternative with private ownership are presented in Tables D.2-V-5, D.2-V-6, D.2-V-7, and D.2-V-8.

D.2.10.2.1 Future Land Use with Federal Ownership

Gaseous radon-222 emissions resulted in the highest activity concentrations of any radionuclide analyzed by at approximately four orders of magnitude under this alternative and land use. The maximum on- and off-property concentrations of radon-222 were modeled at 1.68 and 0.087 pCi/m^3, respectively, for the South Field area. The exposed till and fill in the South Field were the major contributors to the radon-222 impacts. The operable unit-wide radon-222 air concentrations are presented on Figure D.2-6 for Alternative 3 with federal ownership.

Again, the maximum radon-222 value is over three orders of magnitude below the EPA action level of 4,000 pCi/m^3 (4 pCi/l) for indoor radon concentrations. The maximum value is approximately three orders of magnitude below the annual average U.S. residential radon concentration of 1,250 pCi/m^3 (Marcinowski and Napolitano 1993). The difference between Alternatives 2 and 3 is insignificant with regard to radon-222 air concentrations.

The maximum on- and off-property concentrations of uranium-238 were modeled at 1.97 x 10^{-5} and 1.08 x 10^{-6} pCi/m^3, respectively, from the South Field area. The maximum on- and off-property concentrations of uranium-238 were modeled at 5.57 x 10^{-6} and 1.52 x 10^{-7} pCi/m^3, respectively, from the Solid Waste Landfill. The exposed till and fill in the South Field and were the major contributors to the uranium-238 impacts. The operable unit-wide uranium-238 air concentrations are presented on Figure D.2-7 for Alternative 3 with federal ownership.

D.2.10.2.2 Future Land Use with Private Ownership

Residual radium-226 concentrations in exposed soil were estimated to be at or below background concentrations for all subunits under Alternative 3 with private ownership. Therefore, no emissions of radon-222 above background were assumed and no radon-222 concentrations were estimated.

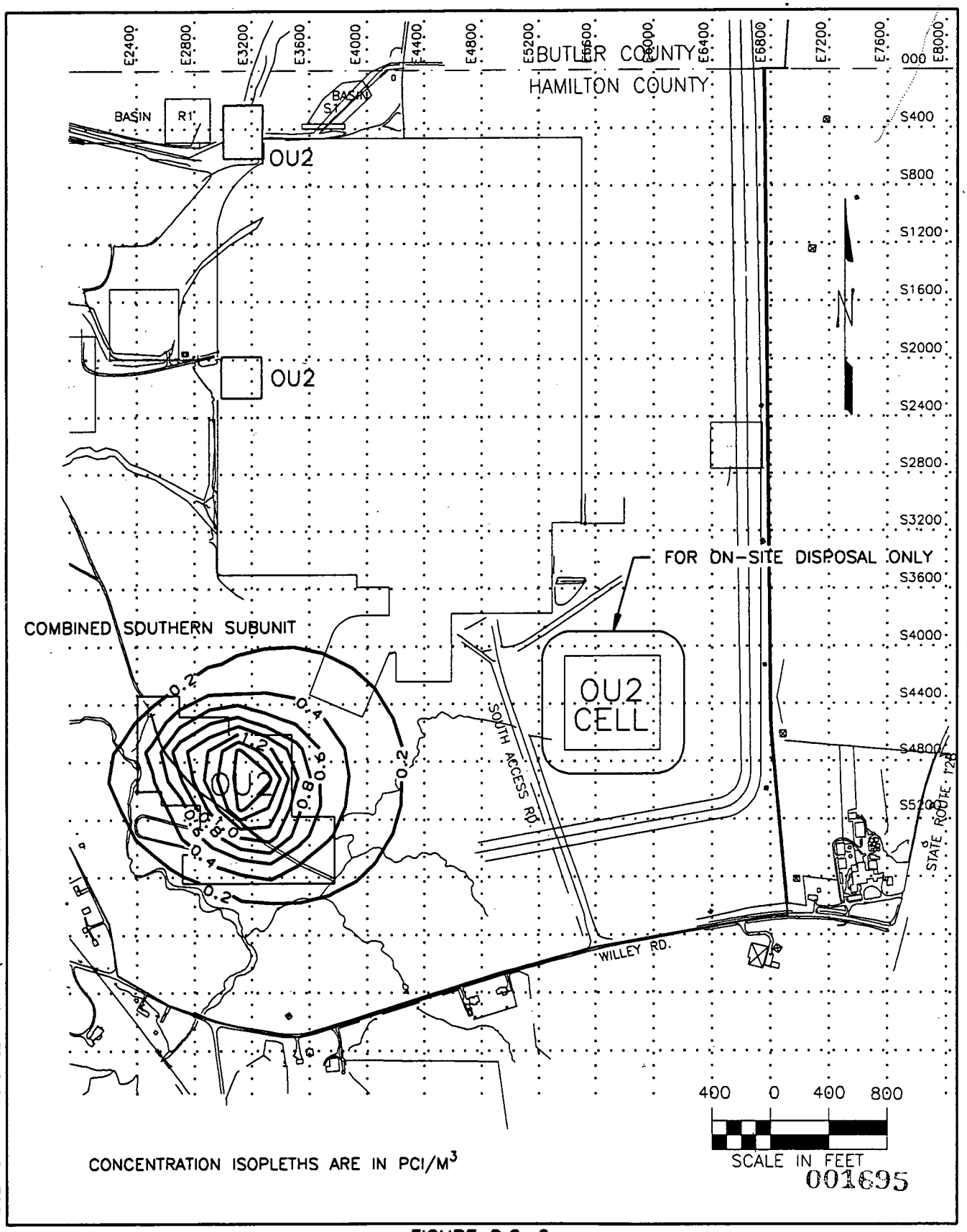

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FIGURE D.2-6

Rn-222 CONCENTRATION IN AIR FOR OFF-SITE AND ON-SITE DISPOSAL ALTERNATIVES
EXPANDED TRESPASSER (IMPACTS ABOVE BACGROUND)

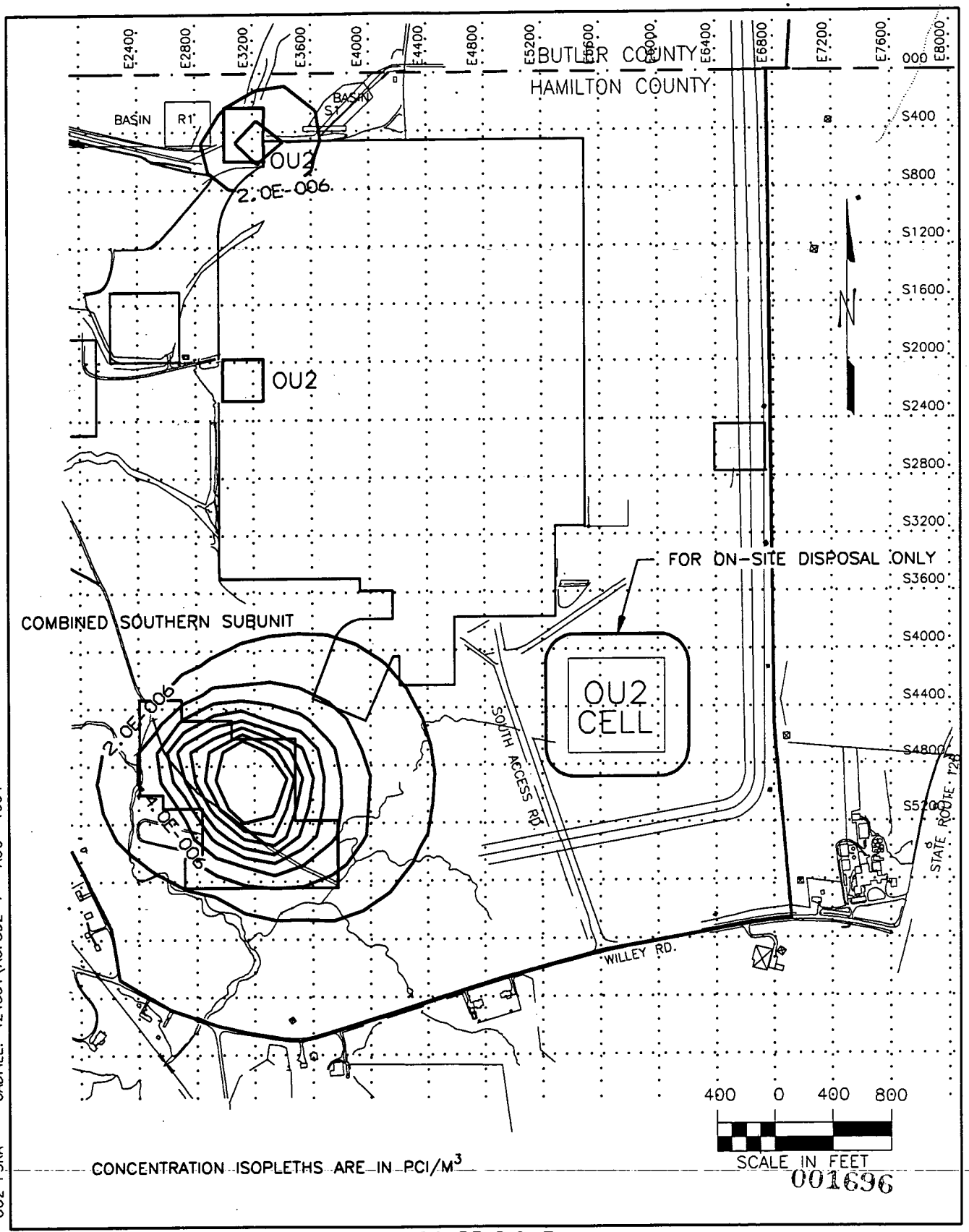

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FIGURE D.2-7

U-238 CONCENTRATION IN AIR FOR OFF-SITE AND ON-SITE DISPOSAL ALTERNATIVES
EXPANDED TRESPASSER (IMPACTS ABOVE BACKGROUND)

The maximum on- and off-property concentrations of uranium-238 were modeled at 1.14×10^{-5} and 8.83×10^{-7} pCi/m^3, respectively, from the South Field area. The exposed GMA in the Inactive Flyash Pile was the major contributor to the uranium-238 impacts. The operable unit-wide uranium-238 air concentrations are presented on Figure D.2-8 for Alternative 3 with private ownership.

D.2.10.3 Alternative 6 - Excavation on On-Site Disposal with Off-site Disposal of Fraction Exceeding Waste Acceptance Criteria

The modeled maximum annual average contaminant concentrations under the on-site disposal alternative with federal ownership are also presented in Tables D.2-V-2, D.2-V-3, D.2-V-4, and D.2-V-8. The modeled maximum annual average contaminant concentrations under the on-site disposal alternative with private ownership are presented in Tables D.2-V-5, D.2-V-6, D.2-V-7, and D.2-V-8.

D.2.10.3.1 Future Land Use with Federal Ownerships

Gaseous radon-222 emissions for Alternative 6 with federal ownership are essentially identical to emissions for Alternative 3 with the same land use. The only difference is the additional radon-222 emissions from the disposal cell. The disposal cell emissions were approximately five orders of magnitude below the exposed soil emissions from the South Field area. Therefore, the air impacts from the disposal cell are insignificant compared to impacts from the South Field area. The operable unit-wide radon-222 air concentrations are also presented on Figure D.2-6 for Alternative 6 with federal ownership.

Estimated uranium-238 emissions for Alternative 6 with federal ownership are identical to emissions for Alternative 3 with the same land use. Therefore, the operable unit-wide uranium-238 air concentrations are also presented on Figure D.2-7 for Alternative 6 with federal ownership.

D.2.10.3.2 Future Land Use with Private Ownership

Residual radium-226 concentrations in exposed soil were estimated to be at or below background concentrations for all subunits under Alternative 6 with private ownership. The only source of radon-222 emissions above background was the disposal cell. The maximum on- and off-property concentrations of radon-222 were modeled at 2.90×10^{-6} and 1.05×10^{-6} pCi/m^3, respectively, from the disposal cell. The operable unit-wide radon-222 air concentrations are presented on Figure D.2-9 for Alternative 6 with private ownership.

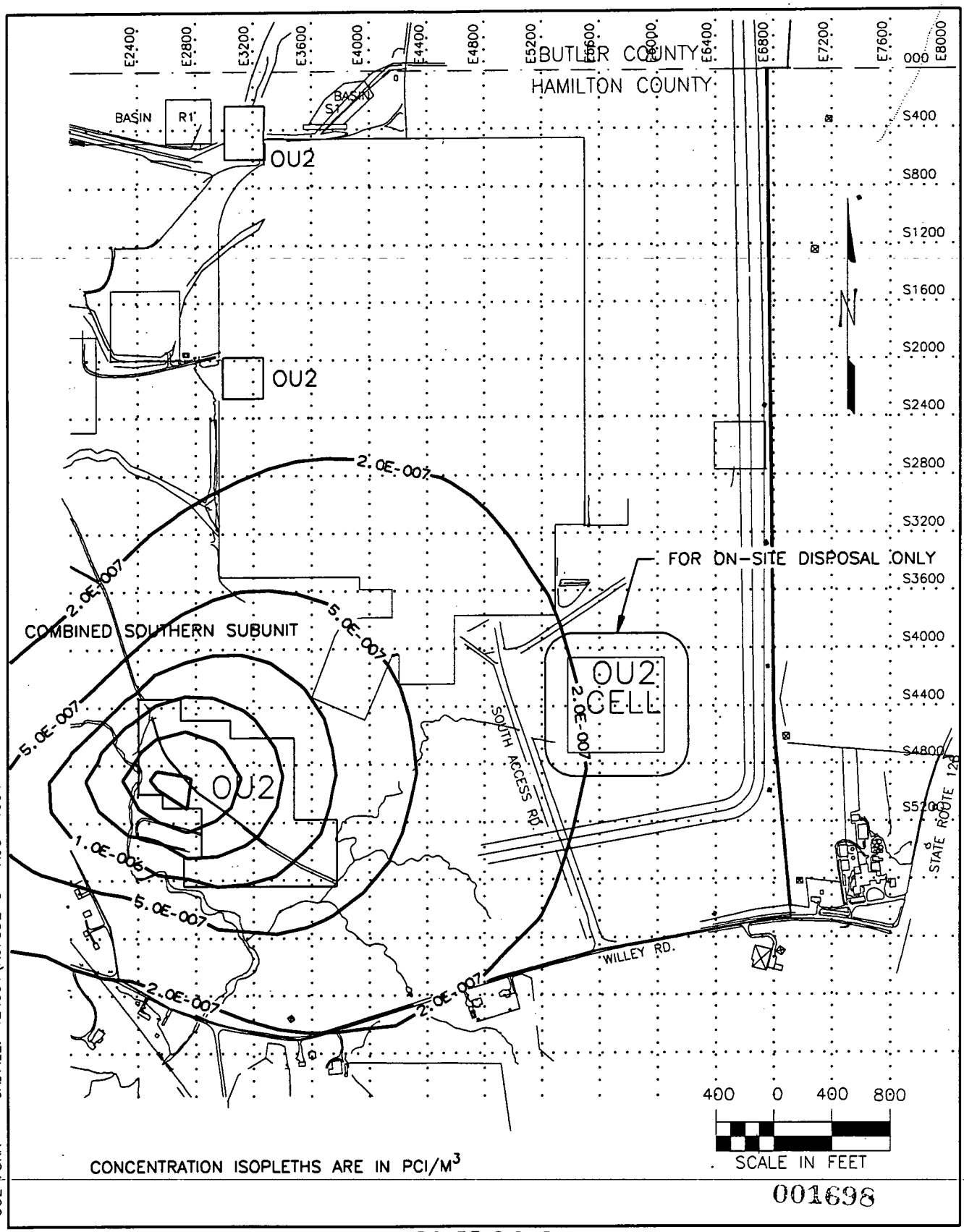

FIGURE D.2-8

U-238 CONCENTRATION IN AIR FOR OFF-SITE AND ON-SITE DISPOSAL ALTERNATIVES
ON-PROPERTY RESIDENT FARMER (IMPACTS ABOVE BACKGROUND)

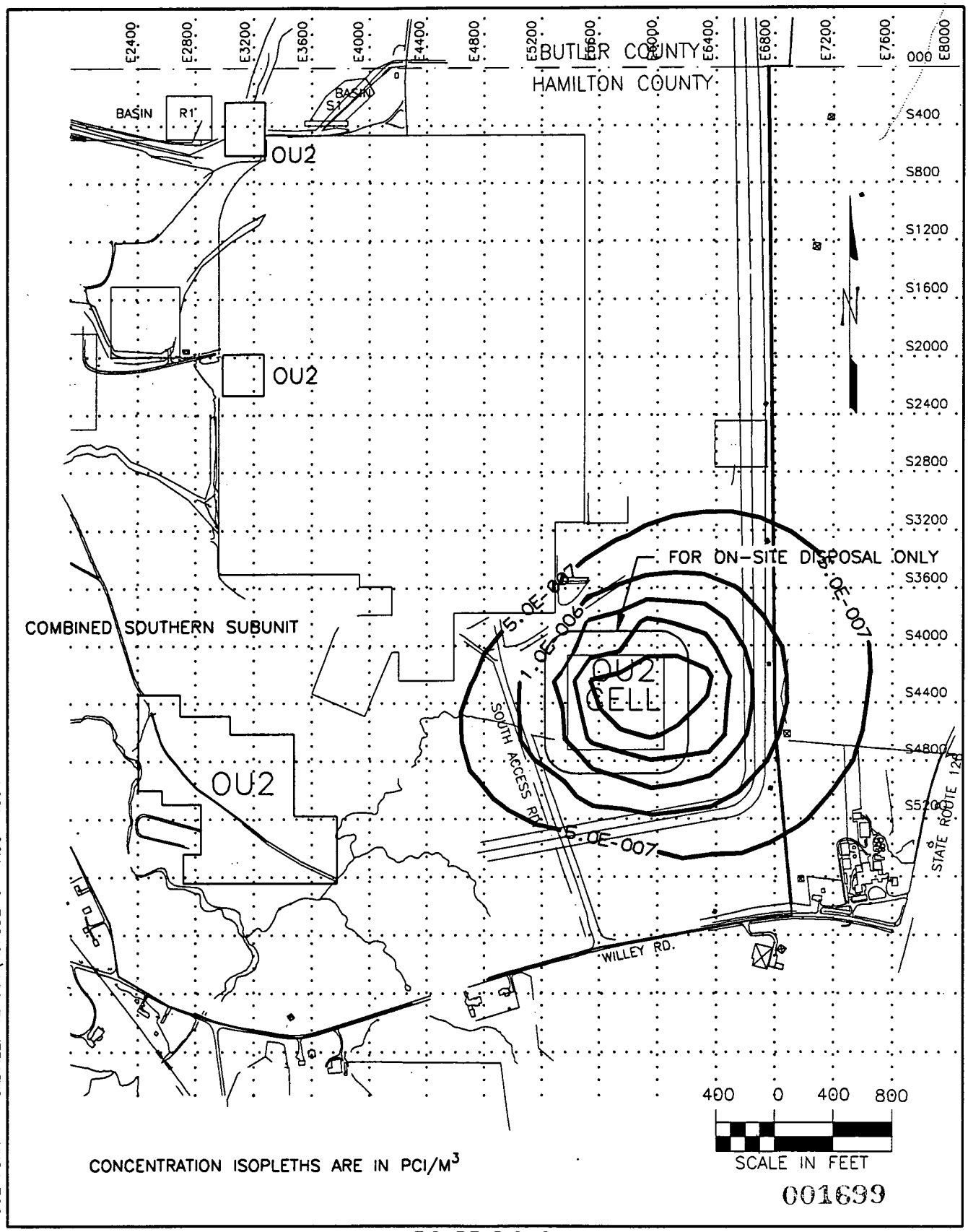

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FIGURE D.2-9

RN-222 CONCENTRATION IN AIR FOR OFF-SITE AND ON-SITE DISPOSAL ALTERNATIVES
ON-PROPERTY RESIDENT FARMER (IMPACTS ABOVE BACKGROUND)

Estimated uranium-238 emissions for Alternative 6 with private ownership are identical to emissions for Alternative 3 with the same land use. Therefore, the operable unit-wide uranium-238 air concentrations are also presented on Figure D.2-8 for Alternative 6 with private ownership.

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ATTACHMENT D.2-I

CONTAMINANT CONCENTRATIONS IN EXPOSED SOIL

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Table D.2-I-1
Contaminant Concentrations in Exposed Soil
South Field - Exposed GMA - On Property Farmer - 10^{-6}
Alternatives: On-Property Disposal Cell; Off-site Disposal

Contaminant	South Field GMA Inside Conc. Term[a]	OU2 Soil PRL (SF Soil)[b]	Minimum of PRL or Conc. Term	Background[b]	OU2 Post-Remedial Incr. Conc.[c]
Radionuclides (pCi/g):					
Cesium-137	0.000	7.20E-01	0.000	0.71	0.000
Neptunium-237	0.000	4.30E-02	0.000	0	0.000
Plutonium-238	NC	NA	NC	0	0.000
Radium-226	0.676	1.43E+00	0.676	1.42	0.000
Radium-228	0.461	1.26E+00	0.461	1.25	0.000
Strontium-90	0.700	1.60E-02	0.016	0	0.016
Technetium-99	0.000	2.10E-02	0.000	0	0.000
Thorium-228	0.330	1.43E+00	0.330	1.43	0.000
Thorium-230	1.370	2.74E+00	1.370	1.97	0.000
Thorium-232	0.330	1.36E+00	0.330	1.36	0.000
Uranium-234	0.585	2.00E+00	0.585	1.04	0.000
Uranium-235/236	0.020	2.40E-01	0.020	0.15	0.000
Uranium-238	0.660	1.47E+00	0.660	1.22	0.000
Inorganics and Organics (mg/kg):					
Antimony	NC	NA	NC	0	0.000
Aroclor 1254	0.000	1.50E-03	0.000	0	0.000
Aroclor 1260	0.000	2.30E-04	0.000	0	0.000
Arsenic	6.200	8.20E+00	6.200	8.2	0.000
Benzo(a)anthracene	0.000	2.30E-02	0.000	0	0.000
Benzo(a)pyrene	0.000	1.50E-03	0.000	0	0.000
Benzo(b)fluoranthene	0.000	1.40E-02	0.000	0	0.000
Benzo(k)fluoranthene	0.000	4.70E-02	0.000	0	0.000
Beryllium	0.000	6.00E-01	0.000	0.6	0.000
Carbazole	NC	NA	NC	NA	0.000
Dibenzo(a,h)anthracene	0.000	4.60E-04	0.000	0	0.000
Dieldrin	0.000	4.00E-05	0.000	0	0.000
Indeno(1,2,3-cd)pyrene	0.000	7.30E-03	0.000	0	0.000
Uranium (total)	10.300	3.40E+00	3.400	3.4	0.000

NA = Not applicable.
NC = Not characterized.
[a]Concentrations from Appendix A.
[b]PRLs and Background Concentrations from Section 2.
[c]A zero value indicates that the residual concentration is at or below background. This subunit/layer does not contribute to risks above background.

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Table D.2-I-2
Contaminant Concentrations in Exposed Soil
Active Flyash Pile - Exposed GMA - On Property Farmer - 10^{-6}
Alternatives: On-Property Disposal Cell; Off-site Disposal

Contaminant	Active Flyash GMA Inside Conc. Term[a]	OU2 Soil PRL (AFP Soil)[b]	Minimum of PRL or Conc. Term	Background[b]	OU2 Post-Remedial Incr. Conc.[c]
Radionuclides (pCi/g):					
Cesium-137	0.000	7.20E-01	0.000	0.71	0.000
Neptunium-237	0.000	4.30E-02	0.000	0	0.000
Plutonium-238	0	NA	NC	0	0.000
Radium-226	0.594	1.43E+00	0.594	1.42	0.000
Radium-228	0.537	1.26E+00	0.537	1.25	0.000
Strontium-90	0.500	1.60E-02	0.016	0	0.016
Technetium-99	0.000	2.10E-02	0.000	0	0.000
Thorium-228	1.190	1.43E+00	1.190	1.43	0.000
Thorium-230	1.420	2.74E+00	1.420	1.97	0.000
Thorium-232	0.965	1.36E+00	0.965	1.36	0.000
Uranium-234	0.921	2.00E+00	0.921	1.04	0.000
Uranium-235/236	0.000	2.40E-01	0.000	0.15	0.000
Uranium-238	0.754	1.47E+00	0.754	1.22	0.000
Inorganics and Organics (mg/kg):					
Antimony	NC	NA	NC	0	0.000
Aroclor 1254	NC	1.50E-03	NC	0	0.000
Aroclor 1260	NC	2.30E-04	NC	0	0.000
Arsenic	NC	8.20E+00	8.200	8.2	0.000
Benzo(a)anthracene	NC	2.30E-02	NC	0	0.000
Benzo(a)pyrene	NC	1.50E-03	NC	0	0.000
Benzo(b)fluoranthene	NC	1.40E-02	NC	0	0.000
Benzo(k)fluoranthene	NC	4.70E-02	NC	0	0.000
Beryllium	NC	6.00E-01	0.600	0.6	0.000
Carbazole	NC	NA	NC	NA	0.000
Dibenzo(a,h)anthracene	NC	4.60E-04	NC	0	0.000
Dieldrin	NC	4.00E-05	NC	0	0.000
Indeno(1,2,3-cd)pyrene	NC	7.30E-03	NC	0	0.000
Uranium (total)	8.416	2.40E+01	8.416	3.4	5.016

NA = Not applicable.
NC = Not characterized.
[a]Concentrations from Appendix A.
[b]PRLs and Background Concentrations from Section 2.
[c]A zero value indicates that the residual concentration is at or below background. This subunit/layer does not contribute to risks above background.

Table D.2-I-3
Contaminant Concentrations in Exposed Soil
Active Flyash Pile - Exposed Till - On Property Farmer - 10^{-6}
Alternatives: On-Property Disposal Cell; Off-site Disposal

Contaminant	Active Flyash Till Other Conc. Term[a]	OU2 Soil PRL (AFP Soil)[b]	Minimum of PRL or Conc. Term	Background[b]	OU2 Post-Remedial Incr. Conc.[c]
Radionuclides (pCi/g):					
Cesium-137	0.000	7.20E-01	0.000	0.71	0.000
Neptunium-237	0.190	4.30E-02	0.043	0	0.043
Plutonium-238	NC	NA	NC	0	0.000
Radium-226	1.140	1.43E+00	1.140	1.42	0.000
Radium-228	0.900	1.26E+00	0.900	1.25	0.000
Strontium-90	1.200	1.60E-02	0.016	0	0.016
Technetium-99	0.000	2.10E-02	0.000	0	0.000
Thorium-228	1.760	1.43E+00	1.430	1.43	0.000
Thorium-230	2.670	2.74E+00	2.670	1.97	0.700
Thorium-232	1.200	1.36E+00	1.200	1.36	0.000
Uranium-234	1.000	2.00E+00	1.000	1.04	0.000
Uranium-235/236	0.034	2.40E-01	0.034	0.15	0.000
Uranium-238	1.050	1.47E+00	1.050	1.22	0.000
Inorganics and Organics (mg/kg):					
Antimony	NC	NA	NC	0	0.000
Aroclor 1254	NC	1.50E-03	NC	0	0.000
Aroclor 1260	NC	2.30E-04	NC	0	0.000
Arsenic	14.000	8.20E+00	8.200	8.2	0.000
Benzo(a)anthracene	NC	2.30E-02	NC	0	0.000
Benzo(a)pyrene	NC	1.50E-03	NC	0	0.000
Benzo(b)fluoranthene	NC	1.40E-02	NC	0	0.000
Benzo(k)fluoranthene	NC	4.70E-02	NC	0	0.000
Beryllium	1.100	6.00E-01	0.600	0.6	0.000
Carbazole	NC	NA	NC	NA	0.000
Dibenzo(a,h)anthracene	NC	4.60E-04	NC	0	0.000
Dieldrin	NC	4.00E-05	NC	0	0.000
Indeno(1,2,3-cd)pyrene	NC	7.30E-03	NC	0	0.000
Uranium (total)	4.270	2.40E+01	4.270	3.4	0.870

NA = Not applicable.
NC = Not characterized.
[a]Concentrations from Appendix A.
[b]PRLs and Background Concentrations from Section 2.
[c]A zero value indicates that the residual concentration is at or below background. This subunit/layer does not contribute to risks above background.

Table D.2-I-4
Contaminant Concentrations in Exposed Soil
Inactive Flyash Pile - Exposed GMA - On Property Farmer - 10^{-6}
Alternatives: On-Property Disposal Cell; Off-site Disposal

Contaminant	Inactive Flyash GMA Inside Conc. Term[a]	OU2 Soil PRL (IFP Soil)[b]	Minimum of PRL or Conc. Term	Background[b]	OU2 Post-Remedial Incr. Conc.[c]
Radionuclides (pCi/g):					
Cesium-137	NC	7.20E-01	NC	0.71	0.000
Neptunium-237	0.180	4.30E-02	0.043	0	0.043
Plutonium-238	0	NA	NC	0	0.000
Radium-226	0.870	1.43E+00	0.870	1.42	0.000
Radium-228	0.530	1.26E+00	0.530	1.25	0.000
Strontium-90	NC	1.60E-02	NC	0	0.000
Technetium-99	0.000	2.10E-02	0.000	0	0.000
Thorium-228	0.410	1.43E+00	0.410	1.43	0.000
Thorium-230	2.030	2.74E+00	2.030	1.97	0.060
Thorium-232	0.360	1.36E+00	0.360	1.36	0.000
Uranium-234	1.290	2.00E+00	1.290	1.04	0.250
Uranium-235/236	0.080	2.40E-01	0.080	0.15	0.000
Uranium-238	1.440	1.47E+00	1.440	1.22	0.220
Inorganics and Organics (mg/kg):					
Antimony	NC	NA	NC	0	0.000
Aroclor 1254	NC	1.50E-03	NC	0	0.000
Aroclor 1260	NC	2.30E-04	NC	0	0.000
Arsenic	5.100	8.20E+00	5.100	8.2	0.000
Benzo(a)anthracene	NC	2.30E-02	NC	0	0.000
Benzo(a)pyrene	NC	1.50E-03	NC	0	0.000
Benzo(b)fluoranthene	NC	1.40E-02	NC	0	0.000
Benzo(k)fluoranthene	NC	4.70E-02	NC	0	0.000
Beryllium	NC	6.00E-01	NC	0.6	0.000
Carbazole	NC	NA	NC	NA	0.000
Dibenzo(a,h)anthracene	0.000	4.60E-04	0.000	0	0.000
Dieldrin	NC	4.00E-05	NC	0	0.000
Indeno(1,2,3-cd)pyrene	NC	7.30E-03	NC	0	0.000
Uranium (total)	5.860	2.10E+01	5.860	3.4	2.460

NA = Not applicable.
NC = Not characterized.
[a]Concentrations from Appendix A.
[b]PRLs and Background Concentrations from Section 2.
[c]A zero value indicates that the residual concentration is at or below background. This subunit/layer does not contribute to risks above background.

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Table D.2-I-5
Contaminant Concentrations in Exposed Soil
Inactive Flyash Pile - Exposed Till - On Property Farmer - 10^{-6}
Alternatives: On-Property Disposal Cell; Off-site Disposal

Contaminant	Inactive Flyash Till Other Conc. Term[a]	OU2 Soil PRL (IFP Soil)[b]	Minimum of PRL or Conc. Term	Background[b]	OU2 Post-Remedial Incr. Conc.[c]
Radionuclides (pCi/g):					
Cesium-137	NC	7.20E-01	NC	0.71	0.000
Neptunium-237	0.160	4.30E-02	0.043	0	0.043
Plutonium-238	NC	NA	NC	0	0.000
Radium-226	1.010	1.43E+00	1.010	1.42	0.000
Radium-228	0.730	1.26E+00	0.730	1.25	0.000
Strontium-90	NC	1.60E-02	NC	0	0.000
Technetium-99	NC	2.10E-02	NC	0	0.000
Thorium-228	0.833	1.43E+00	0.833	1.43	0.000
Thorium-230	1.620	2.74E+00	1.620	1.97	0.000
Thorium-232	0.732	1.36E+00	0.732	1.36	0.000
Uranium-234	0.770	2.00E+00	0.770	1.04	0.000
Uranium-235/236	0.052	2.40E-01	0.052	0.15	0.000
Uranium-238	0.850	1.47E+00	0.850	1.22	0.000
Inorganics and Organics (mg/kg):					
Antimony	NC	NA	NC	0	0.000
Aroclor 1254	NC	1.50E-03	NC	0	0.000
Aroclor 1260	NC	2.30E-04	NC	0	0.000
Arsenic	6.900	8.20E+00	6.900	8.2	0.000
Benzo(a)anthracene	NC	2.30E-02	NC	0	0.000
Benzo(a)pyrene	NC	1.50E-03	NC	0	0.000
Benzo(b)fluoranthene	NC	1.40E-02	NC	0	0.000
Benzo(k)fluoranthene	NC	4.70E-02	NC	0	0.000
Beryllium	NC	6.00E-01	NC	0.6	0.000
Carbazole	NC	NA	NC	NA	0.000
Dibenzo(a,h)anthracene	0.000	4.60E-04	0.000	0	0.000
Dieldrin	NC	4.00E-05	NC	0	0.000
Indeno(1,2,3-cd)pyrene	NC	7.30E-03	NC	0	0.000
Uranium (total)	4.390	2.10E+01	4.390	3.4	0.990

NA = Not applicable.
NC = Not characterized.
[a]Concentrations from Appendix A.
[b]PRLs and Background Concentrations from Section 2.
[c]A zero value indicates that the residual concentration is at or below background. This subunit/layer does not contribute to risks above background.

Table D.2-I-6
Contaminant Concentrations in Exposed Soil
Solid Waste Landfill - Exposed Till - On Property Farmer - 10^{-6}
Alternatives: On-Property Disposal Cell; Off-site Disposal

Contaminant	Solid Waste Till Other Conc. Term[a]	OU2 Soil PRL (SWL Soil)[b]	Minimum of PRL or Conc. Term	Background[b]	OU2 Post-Remedial Incr. Conc.[c]
Radionuclides (pCi/g):					
Cesium-137	NC	NA	NC	0.71	0.000
Neptunium-237	0.400	4.30E-02	0.043	0	0.043
Plutonium-238	0	4.00E-01	0.200	0	0.200
Radium-226	1.000	1.43E+00	1.000	1.42	0.000
Radium-228	0.900	1.26E+00	0.900	1.25	0.000
Strontium-90	0.730	1.60E-02	0.016	0	0.016
Technetium-99	0.000	1.89E-03	0.000	0	0.000
Thorium-228	1.100	1.43E+00	1.100	1.43	0.000
Thorium-230	3.100	2.74E+00	2.740	1.97	0.770
Thorium-232	0.900	1.36E+00	0.900	1.36	0.000
Uranium-234	1.300	1.12E+00	1.120	1.04	0.080
Uranium-235/236	0.100	2.30E-01	0.100	0.15	0.000
Uranium-238	3.600	1.17E+00	1.170	1.22	0.000
Inorganics and Organics (mg/kg):					
Antimony	23	1.33E+00	1.330	0	1.330
Aroclor 1254	NC	NA	NC	0	0.000
Aroclor 1260	NC	NA	NC	0	0.000
Arsenic	7.700	8.20E+00	7.700	8.2	0.000
Benzo(a)anthracene	0.290	2.30E-02	0.023	0	0.023
Benzo(a)pyrene	0.290	1.50E-03	0.002	0	0.002
Benzo(b)fluoranthene	0.260	1.40E-02	0.014	0	0.014
Benzo(k)fluoranthene	NC	NA	NC	0	0.000
Beryllium	1.000	6.00E-01	0.600	0.6	0.000
Carbazole	0.210	6.43E-03	0.006	0.00E+00	0.006
Dibenzo(a,h)anthracene	0.110	4.60E-04	0.000	0	0.000
Dieldrin	NC	NA	NC	0	0.000
Indeno(1,2,3-cd)pyrene	0.210	7.30E-03	0.007	0	0.007
Uranium (total)	7.700	3.40E+00	3.400	3.4	0.000

NA = Not applicable.
NC = Not characterized.
[a]Concentrations from Appendix A.
[b]PRLs and Background Concentrations from Section 2.
[c]A zero value indicates that the residual concentration is at or below background. This subunit/layer does not contribute to risks above background.

Table D.2-I-7
Contaminant Concentrations in Exposed Soil
Lime Sludge Ponds - Exposed Till - On Property Farmer - 10^{-6}
Alternatives: On-Property Disposal Cell; Off-site Disposal

Contaminant	Lime Sludge Till Other Conc. Term[a]	OU2 Soil PRL (LSP Soil)[b]	Minimum of PRL or Conc. Term	Background[b]	OU2 Post-Remedial Incr. Conc.[c]
Radionuclides (pCi/g):					
Cesium-137	0.000	7.20E-01	0.000	0.71	0.000
Neptunium-237	0.130	5.10E-03	0.005	0	0.005
Plutonium-238	NC	NA	NC	0	0.000
Radium-226	1.190	1.43E+00	1.190	1.42	0.000
Radium-228	1.110	1.26E+00	1.110	1.25	0.000
Strontium-90	0.540	5.60E-03	0.006	0	0.006
Technetium-99	0.000	1.89E-03	0.000	0	0.000
Thorium-228	0.970	1.43E+00	0.970	1.43	0.000
Thorium-230	2.490	2.74E+00	2.490	1.97	0.520
Thorium-232	1.050	1.36E+00	1.050	1.36	0.000
Uranium-234	NC	1.26E+00	1.260	1.04	0.000
Uranium-235/236	NC	2.40E-01	0.240	0.15	0.000
Uranium-238	1.140	1.26E+00	1.140	1.22	0.000
Inorganics and Organics (mg/kg):					
Antimony	NC	NA	NC	0	0.000
Aroclor 1254	NC	NA	NC	0	0.000
Aroclor 1260	NC	NA	NC	0	0.000
Arsenic	14.890	NA	14.890	8.2	6.690
Benzo(a)anthracene	NC	NA	NC	0	0.000
Benzo(a)pyrene	NC	NA	NC	0	0.000
Benzo(b)fluoranthene	NC	NA	NC	0	0.000
Benzo(k)fluoranthene	NC	NA	NC	0	0.000
Beryllium	NC	NA	NC	0.6	0.000
Carbazole	NC	NA	NC	NA	0.000
Dibenzo(a,h)anthracene	NC	NA	NC	0	0.000
Dieldrin	NC	NA	NC	0	0.000
Indeno(1,2,3-cd)pyrene	NC	NA	NC	0	0.000
Uranium (total)	14.300	3.40E+00	3.400	3.4	0.000

NA = Not applicable.
NC = Not characterized.
[a]Concentrations from Appendix A.
[b]PRLs and Background Concentrations from Section 2.
[c]A zero value indicates that the residual concentration is at or below background. This subunit/layer does not contribute to risks above background.

Table D.2-I-8
Contaminant Concentrations in Exposed Soil
South Field - Exposed GMA - Expanded Trespasser/Off-Property Farmer - 10^{-6}
Alternatives: On-Property Disposal Cell; Off-site Disposal

Contaminant	South Field GMA Inside Conc. Term[a]	OU2 Soil PRL (SF GMA)[b]	Minimum of PRL or Conc. Term	Background[b]	OU2 Post-Remedial Incr. Conc.[c]
Radionuclides (pCi/g):					
Cesium-137	0.000	NA	NC	0.71	0.000
Neptunium-237	0.000	NA	NC	0	0.000
Plutonium-238	0	NA	NC	0	0.000
Radium-226	0.676	1.80E+00	0.676	1.42	0.000
Radium-228	0.461	2.00E+00	0.461	1.25	0.000
Strontium-90	0.700	NA	0.700	0	0.700
Technetium-99	0.000	7.10E+01	0.000	0	0.000
Thorium-228	0.330	1.80E+00	0.330	1.43	0.000
Thorium-230	1.370	4.02E+02	1.370	1.97	0.000
Thorium-232	0.330	1.50E+00	0.330	1.36	0.000
Uranium-234	0.585	8.68E+00	0.585	1.04	0.000
Uranium-235/236	0.020	7.79E+00	0.020	0.15	0.000
Uranium-238	0.660	6.12E+00	0.660	1.22	0.000
Inorganics and Organics (mg/kg):					
Antimony	NC	NA	NC	0	0.000
Aroclor 1254	0.000	NA	0.000	0	0.000
Aroclor 1260	0.000	2.50E+01	0.000	0	0.000
Arsenic	6.200	NA	6.200	8.2	0.000
Benzo(a)anthracene	0.000	NA	0.000	0	0.000
Benzo(a)pyrene	0.000	2.86E+00	0.000	0	0.000
Benzo(b)fluoranthene	0.000	NA	0.000	0	0.000
Benzo(k)fluoranthene	0.000	NA	0.000	0	0.000
Beryllium	0.000	NA	0.000	0.6	0.000
Carbazole	NC	NA	NC	NA	0.000
Dibenzo(a,h)anthracene	0.000	2.00E+00	0.000	0	0.000
Dieldrin	0.000	NA	0.000	0	0.000
Indeno(1,2,3-cd)pyrene	0.000	1.20E+04	0.000	0	0.000
Uranium (total)	10.300	1.90E+01	10.300	3.4	6.900

NA = Not applicable.
NC = Not characterized.
[a]Concentrations from Appendix A.
[b]PRLs and Background Concentrations from Section 2.
[c]A zero value indicates that the residual concentration is at or below background. This subunit/layer does not contribute to risks above background.

Table D.2-I-9
Contaminant Concentrations in Exposed Soil
South Field - Exposed Till - Expanded Trespasser/Off-Property Farmer - 10^{-6}
Alternatives: On-Property Disposal Cell; Off-site Disposal

Contaminant	South Field Till Impacted Conc. Term[a]	OU2 Soil PRL (SF Till)[b]	Minimum of PRL or Conc. Term	Background[b]	OU2 Post-Remedial Incr. Conc.[c]
Radionuclides (pCi/g):					
Cesium-137	0.000	NA	0.000	0.71	0.000
Neptunium-237	0.291	NA	0.291	0	0.291
Plutonium-238	NC	NA	NC	0	0.000
Radium-226	1.990	1.80E+00	1.800	1.42	0.380
Radium-228	1.444	2.00E+00	1.444	1.25	0.194
Strontium-90	1.100	NA	1.100	0	1.100
Technetium-99	0.900	7.10E+01	0.900	0	0.900
Thorium-228	1.426	1.80E+00	1.426	1.43	0.000
Thorium-230	4.410	4.02E+02	4.410	1.97	2.440
Thorium-232	1.332	1.50E+00	1.332	1.36	0.000
Uranium-234	17.205	4.24E+00	4.240	1.04	3.200
Uranium-235/236	2.730	3.35E+00	2.730	0.15	2.580
Uranium-238	17.888	3.22E+00	3.220	1.22	2.000
Inorganics and Organics (mg/kg):					
Antimony	NC	NA	NC	0	0.000
Aroclor 1254	0.041	NA	0.041	0	0.041
Aroclor 1260	0.000	2.50E+01	0.000	0	0.000
Arsenic	11.900	NA	11.900	8.2	3.700
Benzo(a)anthracene	0.000	NA	0.000	0	0.000
Benzo(a)pyrene	0.000	2.86E+00	0.000	0	0.000
Benzo(b)fluoranthene	0.000	NA	0.000	0	0.000
Benzo(k)fluoranthene	0.000	NA	0.000	0	0.000
Beryllium	0.850	NA	0.850	0.6	0.250
Carbazole	NC	NA	NC	NA	0.000
Dibenzo(a,h)anthracene	0.000	2.00E+00	0.000	0	0.000
Dieldrin	0.000	NA	0.000	0	0.000
Indeno(1,2,3-cd)pyrene	0.000	1.20E+04	0.000	0	0.000
Uranium (total)	189.000	8.00E+00	8.000	3.4	4.600

NA = Not applicable.
NC = Not characterized.
[a]Concentrations from Appendix A.
[b]PRLs and Background Concentrations from Section 2.
[c]A zero value indicates that the residual concentration is at or below background. This subunit/layer does not contribute to risks above background.

Table D.2-I-10
Contaminant Concentrations in Exposed Soil
South Field - Exposed Fill - Expanded Trespasser/Off-Property Farmer - 10^{-6}
Alternatives: On-Property Disposal Cell; Off-site Disposal

Contaminant	South Field Fill Conc. Term[a]	OU2 Soil PRL (SF Till)[b]	Minimum of PRL or Conc. Term	Background[b]	OU2 Post-Remedial Incr. Conc.[c]
Radionuclides (pCi/g):					
Cesium-137	0.692	NA	0.692	0.71	0.000
Neptunium-237	0.369	NA	0.369	0	0.369
Plutonium-238	NC	NA	NC	0	0.000
Radium-226	9.210	1.80E+00	1.800	1.42	0.380
Radium-228	3.740	2.00E+00	2.000	1.25	0.750
Strontium-90	1.360	NA	1.360	0	1.360
Technetium-99	0.900	7.10E+01	0.900	0	0.900
Thorium-228	13.400	1.80E+00	1.800	1.43	0.370
Thorium-230	13.800	4.02E+02	13.800	1.97	11.830
Thorium-232	12.900	1.50E+00	1.500	1.36	0.140
Uranium-234	78.300	4.24E+00	4.240	1.04	3.200
Uranium-235/236	4.050	3.35E+00	3.350	0.15	3.200
Uranium-238	82.700	3.22E+00	3.220	1.22	2.000
Inorganics and Organics (mg/kg):					
Antimony	NC	NA	NC	0	0.000
Aroclor 1254	0.430	NA	0.430	0	0.430
Aroclor 1260	0.038	2.50E+01	0.038	0	0.038
Arsenic	6.975	NA	6.975	8.2	0.000
Benzo(a)anthracene	1.100	NA	1.100	0	1.100
Benzo(a)pyrene	1.800	2.86E+00	1.800	0	1.800
Benzo(b)fluoranthene	1.600	NA	1.600	0	1.600
Benzo(k)fluoranthene	1.600	NA	1.600	0	1.600
Beryllium	0.880	NA	0.880	0.6	0.280
Carbazole	NC	NA	NC	NA	0.000
Dibenzo(a,h)anthracene	0.440	2.00E+00	0.440	0	0.440
Dieldrin	0.010	NA	0.010	0	0.010
Indeno(1,2,3-cd)pyrene	0.620	1.20E+04	0.620	0	0.620
Uranium (total)	297.000	8.00E+00	8.000	3.4	4.600

NA = Not applicable.
NC = Not characterized.
[a]Concentrations from Appendix A.
[b]PRLs and Background Concentrations from Section 2.
[c]A zero value indicates that the residual concentration is at or below background. This subunit/layer does not contribute to risks above background.

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Table D.2-I-11
Contaminant Concentrations in Exposed Soil
Active Flyash Pile - Exposed GMA - Expanded Trespasser/Off-Property Farmer - 10^{-6}
Alternatives: On-Property Disposal Cell; Off-site Disposal

Contaminant	Active Flyash GMA Inside Conc. Term[a]	OU2 Soil PRL (AFP Soil)[b]	Minimum of PRL or Conc. Term	Background[b]	OU2 Post-Remedial Incr. Conc.[c]
Radionuclides (pCi/g):					
Cesium-137	0.000	NA	0.000	0.71	0.000
Neptunium-237	0.000	4.99E+00	0.000	0	0.000
Plutonium-238	0	NA	NC	0	0.000
Radium-226	0.594	1.80E+00	0.594	1.42	0.000
Radium-228	0.537	2.00E+00	0.537	1.25	0.000
Strontium-90	0.500	NA	0.500	0	0.500
Technetium-99	0.000	NA	0.000	0	0.000
Thorium-228	1.190	1.80E+00	1.190	1.43	0.000
Thorium-230	1.420	NA	1.420	1.97	0.000
Thorium-232	0.965	1.50E+00	0.965	1.36	0.000
Uranium-234	0.921	8.64E+00	0.921	1.04	0.000
Uranium-235/236	0.000	7.75E+00	0.000	0.15	0.000
Uranium-238	0.754	6.12E+00	0.754	1.22	0.000
Inorganics and Organics (mg/kg):					
Antimony	NC	NA	NC	0	0.000
Aroclor 1254	NC	NA	NC	0	0.000
Aroclor 1260	NC	NA	NC	0	0.000
Arsenic	NC	1.69E+01	16.900	8.2	8.700
Benzo(a)anthracene	NC	NA	NC	0	0.000
Benzo(a)pyrene	NC	NA	NC	0	0.000
Benzo(b)fluoranthene	NC	NA	NC	0	0.000
Benzo(k)fluoranthene	NC	NA	NC	0	0.000
Beryllium	NC	NA	NC	0.6	0.000
Carbazole	NC	NA	NC	NA	0.000
Dibenzo(a,h)anthracene	NC	NA	NC	0	0.000
Dieldrin	NC	NA	NC	0	0.000
Indeno(1,2,3-cd)pyrene	NC	NA	NC	0	0.000
Uranium (total)	8.416	2.80E+01	8.416	3.4	5.016

NA = Not applicable.
NC = Not characterized.
[a]Concentrations from Appendix A.
[b]PRLs and Background Concentrations from Section 2.
[c]A zero value indicates that the residual concentration is at or below background. This subunit/layer does not contribute to risks above background.

Table D.2-I-12
Contaminant Concentrations in Exposed Soil
Active Flyash Pile - Exposed Till - Expanded Trespasser/Off-Property Farmer - 10^{-6}
Alternatives: On-Property Disposal Cell; Off-site Disposal

Contaminant	Active Flyash Till Impacted Conc. Term[a]	OU2 Soil PRL (AFP Soil)[b]	Minimum of PRL or Conc. Term	Background[b]	OU2 Post-Remedial Incr. Conc.[c]
Radionuclides (pCi/g):					
Cesium-137	0.000	7.20E-01	0.000	0.71	0.000
Neptunium-237	0.400	4.30E-02	0.043	0	0.043
Plutonium-238	NC	NA	NC	0	0.000
Radium-226	1.730	1.43E+00	1.430	1.42	0.010
Radium-228	1.330	1.26E+00	1.260	1.25	0.010
Strontium-90	3.610	NA	3.610	0	3.610
Technetium-99	0.000	NA	0.000	0	0.000
Thorium-228	1.400	1.43E+00	1.400	1.43	0.000
Thorium-230	3.600	NA	3.600	1.97	1.630
Thorium-232	1.350	1.36E+00	1.350	1.36	0.000
Uranium-234	1.270	2.00E+00	1.270	1.24	0.030
Uranium-235/236	0.069	2.40E-01	0.069	0.15	0.000
Uranium-238	2.600	1.47E+00	1.470	1.22	0.250
Inorganics and Organics (mg/kg):					
Antimony	NC	NA	NC	0	0.000
Aroclor 1254	NC	NA	NC	0	0.000
Aroclor 1260	NC	NA	NC	0	0.000
Arsenic	18.700	1.69E+01	16.900	8.2	8.700
Benzo(a)anthracene	NC	NA	NC	0	0.000
Benzo(a)pyrene	NC	NA	NC	0	0.000
Benzo(b)fluoranthene	NC	NA	NC	0	0.000
Benzo(k)fluoranthene	NC	NA	NC	0	0.000
Beryllium	1.400	NA	1.400	0.6	0.800
Carbazole	NC	NA	NC	NA	0.000
Dibenzo(a,h)anthracene	NC	NA	NC	0	0.000
Dieldrin	NC	NA	NC	0	0.000
Indeno(1,2,3-cd)pyrene	NC	NA	NC	0	0.000
Uranium (total)	7.170	2.80E+01	7.170	3.4	3.770

NA = Not applicable.
NC = Not characterized.
[a]Concentrations from Appendix A.
[b]PRLs and Background Concentrations from Section 2.
[c]A zero value indicates that the residual concentration is at or below background. This subunit/layer does not contribute to risks above background.

Table D.2-I-13
Contaminant Concentrations in Exposed Soil
Inactive Flyash Pile – Exposed GMA – Expanded Trespasser/Off-Property Farmer – 10^{-6}
Alternatives: On-Property Disposal Cell; Off-site Disposal

Contaminant	Inactive Flyash GMA Inside Conc. Term[a]	OU2 Soil PRL (IFP GMA)[b]	Minimum of PRL or Conc. Term	Background[b]	OU2 Post-Remedial Incr. Conc.[c]
Radionuclides (pCi/g):					
Cesium-137	NC	NA	NC	0.71	0.000
Neptunium-237	0.180	NA	0.180	0	0.180
Plutonium-238	0	NA	NC	0	0.000
Radium-226	0.870	1.80E+00	0.870	1.42	0.000
Radium-228	0.530	2.00E+00	0.530	1.25	0.000
Strontium-90	NC	NA	NC	0	0.000
Technetium-99	0.000	NA	0.000	0	0.000
Thorium-228	0.410	1.80E+00	0.410	1.43	0.000
Thorium-230	2.030	NA	2.030	1.97	0.060
Thorium-232	0.360	1.50E+00	0.360	1.36	0.000
Uranium-234	1.290	8.68E+00	1.290	1.04	0.250
Uranium-235/236	0.080	7.79E+00	0.080	0.15	0.000
Uranium-238	1.440	6.12E+00	1.440	1.22	0.220
Inorganics and Organics (mg/kg):					
Antimony	NC	NA	NC	0	0.000
Aroclor 1254	NC	NA	NC	0	0.000
Aroclor 1260	NC	NA	NC	0	0.000
Arsenic	5.100	1.69E+01	5.100	8.2	0.000
Benzo(a)anthracene	NC	NA	NC	0	0.000
Benzo(a)pyrene	NC	NA	NC	0	0.000
Benzo(b)fluoranthene	NC	NA	NC	0	0.000
Benzo(k)fluoranthene	NC	NA	NC	0	0.000
Beryllium	NC	NA	NC	0.6	0.000
Carbazole	NC	NA	NC	NA	0.000
Dibenzo(a,h)anthracene	0.000	NA	0.000	0	0.000
Dieldrin	NC	NA	NC	0	0.000
Indeno(1,2,3-cd)pyrene	NC	NA	NC	0	0.000
Uranium (total)	5.860	1.90E+01	5.860	3.4	2.460

NA = Not applicable.
NC = Not characterized.
[a]Concentrations from Appendix A.
[b]PRLs and Background Concentrations from Section 2.
[c]A zero value indicates that the residual concentration is at or below background. This subunit/layer does not contribute to risks above background.

Table D.2-I-14
Contaminant Concentrations in Exposed Soil
Inactive Flyash Pile - Exposed Till - Expanded Trespasser/Off-Property Farmer - 10^{-6}
Alternatives: On-Property Disposal Cell; Off-site Disposal

Contaminant	Inactive Flyash Till Other Conc. Term[a]	OU2 Soil PRL (IFP Till)[b]	Minimum of PRL or Conc. Term	Background[b]	OU2 Post-Remedial Incr. Conc.[c]
Radionuclides (pCi/g):					
Cesium-137	NC	NA	NC	0.71	0.000
Neptunium-237	0.160	NA	0.160	0	0.160
Plutonium-238	NC	NA	NC	0	0.000
Radium-226	1.010	1.80E+00	1.010	1.42	0.000
Radium-228	0.730	2.00E+00	0.730	1.25	0.000
Strontium-90	NC	NA	NC	0	0.000
Technetium-99	NC	NA	NC	0	0.000
Thorium-228	0.833	1.80E+00	0.833	1.43	0.000
Thorium-230	1.620	NA	1.620	1.97	0.000
Thorium-232	0.732	1.50E+00	0.732	1.36	0.000
Uranium-234	0.770	4.24E+00	0.770	1.04	0.000
Uranium-235/236	0.052	3.35E+00	0.052	0.15	0.000
Uranium-238	0.850	3.22E+00	0.850	1.22	0.000
Inorganics and Organics (mg/kg):					
Antimony	NC	NA	NC	0	0.000
Aroclor 1254	NC	NA	NC	0	0.000
Aroclor 1260	NC	NA	NC	0	0.000
Arsenic	6.900	1.69E+01	6.900	8.2	0.000
Benzo(a)anthracene	NC	NA	NC	0	0.000
Benzo(a)pyrene	NC	NA	NC	0	0.000
Benzo(b)fluoranthene	NC	NA	NC	0	0.000
Benzo(k)fluoranthene	NC	NA	NC	0	0.000
Beryllium	NC	NA	NC	0.6	0.000
Carbazole	NC	NA	NC	NA	0.000
Dibenzo(a,h)anthracene	0.000	NA	0.000	0	0.000
Dieldrin	NC	NA	NC	0	0.000
Indeno(1,2,3-cd)pyrene	NC	NA	NC	0	0.000
Uranium (total)	4.390	8.00E+00	4.390	3.4	0.990

NA = Not applicable.
NC = Not characterized.
[a]Concentrations from Appendix A.
[b]PRLs and Background Concentrations from Section 2.
[c]A zero value indicates that the residual concentration is at or below background. This subunit/layer does not contribute to risks above background.

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Table D.2-I-15
Contaminant Concentrations in Exposed Soil
Solid Waste Landfill - Exposed Till - Expanded Trespasser/Off-Property Farmer - 10^{-6}
Alternatives: On-Property Disposal Cell; Off-site Disposal

Contaminant	Solid Waste Till Other Conc. Term[a]	OU2 Soil PRL (SWL Soil)[b]	Minimum of PRL or Conc. Term	Background[b]	OU2 Post-Remedial Incr. Conc.[c]
Radionuclides (pCi/g):					
Cesium-137	NC	NA	NC	0.71	0.000
Neptunium-237	0.400	NA	0.400	0	0.400
Plutonium-238	0	NA	0.200	0	0.200
Radium-226	1.000	1.80E+00	1.000	1.42	0.000
Radium-228	0.900	2.00E+00	0.900	1.25	0.000
Strontium-90	0.730	NA	0.730	0	0.730
Technetium-99	0.000	NA	0.000	0	0.000
Thorium-228	1.100	1.80E+00	1.100	1.43	0.000
Thorium-230	3.100	NA	3.100	1.97	1.130
Thorium-232	0.900	1.50E+00	0.900	1.36	0.000
Uranium-234	1.300	6.29E+01	1.300	1.04	0.260
Uranium-235/236	0.100	6.31E+01	0.100	0.15	0.000
Uranium-238	3.600	5.48E+01	3.600	1.22	2.380
Inorganics and Organics (mg/kg):					
Antimony	23	NA	22.600	0	22.600
Aroclor 1254	NC	NA	NC	0	0.000
Aroclor 1260	NC	NA	NC	0	0.000
Arsenic	7.700	NA	7.700	8.2	0.000
Benzo(a)anthracene	0.290	NA	0.290	0	0.290
Benzo(a)pyrene	0.290	NA	0.290	0	0.290
Benzo(b)fluoranthene	0.260	NA	0.260	0	0.260
Benzo(k)fluoranthene	NC	NA	NC	0	0.000
Beryllium	1.000	NA	1.000	0.6	0.400
Carbazole	0.210	NA	0.210	0.00E+00	0.210
Dibenzo(a,h)anthracene	0.110	NA	0.110	0	0.110
Dieldrin	NC	NA	NC	0	0.000
Indeno(1,2,3-cd)pyrene	0.210	NA	0.210	0	0.210
Uranium (total)	7.700	9.56E+02	7.700	3.4	4.300

NA = Not applicable.
NC = Not characterized.
[a]Concentrations from Appendix A.
[b]PRLs and Background Concentrations from Section 2.
[c]A zero value indicates that the residual concentration is at or below background. This subunit/layer does not contribute to risks above background.

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Table D.2-I-16
Contaminant Concentrations in Exposed Soil
Lime Sludge Ponds - Exposed Till - Expanded Trespasser/Off-Property Farmer - 10^{-6}
Alternatives: On-Property Disposal Cell; Off-site Disposal

Contaminant	Lime Sludge Till Other Conc. Term[a]	OU2 Soil PRL (LSP Soil)[b]	Minimum of PRL or Conc. Term	Background[b]	OU2 Post-Remedial Incr. Conc.[c]
Radionuclides (pCi/g):					
Cesium-137	0.000	NA	0.000	0.71	0.000
Neptunium-237	0.130	NA	0.130	0	0.130
Plutonium-238	NC	NA	NC	0	0.000
Radium-226	1.190	1.80E+00	1.190	1.42	0.000
Radium-228	1.110	2.00E+00	1.110	1.25	0.000
Strontium-90	0.540	NA	0.540	0	0.540
Technetium-99	0.000	NA	0.000	0	0.000
Thorium-228	0.970	1.80E+00	0.970	1.43	0.000
Thorium-230	2.490	NA	2.490	1.97	0.520
Thorium-232	1.050	1.50E+00	1.050	1.36	0.000
Uranium-234	NC	1.96E+02	196.000	1.04	0.000
Uranium-235/236	NC	1.95E+02	195.000	0.15	0.000
Uranium-238	1.140	5.48E+01	1.140	1.22	0.000
Inorganics and Organics (mg/kg):					
Antimony	NC	NA	NC	0	0.000
Aroclor 1254	NC	NA	NC	0	0.000
Aroclor 1260	NC	NA	NC	0	0.000
Arsenic	14.890	NA	14.890	8.2	6.690
Benzo(a)anthracene	NC	NA	NC	0	0.000
Benzo(a)pyrene	NC	NA	NC	0	0.000
Benzo(b)fluoranthene	NC	NA	NC	0	0.000
Benzo(k)fluoranthene	NC	NA	NC	0	0.000
Beryllium	NC	NA	NC	0.6	0.000
Carbazole	NC	NA	NC	NA	0.000
Dibenzo(a,h)anthracene	NC	NA	NC	0	0.000
Dieldrin	NC	NA	NC	0	0.000
Indeno(1,2,3-cd)pyrene	NC	NA	NC	0	0.000
Uranium (total)	14.300	1.36E+02	14.300	3.4	10.900

NA = Not applicable.
NC = Not characterized.
[a]Concentrations from Appendix A.
[b]PRLs and Background Concentrations from Section 2.
[c]A zero value indicates that the residual concentration is at or below background. This subunit/layer does not contribute to risks above background.

Table D.2-I-17
Contaminant Concentrations in Exposed Soil
South Field - Exposed GMA - Expanded Trespasser/Off-Property Farmer - 10^{-6}
Alternatives: Consolidation/Capping

Contaminant	South Field GMA Inside Conc. Term[a]	OU2 Soil PRL (SF GMA)[b]	Minimum of PRL or Conc. Term	Background[b]	OU2 Post-Remedial Incr. Conc.[c]
Radionuclides (pCi/g):					
Cesium-137	0.000	NA	NC	0.71	0.000
Neptunium-237	0.000	NA	NC	0	0.000
Plutonium-238	0	NA	NC	0	0.000
Radium-226	0.676	NA	0.676	1.42	0.000
Radium-228	0.461	NA	0.461	1.25	0.000
Strontium-90	0.700	NA	0.700	0	0.700
Technetium-99	0.000	NA	0.000	0	0.000
Thorium-228	0.330	NA	0.330	1.43	0.000
Thorium-230	1.370	NA	1.370	1.97	0.000
Thorium-232	0.330	NA	0.330	1.36	0.000
Uranium-234	0.585	1.00E+04	0.585	1.04	0.000
Uranium-235/236	0.020	1.00E+04	0.020	0.15	0.000
Uranium-238	0.660	1.00E+04	0.660	1.22	0.000
Inorganics and Organics (mg/kg):					
Antimony	NC	NA	NC	0	0.000
Aroclor 1254	0.000	NA	0.000	0	0.000
Aroclor 1260	0.000	NA	0.000	0	0.000
Arsenic	6.200	NA	6.200	8.2	0.000
Benzo(a)anthracene	0.000	NA	0.000	0	0.000
Benzo(a)pyrene	0.000	NA	0.000	0	0.000
Benzo(b)fluoranthene	0.000	NA	0.000	0	0.000
Benzo(k)fluoranthene	0.000	NA	0.000	0	0.000
Beryllium	0.000	NA	0.000	0.6	0.000
Carbazole	NC	NA	NC	NA	0.000
Dibenzo(a,h)anthracene	0.000	NA	0.000	0	0.000
Dieldrin	0.000	NA	0.000	0	0.000
Indeno(1,2,3-cd)pyrene	0.000	NA	0.000	0	0.000
Uranium (total)	10.300	1.00E+04	10.300	3.4	6.900

NA = Not applicable.
NC = Not characterized.
[a]Concentrations from Appendix A.
[b]PRLs and Background Concentrations from Section 2.
[c]A zero value indicates that the residual concentration is at or below background. This subunit/layer does not contribute to risks above background.

Table D.2-I-18
Contaminant Concentrations in Exposed Soil
South Field - Exposed Till - Expanded Trespasser/Off-Property Farmer - 10^{-6}
Alternatives: Consolidation/Capping

Contaminant	South Field Till Impacted Conc. Term[a]	OU2 Soil PRL (SF Till)[b]	Minimum of PRL or Conc. Term	Background[b]	OU2 Post-Remedial Incr. Conc.[c]
Radionuclides (pCi/g):					
Cesium-137	0.000	NA	0.000	0.71	0.000
Neptunium-237	0.291	NA	0.291	0	0.291
Plutonium-238	NC	NA	NC	0	0.000
Radium-226	1.990	NA	1.990	1.42	0.570
Radium-228	1.444	NA	1.444	1.25	0.194
Strontium-90	1.100	NA	1.100	0	1.100
Technetium-99	0.900	NA	0.900	0	0.900
Thorium-228	1.426	NA	1.426	1.43	0.000
Thorium-230	4.410	NA	4.410	1.97	2.440
Thorium-232	1.332	NA	1.332	1.36	0.000
Uranium-234	17.205	1.00E+04	17.205	1.04	16.165
Uranium-235/236	2.730	1.00E+04	2.730	0.15	2.580
Uranium-238	17.888	1.00E+04	17.888	1.22	16.668
Inorganics and Organics (mg/kg):					
Antimony	NC	NA	NC	0	0.000
Aroclor 1254	0.041	NA	0.041	0	0.041
Aroclor 1260	0.000	NA	0.000	0	0.000
Arsenic	11.900	NA	11.900	8.2	3.700
Benzo(a)anthracene	0.000	NA	0.000	0	0.000
Benzo(a)pyrene	0.000	NA	0.000	0	0.000
Benzo(b)fluoranthene	0.000	NA	0.000	0	0.000
Benzo(k)fluoranthene	0.000	NA	0.000	0	0.000
Beryllium	0.850	NA	0.850	0.6	0.250
Carbazole	NC	NA	NC	NA	0.000
Dibenzo(a,h)anthracene	0.000	NA	0.000	0	0.000
Dieldrin	0.000	NA	0.000	0	0.000
Indeno(1,2,3-cd)pyrene	0.000	NA	0.000	0	0.000
Uranium (total)	189.000	1.00E+04	189.000	3.4	185.600

NA = Not applicable.
NC = Not characterized.
[a]Concentrations from Appendix A.
[b]PRLs and Background Concentrations from Section 2.
[c]A zero value indicates that the residual concentration is at or below background. This subunit/layer does not contribute to risks above background.

Table D.2-I-19
Contaminant Concentrations in Exposed Soil
Active Flyash Pile - Exposed GMA - Expanded Trespasser/Off-Property Farmer - 10^{-6}
Alternatives: Consolidation/Capping

Contaminant	Active Flyash GMA Inside Conc. Term[a]	OU2 Soil PRL (AFP Soil)[b]	Minimum of PRL or Conc. Term	Background[b]	OU2 Post-Remedial Incr. Conc.[c]
Radionuclides (pCi/g):					
Cesium-137	0.000	NA	0.000	0.71	0.000
Neptunium-237	0.000	NA	0.000	0	0.000
Plutonium-238	0	NA	NC	0	0.000
Radium-226	0.594	NA	0.594	1.42	0.000
Radium-228	0.537	NA	0.537	1.25	0.000
Strontium-90	0.500	NA	0.500	0	0.500
Technetium-99	0.000	NA	0.000	0	0.000
Thorium-228	1.190	NA	1.190	1.43	0.000
Thorium-230	1.420	NA	1.420	1.97	0.000
Thorium-232	0.965	NA	0.965	1.36	0.000
Uranium-234	0.921	1.00E+04	0.921	1.04	0.000
Uranium-235/236	0.000	1.00E+04	0.000	0.15	0.000
Uranium-238	0.754	1.00E+04	0.754	1.22	0.000
Inorganics and Organics (mg/kg):					
Antimony	NC	NA	NC	0	0.000
Aroclor 1254	NC	NA	NC	0	0.000
Aroclor 1260	NC	NA	NC	0	0.000
Arsenic	NC	NA	NC	8.2	0.000
Benzo(a)anthracene	NC	NA	NC	0	0.000
Benzo(a)pyrene	NC	NA	NC	0	0.000
Benzo(b)fluoranthene	NC	NA	NC	0	0.000
Benzo(k)fluoranthene	NC	NA	NC	0	0.000
Beryllium	NC	NA	NC	0.6	0.000
Carbazole	NC	NA	NC	NA	0.000
Dibenzo(a,h)anthracene	NC	NA	NC	0	0.000
Dieldrin	NC	NA	NC	0	0.000
Indeno(1,2,3-cd)pyrene	NC	NA	NC	0	0.000
Uranium (total)	8.416	1.00E+04	8.416	3.4	5.016

NA = Not applicable.
NC = Not characterized.
[a]Concentrations from Appendix A.
[b]PRLs and Background Concentrations from Section 2.
[c]A zero value indicates that the residual concentration is at or below background. This subunit/layer does not contribute to risks above background.

Table D.2-I-20
Contaminant Concentrations in Exposed Soil
Active Flyash Pile - Exposed Till - Expanded Trespasser/Off-Property Farmer - 10^{-6}
Alternatives: Consolidation/Capping

Contaminant	Active Flyash Till Impacted Conc. Term[a]	OU2 Soil PRL (AFP Soil)[b]	Minimum of PRL or Conc. Term	Background[b]	OU2 Post-Remedial Incr. Conc.[c]
Radionuclides (pCi/g):					
Cesium-137	0.000	NA	0.000	0.71	0.000
Neptunium-237	0.400	NA	0.400	0	0.400
Plutonium-238	NC	NA	NC	0	0.000
Radium-226	1.730	NA	1.730	1.42	0.310
Radium-228	1.330	NA	1.330	1.25	0.080
Strontium-90	3.610	NA	3.610	0	3.610
Technetium-99	0.000	NA	0.000	0	0.000
Thorium-228	1.400	NA	1.400	1.43	0.000
Thorium-230	3.600	NA	3.600	1.97	1.630
Thorium-232	1.350	NA	1.350	1.36	0.000
Uranium-234	1.270	1.00E+04	1.270	1.24	0.030
Uranium-235/236	0.069	1.00E+04	0.069	0.15	0.000
Uranium-238	2.600	1.00E+04	2.600	1.22	1.380
Inorganics and Organics (mg/kg):					
Antimony	NC	NA	NC	0	0.000
Aroclor 1254	NC	NA	NC	0	0.000
Aroclor 1260	NC	NA	NC	0	0.000
Arsenic	18.700	NA	18.700	8.2	10.500
Benzo(a)anthracene	NC	NA	NC	0	0.000
Benzo(a)pyrene	NC	NA	NC	0	0.000
Benzo(b)fluoranthene	NC	NA	NC	0	0.000
Benzo(k)fluoranthene	NC	NA	NC	0	0.000
Beryllium	1.400	NA	1.400	0.6	0.800
Carbazole	NC	NA	NC	NA	0.000
Dibenzo(a,h)anthracene	NC	NA	NC	0	0.000
Dieldrin	NC	NA	NC	0	0.000
Indeno(1,2,3-cd)pyrene	NC	NA	NC	0	0.000
Uranium (total)	7.170	1.00E+04	7.170	3.4	3.770

NA = Not applicable.
NC = Not characterized.
[a]Concentrations from Appendix A.
[b]PRLs and Background Concentrations from Section 2.
[c]A zero value indicates that the residual concentration is at or below background. This subunit/layer does not contribute to risks above background.

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Table D.2-I-21
Contaminant Concentrations in Exposed Soil
Inactive Flyash Pile - Exposed GMA - Expanded Trespasser/Off-Property Farmer - 10^{-6}
Alternatives: Consolidation/Capping

Contaminant	Inactive Flyash GMA Inside Conc. Term[a]	OU2 Soil PRL (IFP GMA)[b]	Minimum of PRL or Conc. Term	Background[b]	OU2 Post-Remedial Incr. Conc.[c]
Radionuclides (pCi/g):					
Cesium-137	NC	NA	NC	0.71	0.000
Neptunium-237	0.180	NA	0.180	0	0.180
Plutonium-238	0	NA	NC	0	0.000
Radium-226	0.870	NA	0.870	1.42	0.000
Radium-228	0.530	NA	0.530	1.25	0.000
Strontium-90	NC	NA	NC	0	0.000
Technetium-99	0.000	NA	0.000	0	0.000
Thorium-228	0.410	NA	0.410	1.43	0.000
Thorium-230	2.030	NA	2.030	1.97	0.060
Thorium-232	0.360	NA	0.360	1.36	0.000
Uranium-234	1.290	1.00E+04	1.290	1.04	0.250
Uranium-235/236	0.080	1.00E+04	0.080	0.15	0.000
Uranium-238	1.440	1.00E+04	1.440	1.22	0.220
Inorganics and Organics (mg/kg):					
Antimony	NC	NA	NC	0	0.000
Aroclor 1254	NC	NA	NC	0	0.000
Aroclor 1260	NC	NA	NC	0	0.000
Arsenic	5.100	NA	5.100	8.2	0.000
Benzo(a)anthracene	NC	NA	NC	0	0.000
Benzo(a)pyrene	NC	NA	NC	0	0.000
Benzo(b)fluoranthene	NC	NA	NC	0	0.000
Benzo(k)fluoranthene	NC	NA	NC	0	0.000
Beryllium	NC	NA	NC	0.6	0.000
Carbazole	NC	NA	NC	NA	0.000
Dibenzo(a,h)anthracene	0.000	NA	0.000	0	0.000
Dieldrin	NC	NA	NC	0	0.000
Indeno(1,2,3-cd)pyrene	NC	NA	NC	0	0.000
Uranium (total)	5.860	1.00E+04	5.860	3.4	2.460

NA = Not applicable.
NC = Not characterized.
[a]Concentrations from Appendix A.
[b]PRLs and Background Concentrations from Section 2.
[c]A zero value indicates that the residual concentration is at or below background. This subunit/layer does not contribute to risks above background.

Table D.2-I-22
Contaminant Concentrations in Exposed Soil
Inactive Flyash Pile - Exposed Till - Expanded Trespasser/Off-Property Farmer - 10^{-6}
Alternatives: Consolidation/Capping

Contaminant	Inactive Flyash Till Other Conc. Term[a]	OU2 Soil PRL (IFP Soil)[b]	Minimum of PRL or Conc. Term	Background[b]	OU2 Post-Remedial Incr. Conc.[c]
Radionuclides (pCi/g):					
Cesium-137	NC	NA	NC	0.71	0.000
Neptunium-237	0.160	NA	0.160	0	0.160
Plutonium-238	NC	NA	NC	0	0.000
Radium-226	1.010	NA	1.010	1.42	0.000
Radium-228	0.730	NA	0.730	1.25	0.000
Strontium-90	NC	NA	NC	0	0.000
Technetium-99	NC	NA	NC	0	0.000
Thorium-228	0.833	NA	0.833	1.43	0.000
Thorium-230	1.620	NA	1.620	1.97	0.000
Thorium-232	0.732	NA	0.732	1.36	0.000
Uranium-234	0.770	1.00E+04	0.770	1.04	0.000
Uranium-235/236	0.052	1.00E+04	0.052	0.15	0.000
Uranium-238	0.850	1.00E+04	0.850	1.22	0.000
Inorganics and Organics (mg/kg):					
Antimony	NC	NA	NC	0	0.000
Aroclor 1254	NC	NA	NC	0	0.000
Aroclor 1260	NC	NA	NC	0	0.000
Arsenic	6.900	NA	6.900	8.2	0.000
Benzo(a)anthracene	NC	NA	NC	0	0.000
Benzo(a)pyrene	NC	NA	NC	0	0.000
Benzo(b)fluoranthene	NC	NA	NC	0	0.000
Benzo(k)fluoranthene	NC	NA	NC	0	0.000
Beryllium	NC	NA	NC	0.6	0.000
Carbazole	NC	NA	NC	NA	0.000
Dibenzo(a,h)anthracene	0.000	NA	0.000	0	0.000
Dieldrin	NC	NA	NC	0	0.000
Indeno(1,2,3-cd)pyrene	NC	NA	NC	0	0.000
Uranium (total)	4.390	1.00E+04	4.390	3.4	0.990

NA = Not applicable.
NC = Not characterized.
[a]Concentrations from Appendix A.
[b]PRLs and Background Concentrations from Section 2.
[c]A zero value indicates that the residual concentration is at or below background. This subunit/layer does not contribute to risks above background.

ATTACHMENT D.2-II

CONTAMINANT AIR EMISSION RATES

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Table D.2-II-1
Contaminant Emission Rates
South Field - Exposed GMA - On Property Farmer - 10^{-6}
Alternatives: On-Property Disposal Cell; Off-site Disposal

	Emission Rates Above Background	
Contaminant	Inhalable Particulates (PM10)	Total Particulates (TSP)
Radionuclides (pCi/s/m^2):		
Cesium-137	0.00E+00	0.00E+00
Neptunium-237	0.00E+00	0.00E+00
Plutonium-238	0.00E+00	0.00E+00
Radium-226	0.00E+00	0.00E+00
Radium-228	0.00E+00	0.00E+00
Strontium-90	2.54E-07	5.09E-07
Technetium-99	0.00E+00	0.00E+00
Thorium-228	0.00E+00	0.00E+00
Thorium-230	0.00E+00	0.00E+00
Thorium-232	0.00E+00	0.00E+00
Uranium-234	0.00E+00	0.00E+00
Uranium-235/236	0.00E+00	0.00E+00
Uranium-238	0.00E+00	0.00E+00
Inorganics and Organics (g/s/m^2):		
Antimony	0.00E+00	0.00E+00
Aroclor 1254	0.00E+00	0.00E+00
Aroclor 1260	0.00E+00	0.00E+00
Arsenic	0.00E+00	0.00E+00
Benzo(a)anthracene	0.00E+00	0.00E+00
Benzo(a)pyrene	0.00E+00	0.00E+00
Benzo(b)fluoranthene	0.00E+00	0.00E+00
Benzo(k)fluoranthene	0.00E+00	0.00E+00
Beryllium	0.00E+00	0.00E+00
Carbazole	0.00E+00	0.00E+00
Dibenzo(a,h)anthracene	0.00E+00	0.00E+00
Dieldrin	0.00E+00	0.00E+00
Indeno(1,2,3-cd)pyrene	0.00E+00	0.00E+00
Uranium (total)	0.00E+00	0.00E+00

Table D.2–II–2
Contaminant Emission Rates
Active Flyash Pile – Exposed GMA – On Property Farmer – 10^{-6}
Alternatives: On–Property Disposal Cell; Off–site Disposal

	Emission Rates Above Background	
Contaminant	Inhalable Particulates (PM10)	Total Particulates (TSP)
Radionuclides (pCi/s/m^2):		
Cesium–137	0.00E+00	0.00E+00
Neptunium–237	0.00E+00	0.00E+00
Plutonium–238	0.00E+00	0.00E+00
Radium–226	0.00E+00	0.00E+00
Radium–228	0.00E+00	0.00E+00
Strontium–90	2.54E–07	5.09E–07
Technetium–99	0.00E+00	0.00E+00
Thorium–228	0.00E+00	0.00E+00
Thorium–230	0.00E+00	0.00E+00
Thorium–232	0.00E+00	0.00E+00
Uranium–234	0.00E+00	0.00E+00
Uranium–235/236	0.00E+00	0.00E+00
Uranium–238	0.00E+00	0.00E+00
Inorganics and Organics (g/s/m^2):		
Antimony	0.00E+00	0.00E+00
Aroclor 1254	0.00E+00	0.00E+00
Aroclor 1260	0.00E+00	0.00E+00
Arsenic	0.00E+00	0.00E+00
Benzo(a)anthracene	0.00E+00	0.00E+00
Benzo(a)pyrene	0.00E+00	0.00E+00
Benzo(b)fluoranthene	0.00E+00	0.00E+00
Benzo(k)fluoranthene	0.00E+00	0.00E+00
Beryllium	0.00E+00	0.00E+00
Carbazole	0.00E+00	0.00E+00
Dibenzo(a,h)anthracene	0.00E+00	0.00E+00
Dieldrin	0.00E+00	0.00E+00
Indeno(1,2,3–cd)pyrene	0.00E+00	0.00E+00
Uranium (total)	7.98E–05	1.60E–04

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Table D.2–II–3
Contaminant Emission Rates
Active Flyash Pile – Exposed Till – On Property Farmer – 10^{-6}
Alternatives: On–Property Disposal Cell; Off–site Disposal

	Emission Rates Above Background	
Contaminant	Inhalable Particulates (PM10)	Total Particulates (TSP)
Radionuclides (pCi/s/m^2):		
Cesium–137	0.00E+00	0.00E+00
Neptunium–237	6.84E–07	1.37E–06
Plutonium–238	0.00E+00	0.00E+00
Radium–226	0.00E+00	0.00E+00
Radium–228	0.00E+00	0.00E+00
Strontium–90	2.54E–07	5.09E–07
Technetium–99	0.00E+00	0.00E+00
Thorium–228	0.00E+00	0.00E+00
Thorium–230	1.11E–05	2.23E–05
Thorium–232	0.00E+00	0.00E+00
Uranium–234	0.00E+00	0.00E+00
Uranium–235/236	0.00E+00	0.00E+00
Uranium–238	0.00E+00	0.00E+00
Inorganics and Organics (g/s/m^2):		
Antimony	0.00E+00	0.00E+00
Aroclor 1254	0.00E+00	0.00E+00
Aroclor 1260	0.00E+00	0.00E+00
Arsenic	0.00E+00	0.00E+00
Benzo(a)anthracene	0.00E+00	0.00E+00
Benzo(a)pyrene	0.00E+00	0.00E+00
Benzo(b)fluoranthene	0.00E+00	0.00E+00
Benzo(k)fluoranthene	0.00E+00	0.00E+00
Beryllium	0.00E+00	0.00E+00
Carbazole	0.00E+00	0.00E+00
Dibenzo(a,h)anthracene	0.00E+00	0.00E+00
Dieldrin	0.00E+00	0.00E+00
Indeno(1,2,3–cd)pyrene	0.00E+00	0.00E+00
Uranium (total)	1.38E–05	2.77E–05

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Table D.2-II-4
Contaminant Emission Rates
Inactive Flyash Pile - Exposed GMA - On Property Farmer - 10^{-6}
Alternatives: On-Property Disposal Cell; Off-site Disposal

	Emission Rates Above Background	
Contaminant	Inhalable Particulates (PM10)	Total Particulates (TSP)
Radionuclides (pCi/s/m^2):		
Cesium-137	0.00E+00	0.00E+00
Neptunium-237	6.84E-07	1.37E-06
Plutonium-238	0.00E+00	0.00E+00
Radium-226	0.00E+00	0.00E+00
Radium-228	0.00E+00	0.00E+00
Strontium-90	0.00E+00	0.00E+00
Technetium-99	0.00E+00	0.00E+00
Thorium-228	0.00E+00	0.00E+00
Thorium-230	9.54E-07	1.91E-06
Thorium-232	0.00E+00	0.00E+00
Uranium-234	3.98E-06	7.95E-06
Uranium-235/236	0.00E+00	0.00E+00
Uranium-238	3.50E-06	7.00E-06
Inorganics and Organics (g/s/m^2):		
Antimony	0.00E+00	0.00E+00
Aroclor 1254	0.00E+00	0.00E+00
Aroclor 1260	0.00E+00	0.00E+00
Arsenic	0.00E+00	0.00E+00
Benzo(a)anthracene	0.00E+00	0.00E+00
Benzo(a)pyrene	0.00E+00	0.00E+00
Benzo(b)fluoranthene	0.00E+00	0.00E+00
Benzo(k)fluoranthene	0.00E+00	0.00E+00
Beryllium	0.00E+00	0.00E+00
Carbazole	0.00E+00	0.00E+00
Dibenzo(a,h)anthracene	0.00E+00	0.00E+00
Dieldrin	0.00E+00	0.00E+00
Indeno(1,2,3-cd)pyrene	0.00E+00	0.00E+00
Uranium (total)	3.91E-05	7.82E-05

Table D.2–II–5
Contaminant Emission Rates
Inactive Flyash Pile – Exposed Till – On Property Farmer – 10^{-6}
Alternatives: On–Property Disposal Cell; Off–site Disposal

Contaminant	Emission Rates Above Background	
	Inhalable Particulates (PM10)	Total Particulates (TSP)
Radionuclides (pCi/s/m^2):		
Cesium–137	0.00E+00	0.00E+00
Neptunium–237	6.84E–07	1.37E–06
Plutonium–238	0.00E+00	0.00E+00
Radium–226	0.00E+00	0.00E+00
Radium–228	0.00E+00	0.00E+00
Strontium–90	0.00E+00	0.00E+00
Technetium–99	0.00E+00	0.00E+00
Thorium–228	0.00E+00	0.00E+00
Thorium–230	0.00E+00	0.00E+00
Thorium–232	0.00E+00	0.00E+00
Uranium–234	0.00E+00	0.00E+00
Uranium–235/236	0.00E+00	0.00E+00
Uranium–238	0.00E+00	0.00E+00
Inorganics and Organics (g/s/m^2):		
Antimony	0.00E+00	0.00E+00
Aroclor 1254	0.00E+00	0.00E+00
Aroclor 1260	0.00E+00	0.00E+00
Arsenic	0.00E+00	0.00E+00
Benzo(a)anthracene	0.00E+00	0.00E+00
Benzo(a)pyrene	0.00E+00	0.00E+00
Benzo(b)fluoranthene	0.00E+00	0.00E+00
Benzo(k)fluoranthene	0.00E+00	0.00E+00
Beryllium	0.00E+00	0.00E+00
Carbazole	0.00E+00	0.00E+00
Dibenzo(a,h)anthracene	0.00E+00	0.00E+00
Dieldrin	0.00E+00	0.00E+00
Indeno(1,2,3–cd)pyrene	0.00E+00	0.00E+00
Uranium (total)	1.57E–05	3.15E–05

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Table D.2-II-6
Contaminant Emission Rates
Solid Waste Landfill - Exposed Till - On Property Farmer - 10^{-6}
Alternatives: On-Property Disposal Cell; Off-site Disposal

	Emission Rates Above Background	
Contaminant	Inhalable Particulates (PM10)	Total Particulates (TSP)
Radionuclides (pCi/s/m^2):		
Cesium-137	0.00E+00	0.00E+00
Neptunium-237	6.84E-07	1.37E-06
Plutonium-238	3.18E-06	6.36E-06
Radium-226	0.00E+00	0.00E+00
Radium-228	0.00E+00	0.00E+00
Strontium-90	2.54E-07	5.09E-07
Technetium-99	0.00E+00	0.00E+00
Thorium-228	0.00E+00	0.00E+00
Thorium-230	1.22E-05	2.45E-05
Thorium-232	0.00E+00	0.00E+00
Uranium-234	1.27E-06	2.54E-06
Uranium-235/236	0.00E+00	0.00E+00
Uranium-238	0.00E+00	0.00E+00
Inorganics and Organics (g/s/m^2):		
Antimony	2.11E-05	4.23E-05
Aroclor 1254	0.00E+00	0.00E+00
Aroclor 1260	0.00E+00	0.00E+00
Arsenic	0.00E+00	0.00E+00
Benzo(a)anthracene	3.66E-07	7.31E-07
Benzo(a)pyrene	2.39E-08	4.77E-08
Benzo(b)fluoranthene	2.23E-07	4.45E-07
Benzo(k)fluoranthene	0.00E+00	0.00E+00
Beryllium	0.00E+00	0.00E+00
Carbazole	1.02E-07	2.04E-07
Dibenzo(a,h)anthracene	7.31E-09	1.46E-08
Dieldrin	0.00E+00	0.00E+00
Indeno(1,2,3-cd)pyrene	1.16E-07	2.32E-07
Uranium (total)	0.00E+00	0.00E+00

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Table D.2-II-7
Contaminant Emission Rates
Lime Sludge Ponds - Exposed Till - On Property Farmer - 10^{-6}
Alternatives: On-Property Disposal Cell; Off-site Disposal

	Emission Rates Above Background	
Contaminant	Inhalable Particulates (PM10)	Total Particulates (TSP)
Radionuclides (pCi/s/m^2):		
Cesium-137	0.00E+00	0.00E+00
Neptunium-237	8.11E-08	1.62E-07
Plutonium-238	0.00E+00	0.00E+00
Radium-226	0.00E+00	0.00E+00
Radium-228	0.00E+00	0.00E+00
Strontium-90	8.90E-08	1.78E-07
Technetium-99	0.00E+00	0.00E+00
Thorium-228	0.00E+00	0.00E+00
Thorium-230	8.27E-06	1.65E-05
Thorium-232	0.00E+00	0.00E+00
Uranium-234	0.00E+00	0.00E+00
Uranium-235/236	0.00E+00	0.00E+00
Uranium-238	0.00E+00	0.00E+00
Inorganics and Organics (g/s/m^2):		
Antimony	0.00E+00	0.00E+00
Aroclor 1254	0.00E+00	0.00E+00
Aroclor 1260	0.00E+00	0.00E+00
Arsenic	1.06E-04	2.13E-04
Benzo(a)anthracene	0.00E+00	0.00E+00
Benzo(a)pyrene	0.00E+00	0.00E+00
Benzo(b)fluoranthene	0.00E+00	0.00E+00
Benzo(k)fluoranthene	0.00E+00	0.00E+00
Beryllium	0.00E+00	0.00E+00
Carbazole	0.00E+00	0.00E+00
Dibenzo(a,h)anthracene	0.00E+00	0.00E+00
Dieldrin	0.00E+00	0.00E+00
Indeno(1,2,3-cd)pyrene	0.00E+00	0.00E+00
Uranium (total)	0.00E+00	0.00E+00

Table D.2-II-8
Contaminant Emission Rates
South Field - Exposed GMA - Expanded Trespasser/Off-Property Farmer - 10^{-6}
Alternatives: On-Property Disposal Cell; Off-site Disposal

	Emission Rates Above Background	
Contaminant	Inhalable Particulates (PM10)	Total Particulates (TSP)
Radionuclides (pCi/s/m^2):		
Cesium-137	0.00E+00	0.00E+00
Neptunium-237	0.00E+00	0.00E+00
Plutonium-238	0.00E+00	0.00E+00
Radium-226	0.00E+00	0.00E+00
Radium-228	0.00E+00	0.00E+00
Strontium-90	8.47E-07	1.69E-06
Technetium-99	0.00E+00	0.00E+00
Thorium-228	0.00E+00	0.00E+00
Thorium-230	0.00E+00	0.00E+00
Thorium-232	0.00E+00	0.00E+00
Uranium-234	0.00E+00	0.00E+00
Uranium-235/236	0.00E+00	0.00E+00
Uranium-238	0.00E+00	0.00E+00
Inorganics and Organics (g/s/m^2):		
Antimony	0.00E+00	0.00E+00
Aroclor 1254	0.00E+00	0.00E+00
Aroclor 1260	0.00E+00	0.00E+00
Arsenic	0.00E+00	0.00E+00
Benzo(a)anthracene	0.00E+00	0.00E+00
Benzo(a)pyrene	0.00E+00	0.00E+00
Benzo(b)fluoranthene	0.00E+00	0.00E+00
Benzo(k)fluoranthene	0.00E+00	0.00E+00
Beryllium	0.00E+00	0.00E+00
Carbazole	0.00E+00	0.00E+00
Dibenzo(a,h)anthracene	0.00E+00	0.00E+00
Dieldrin	0.00E+00	0.00E+00
Indeno(1,2,3-cd)pyrene	0.00E+00	0.00E+00
Uranium (total)	8.35E-06	1.67E-05

Table D.2-II-9
Contaminant Emission Rates
South Field - Exposed Till - Expanded Trespasser/Off-Property Farmer - 10^{-6}
Alternatives: On-Property Disposal Cell; Off-site Disposal

	Emission Rates Above Background	
Contaminant	Inhalable Particulates (PM10)	Total Particulates (TSP)
Radionuclides (pCi/s/m^2):		
Cesium-137	0.00E+00	0.00E+00
Neptunium-237	3.52E-07	7.04E-07
Plutonium-238	0.00E+00	0.00E+00
Radium-226	4.60E-07	9.20E-07
Radium-228	2.35E-07	4.69E-07
Strontium-90	1.33E-06	2.66E-06
Technetium-99	1.09E-06	2.18E-06
Thorium-228	0.00E+00	0.00E+00
Thorium-230	2.95E-06	5.90E-06
Thorium-232	0.00E+00	0.00E+00
Uranium-234	3.87E-06	7.74E-06
Uranium-235/236	3.12E-06	6.24E-06
Uranium-238	2.42E-06	4.84E-06
Inorganics and Organics (g/s/m^2):		
Antimony	0.00E+00	0.00E+00
Aroclor 1254	4.96E-08	9.92E-08
Aroclor 1260	0.00E+00	0.00E+00
Arsenic	4.48E-06	8.95E-06
Benzo(a)anthracene	0.00E+00	0.00E+00
Benzo(a)pyrene	0.00E+00	0.00E+00
Benzo(b)fluoranthene	0.00E+00	0.00E+00
Benzo(k)fluoranthene	0.00E+00	0.00E+00
Beryllium	3.03E-07	6.05E-07
Carbazole	0.00E+00	0.00E+00
Dibenzo(a,h)anthracene	0.00E+00	0.00E+00
Dieldrin	0.00E+00	0.00E+00
Indeno(1,2,3-cd)pyrene	0.00E+00	0.00E+00
Uranium (total)	5.57E-06	1.11E-05

0882

Table D.2-II-10
Contaminant Emission Rates
South Field - Exposed Fill - Expanded Trespasser/Off-Property Farmer - 10^{-6}
Alternatives: On-Property Disposal Cell; Off-site Disposal

	Emission Rates Above Background	
Contaminant	Inhalable Particulates (PM10)	Total Particulates (TSP)
Radionuclides (pCi/s/m^2):		
Cesium-137	0.00E+00	0.00E+00
Neptunium-237	4.46E-07	8.93E-07
Plutonium-238	0.00E+00	0.00E+00
Radium-226	4.60E-07	9.20E-07
Radium-228	9.08E-07	1.82E-06
Strontium-90	1.65E-06	3.29E-06
Technetium-99	1.09E-06	2.18E-06
Thorium-228	4.48E-07	8.95E-07
Thorium-230	1.43E-05	2.86E-05
Thorium-232	1.69E-07	3.39E-07
Uranium-234	3.87E-06	7.74E-06
Uranium-235/236	3.87E-06	7.74E-06
Uranium-238	2.42E-06	4.84E-06
Inorganics and Organics (g/s/m^2):		
Antimony	0.00E+00	0.00E+00
Aroclor 1254	5.20E-07	1.04E-06
Aroclor 1260	4.60E-08	9.20E-08
Arsenic	0.00E+00	0.00E+00
Benzo(a)anthracene	1.33E-06	2.66E-06
Benzo(a)pyrene	2.18E-06	4.36E-06
Benzo(b)fluoranthene	1.94E-06	3.87E-06
Benzo(k)fluoranthene	1.94E-06	3.87E-06
Beryllium	3.39E-07	6.78E-07
Carbazole	0.00E+00	0.00E+00
Dibenzo(a,h)anthracene	5.32E-07	1.06E-06
Dieldrin	1.17E-08	2.35E-08
Indeno(1,2,3-cd)pyrene	7.50E-07	1.50E-06
Uranium (total)	5.57E-06	1.11E-05

5860

Table D.2-II-11
Contaminant Emission Rates
Active Flyash Pile - Exposed GMA - Expanded Trespasser/Off-Property Farmer - 10^{-6}
Alternatives: On-Property Disposal Cell; Off-site Disposal

	Emission Rates Above Background	
Contaminant	Inhalable Particulates (PM10)	Total Particulates (TSP)
Radionuclides (pCi/s/m^2):		
Cesium-137	0.00E+00	0.00E+00
Neptunium-237	0.00E+00	0.00E+00
Plutonium-238	0.00E+00	0.00E+00
Radium-226	0.00E+00	0.00E+00
Radium-228	0.00E+00	0.00E+00
Strontium-90	6.05E-07	1.21E-06
Technetium-99	0.00E+00	0.00E+00
Thorium-228	0.00E+00	0.00E+00
Thorium-230	0.00E+00	0.00E+00
Thorium-232	0.00E+00	0.00E+00
Uranium-234	0.00E+00	0.00E+00
Uranium-235/236	0.00E+00	0.00E+00
Uranium-238	0.00E+00	0.00E+00
Inorganics and Organics (g/s/m^2):		
Antimony	0.00E+00	0.00E+00
Aroclor 1254	0.00E+00	0.00E+00
Aroclor 1260	0.00E+00	0.00E+00
Arsenic	1.05E-05	2.11E-05
Benzo(a)anthracene	0.00E+00	0.00E+00
Benzo(a)pyrene	0.00E+00	0.00E+00
Benzo(b)fluoranthene	0.00E+00	0.00E+00
Benzo(k)fluoranthene	0.00E+00	0.00E+00
Beryllium	0.00E+00	0.00E+00
Carbazole	0.00E+00	0.00E+00
Dibenzo(a,h)anthracene	0.00E+00	0.00E+00
Dieldrin	0.00E+00	0.00E+00
Indeno(1,2,3-cd)pyrene	0.00E+00	0.00E+00
Uranium (total)	6.07E-06	1.21E-05

Table D.2-II-12
Contaminant Emission Rates
Active Flyash Pile - Exposed Till - Expanded Trespasser/Off-Property Farmer - 10^{-6}
Alternatives: On-Property Disposal Cell; Off-site Disposal

	Emission Rates Above Background	
Contaminant	Inhalable Particulates (PM10)	Total Particulates (TSP)
Radionuclides (pCi/s/m^2):		
Cesium-137	0.00E+00	0.00E+00
Neptunium-237	5.20E-08	1.04E-07
Plutonium-238	0.00E+00	0.00E+00
Radium-226	1.21E-08	2.42E-08
Radium-228	1.21E-08	2.42E-08
Strontium-90	4.37E-06	8.74E-06
Technetium-99	0.00E+00	0.00E+00
Thorium-228	0.00E+00	0.00E+00
Thorium-230	1.97E-06	3.94E-06
Thorium-232	0.00E+00	0.00E+00
Uranium-234	3.63E-08	7.26E-08
Uranium-235/236	0.00E+00	0.00E+00
Uranium-238	3.03E-07	6.05E-07
Inorganics and Organics (g/s/m^2):		
Antimony	0.00E+00	0.00E+00
Aroclor 1254	0.00E+00	0.00E+00
Aroclor 1260	0.00E+00	0.00E+00
Arsenic	1.05E-05	2.11E-05
Benzo(a)anthracene	0.00E+00	0.00E+00
Benzo(a)pyrene	0.00E+00	0.00E+00
Benzo(b)fluoranthene	0.00E+00	0.00E+00
Benzo(k)fluoranthene	0.00E+00	0.00E+00
Beryllium	9.68E-07	1.94E-06
Carbazole	0.00E+00	0.00E+00
Dibenzo(a,h)anthracene	0.00E+00	0.00E+00
Dieldrin	0.00E+00	0.00E+00
Indeno(1,2,3-cd)pyrene	0.00E+00	0.00E+00
Uranium (total)	4.56E-06	9.12E-06

5860

Table D.2-II-13
Contaminant Emission Rates
Inactive Flyash Pile - Exposed GMA - Expanded Trespasser/Off-Property Farmer - 10^{-6}
Alternatives: On-Property Disposal Cell; Off-site Disposal

	Emission Rates Above Background	
Contaminant	Inhalable Particulates (PM10)	Total Particulates (TSP)
Radionuclides (pCi/s/m^2):		
Cesium-137	0.00E+00	0.00E+00
Neptunium-237	2.18E-07	4.36E-07
Plutonium-238	0.00E+00	0.00E+00
Radium-226	0.00E+00	0.00E+00
Radium-228	0.00E+00	0.00E+00
Strontium-90	0.00E+00	0.00E+00
Technetium-99	0.00E+00	0.00E+00
Thorium-228	0.00E+00	0.00E+00
Thorium-230	7.26E-08	1.45E-07
Thorium-232	0.00E+00	0.00E+00
Uranium-234	3.03E-07	6.05E-07
Uranium-235/236	0.00E+00	0.00E+00
Uranium-238	2.66E-07	5.32E-07
Inorganics and Organics (g/s/m^2):		
Antimony	0.00E+00	0.00E+00
Aroclor 1254	0.00E+00	0.00E+00
Aroclor 1260	0.00E+00	0.00E+00
Arsenic	0.00E+00	0.00E+00
Benzo(a)anthracene	0.00E+00	0.00E+00
Benzo(a)pyrene	0.00E+00	0.00E+00
Benzo(b)fluoranthene	0.00E+00	0.00E+00
Benzo(k)fluoranthene	0.00E+00	0.00E+00
Beryllium	0.00E+00	0.00E+00
Carbazole	0.00E+00	0.00E+00
Dibenzo(a,h)anthracene	0.00E+00	0.00E+00
Dieldrin	0.00E+00	0.00E+00
Indeno(1,2,3-cd)pyrene	0.00E+00	0.00E+00
Uranium (total)	2.98E-06	5.95E-06

Table D.2–II–14
Contaminant Emission Rates
Inactive Flyash Pile – Exposed Till – Expanded Trespasser/Off–Property Farmer – 10^{-6}
Alternatives: On–Property Disposal Cell; Off–site Disposal

	Emission Rates Above Background	
Contaminant	Inhalable Particulates (PM10)	Total Particulates (TSP)
Radionuclides (pCi/s/m^2):		
Cesium–137	0.00E+00	0.00E+00
Neptunium–237	1.94E–07	3.87E–07
Plutonium–238	0.00E+00	0.00E+00
Radium–226	0.00E+00	0.00E+00
Radium–228	0.00E+00	0.00E+00
Strontium–90	0.00E+00	0.00E+00
Technetium–99	0.00E+00	0.00E+00
Thorium–228	0.00E+00	0.00E+00
Thorium–230	0.00E+00	0.00E+00
Thorium–232	0.00E+00	0.00E+00
Uranium–234	0.00E+00	0.00E+00
Uranium–235/236	0.00E+00	0.00E+00
Uranium–238	0.00E+00	0.00E+00
Inorganics and Organics (g/s/m^2):		
Antimony	0.00E+00	0.00E+00
Aroclor 1254	0.00E+00	0.00E+00
Aroclor 1260	0.00E+00	0.00E+00
Arsenic	0.00E+00	0.00E+00
Benzo(a)anthracene	0.00E+00	0.00E+00
Benzo(a)pyrene	0.00E+00	0.00E+00
Benzo(b)fluoranthene	0.00E+00	0.00E+00
Benzo(k)fluoranthene	0.00E+00	0.00E+00
Beryllium	0.00E+00	0.00E+00
Carbazole	0.00E+00	0.00E+00
Dibenzo(a,h)anthracene	0.00E+00	0.00E+00
Dieldrin	0.00E+00	0.00E+00
Indeno(1,2,3–cd)pyrene	0.00E+00	0.00E+00
Uranium (total)	1.20E–06	2.40E–06

Table D.2-II-15
Contaminant Emission Rates
Solid Waste Landfill - Exposed Till - Expanded Trespasser/Off-Property Farmer - 10^{-6}
Alternatives: On-Property Disposal Cell; Off-site Disposal

	Emission Rates Above Background	
Contaminant	Inhalable Particulates (PM10)	Total Particulates (TSP)
Radionuclides (pCi/s/m^2):		
Cesium-137	0.00E+00	0.00E+00
Neptunium-237	4.84E-07	9.68E-07
Plutonium-238	2.42E-07	4.84E-07
Radium-226	0.00E+00	0.00E+00
Radium-228	0.00E+00	0.00E+00
Strontium-90	8.83E-07	1.77E-06
Technetium-99	0.00E+00	0.00E+00
Thorium-228	0.00E+00	0.00E+00
Thorium-230	1.37E-06	2.73E-06
Thorium-232	0.00E+00	0.00E+00
Uranium-234	3.15E-07	6.29E-07
Uranium-235/236	0.00E+00	0.00E+00
Uranium-238	2.88E-06	5.76E-06
Inorganics and Organics (g/s/m^2):		
Antimony	2.73E-05	5.47E-05
Aroclor 1254	0.00E+00	0.00E+00
Aroclor 1260	0.00E+00	0.00E+00
Arsenic	0.00E+00	0.00E+00
Benzo(a)anthracene	3.51E-07	7.02E-07
Benzo(a)pyrene	3.51E-07	7.02E-07
Benzo(b)fluoranthene	3.15E-07	6.29E-07
Benzo(k)fluoranthene	0.00E+00	0.00E+00
Beryllium	4.84E-07	9.68E-07
Carbazole	2.54E-07	5.08E-07
Dibenzo(a,h)anthracene	1.33E-07	2.66E-07
Dieldrin	0.00E+00	0.00E+00
Indeno(1,2,3-cd)pyrene	2.54E-07	5.08E-07
Uranium (total)	5.20E-06	1.04E-05

0086

Table D.2–II–16
Contaminant Emission Rates
Lime Sludge Ponds – Exposed Till – Expanded Trespasser/Off–Property Farmer – 10^{-6}
Alternatives: On–Property Disposal Cell; Off–site Disposal

	Emission Rates Above Background	
Contaminant	Inhalable Particulates (PM10)	Total Particulates (TSP)
Radionuclides (pCi/s/m^2):		
Cesium–137	0.00E+00	0.00E+00
Neptunium–237	1.57E–07	3.15E–07
Plutonium–238	0.00E+00	0.00E+00
Radium–226	0.00E+00	0.00E+00
Radium–228	0.00E+00	0.00E+00
Strontium–90	6.53E–07	1.31E–06
Technetium–99	0.00E+00	0.00E+00
Thorium–228	0.00E+00	0.00E+00
Thorium–230	6.29E–07	1.26E–06
Thorium–232	0.00E+00	0.00E+00
Uranium–234	0.00E+00	0.00E+00
Uranium–235/236	0.00E+00	0.00E+00
Uranium–238	0.00E+00	0.00E+00
Inorganics and Organics (g/s/m^2):		
Antimony	0.00E+00	0.00E+00
Aroclor 1254	0.00E+00	0.00E+00
Aroclor 1260	0.00E+00	0.00E+00
Arsenic	8.09E–06	1.62E–05
Benzo(a)anthracene	0.00E+00	0.00E+00
Benzo(a)pyrene	0.00E+00	0.00E+00
Benzo(b)fluoranthene	0.00E+00	0.00E+00
Benzo(k)fluoranthene	0.00E+00	0.00E+00
Beryllium	0.00E+00	0.00E+00
Carbazole	0.00E+00	0.00E+00
Dibenzo(a,h)anthracene	0.00E+00	0.00E+00
Dieldrin	0.00E+00	0.00E+00
Indeno(1,2,3–cd)pyrene	0.00E+00	0.00E+00
Uranium (total)	1.32E–05	2.64E–05

5860

Table D.2-II-17
Contaminant Emission Rates
South Field - Exposed GMA - Expanded Trespasser/Off-Property Farmer - 10^{-6}
Alternatives: Consolidation/Capping

	Emission Rates Above Background	
Contaminant	Inhalable Particulates (PM10)	Total Particulates (TSP)
Radionuclides (pCi/s/m^2):		
Cesium-137	0.00E+00	0.00E+00
Neptunium-237	0.00E+00	0.00E+00
Plutonium-238	0.00E+00	0.00E+00
Radium-226	0.00E+00	0.00E+00
Radium-228	0.00E+00	0.00E+00
Strontium-90	8.47E-07	1.69E-06
Technetium-99	0.00E+00	0.00E+00
Thorium-228	0.00E+00	0.00E+00
Thorium-230	0.00E+00	0.00E+00
Thorium-232	0.00E+00	0.00E+00
Uranium-234	0.00E+00	0.00E+00
Uranium-235/236	0.00E+00	0.00E+00
Uranium-238	0.00E+00	0.00E+00
Inorganics and Organics (g/s/m^2):		
Antimony	0.00E+00	0.00E+00
Aroclor 1254	0.00E+00	0.00E+00
Aroclor 1260	0.00E+00	0.00E+00
Arsenic	0.00E+00	0.00E+00
Benzo(a)anthracene	0.00E+00	0.00E+00
Benzo(a)pyrene	0.00E+00	0.00E+00
Benzo(b)fluoranthene	0.00E+00	0.00E+00
Benzo(k)fluoranthene	0.00E+00	0.00E+00
Beryllium	0.00E+00	0.00E+00
Carbazole	0.00E+00	0.00E+00
Dibenzo(a,h)anthracene	0.00E+00	0.00E+00
Dieldrin	0.00E+00	0.00E+00
Indeno(1,2,3-cd)pyrene	0.00E+00	0.00E+00
Uranium (total)	8.35E-06	1.67E-05

001746

Table D.2–II–18
Contaminant Emission Rates
South Field – Exposed Till – Expanded Trespasser/Off–Property Farmer – 10^{-6}
Alternatives: Consolidation/Capping

Contaminant	Emission Rates Above Background	
	Inhalable Particulates (PM10)	Total Particulates (TSP)
Radionuclides (pCi/s/m^2):		
Cesium–137	0.00E+00	0.00E+00
Neptunium–237	3.52E–07	7.04E–07
Plutonium–238	0.00E+00	0.00E+00
Radium–226	6.90E–07	1.38E–06
Radium–228	2.35E–07	4.69E–07
Strontium–90	1.33E–06	2.66E–06
Technetium–99	1.09E–06	2.18E–06
Thorium–228	0.00E+00	0.00E+00
Thorium–230	2.95E–06	5.90E–06
Thorium–232	0.00E+00	0.00E+00
Uranium–234	1.96E–05	3.91E–05
Uranium–235/236	3.12E–06	6.24E–06
Uranium–238	2.02E–05	4.03E–05
Inorganics and Organics (g/s/m^2):		
Antimony	0.00E+00	0.00E+00
Aroclor 1254	4.96E–08	9.92E–08
Aroclor 1260	0.00E+00	0.00E+00
Arsenic	4.48E–06	8.95E–06
Benzo(a)anthracene	0.00E+00	0.00E+00
Benzo(a)pyrene	0.00E+00	0.00E+00
Benzo(b)fluoranthene	0.00E+00	0.00E+00
Benzo(k)fluoranthene	0.00E+00	0.00E+00
Beryllium	3.03E–07	6.05E–07
Carbazole	0.00E+00	0.00E+00
Dibenzo(a,h)anthracene	0.00E+00	0.00E+00
Dieldrin	0.00E+00	0.00E+00
Indeno(1,2,3–cd)pyrene	0.00E+00	0.00E+00
Uranium (total)	2.25E–04	4.49E–04

Table D.2-II-19
Contaminant Emission Rates
Active Flyash Pile - Exposed GMA - Expanded Trespasser/Off-Property Farmer - 10^{-6}
Alternatives: Consolidation/Capping

	Emission Rates Above Background	
Contaminant	Inhalable Particulates (PM10)	Total Particulates (TSP)
Radionuclides (pCi/s/m^2):		
Cesium-137	0.00E+00	0.00E+00
Neptunium-237	0.00E+00	0.00E+00
Plutonium-238	0.00E+00	0.00E+00
Radium-226	0.00E+00	0.00E+00
Radium-228	0.00E+00	0.00E+00
Strontium-90	6.05E-07	1.21E-06
Technetium-99	0.00E+00	0.00E+00
Thorium-228	0.00E+00	0.00E+00
Thorium-230	0.00E+00	0.00E+00
Thorium-232	0.00E+00	0.00E+00
Uranium-234	0.00E+00	0.00E+00
Uranium-235/236	0.00E+00	0.00E+00
Uranium-238	0.00E+00	0.00E+00
Inorganics and Organics (g/s/m^2):		
Antimony	0.00E+00	0.00E+00
Aroclor 1254	0.00E+00	0.00E+00
Aroclor 1260	0.00E+00	0.00E+00
Arsenic	0.00E+00	0.00E+00
Benzo(a)anthracene	0.00E+00	0.00E+00
Benzo(a)pyrene	0.00E+00	0.00E+00
Benzo(b)fluoranthene	0.00E+00	0.00E+00
Benzo(k)fluoranthene	0.00E+00	0.00E+00
Beryllium	0.00E+00	0.00E+00
Carbazole	0.00E+00	0.00E+00
Dibenzo(a,h)anthracene	0.00E+00	0.00E+00
Dieldrin	0.00E+00	0.00E+00
Indeno(1,2,3-cd)pyrene	0.00E+00	0.00E+00
Uranium (total)	6.07E-06	1.21E-05

Table D.2–II–20
Contaminant Emission Rates
Active Flyash Pile – Exposed Till – Expanded Trespasser/Off–Property Farmer – 10^{-6}
Alternatives: Consolidation/Capping

	Emission Rates Above Background	
Contaminant	Inhalable Particulates (PM10)	Total Particulates (TSP)
Radionuclides (pCi/s/m^2):		
Cesium–137	0.00E+00	0.00E+00
Neptunium–237	4.84E–07	9.68E–07
Plutonium–238	0.00E+00	0.00E+00
Radium–226	3.75E–07	7.50E–07
Radium–228	9.68E–08	1.94E–07
Strontium–90	4.37E–06	8.74E–06
Technetium–99	0.00E+00	0.00E+00
Thorium–228	0.00E+00	0.00E+00
Thorium–230	1.97E–06	3.94E–06
Thorium–232	0.00E+00	0.00E+00
Uranium–234	3.63E–08	7.26E–08
Uranium–235/236	0.00E+00	0.00E+00
Uranium–238	1.67E–06	3.34E–06
Inorganics and Organics (g/s/m^2):		
Antimony	0.00E+00	0.00E+00
Aroclor 1254	0.00E+00	0.00E+00
Aroclor 1260	0.00E+00	0.00E+00
Arsenic	1.27E–05	2.54E–05
Benzo(a)anthracene	0.00E+00	0.00E+00
Benzo(a)pyrene	0.00E+00	0.00E+00
Benzo(b)fluoranthene	0.00E+00	0.00E+00
Benzo(k)fluoranthene	0.00E+00	0.00E+00
Beryllium	9.68E–07	1.94E–06
Carbazole	0.00E+00	0.00E+00
Dibenzo(a,h)anthracene	0.00E+00	0.00E+00
Dieldrin	0.00E+00	0.00E+00
Indeno(1,2,3–cd)pyrene	0.00E+00	0.00E+00
Uranium (total)	4.56E–06	9.12E–06

Table D.2-II-21
Contaminant Emission Rates
Inactive Flyash Pile - Exposed GMA - Expanded Trespasser/Off-Property Farmer - 10^{-6}
Alternatives: Consolidation/Capping

	Emission Rates Above Background	
Contaminant	Inhalable Particulates (PM10)	Total Particulates (TSP)
Radionuclides (pCi/s/m^2):		
Cesium-137	0.00E+00	0.00E+00
Neptunium-237	2.18E-07	4.36E-07
Plutonium-238	0.00E+00	0.00E+00
Radium-226	0.00E+00	0.00E+00
Radium-228	0.00E+00	0.00E+00
Strontium-90	0.00E+00	0.00E+00
Technetium-99	0.00E+00	0.00E+00
Thorium-228	0.00E+00	0.00E+00
Thorium-230	7.26E-08	1.45E-07
Thorium-232	0.00E+00	0.00E+00
Uranium-234	3.03E-07	6.05E-07
Uranium-235/236	0.00E+00	0.00E+00
Uranium-238	2.66E-07	5.32E-07
Inorganics and Organics (g/s/m^2):		
Antimony	0.00E+00	0.00E+00
Aroclor 1254	0.00E+00	0.00E+00
Aroclor 1260	0.00E+00	0.00E+00
Arsenic	0.00E+00	0.00E+00
Benzo(a)anthracene	0.00E+00	0.00E+00
Benzo(a)pyrene	0.00E+00	0.00E+00
Benzo(b)fluoranthene	0.00E+00	0.00E+00
Benzo(k)fluoranthene	0.00E+00	0.00E+00
Beryllium	0.00E+00	0.00E+00
Carbazole	0.00E+00	0.00E+00
Dibenzo(a,h)anthracene	0.00E+00	0.00E+00
Dieldrin	0.00E+00	0.00E+00
Indeno(1,2,3-cd)pyrene	0.00E+00	0.00E+00
Uranium (total)	2.98E-06	5.95E-06

Table D.2–II–22
Contaminant Emission Rates
Inactive Flyash Pile – Exposed Till – Expanded Trespasser/Off–Property Farmer – 10^{-6}
Alternatives: Consolidation/Capping

	Emission Rates Above Background	
Contaminant	Inhalable Particulates (PM10)	Total Particulates (TSP)
Radionuclides (pCi/s/m^2)		
Cesium–137	0.00E+00	0.00E+00
Neptunium–237	1.94E–07	3.87E–07
Plutonium–238	0.00E+00	0.00E+00
Radium–226	0.00E+00	0.00E+00
Radium–228	0.00E+00	0.00E+00
Strontium–90	0.00E+00	0.00E+00
Technetium–99	0.00E+00	0.00E+00
Thorium–228	0.00E+00	0.00E+00
Thorium–230	0.00E+00	0.00E+00
Thorium–232	0.00E+00	0.00E+00
Uranium–234	0.00E+00	0.00E+00
Uranium–235/236	0.00E+00	0.00E+00
Uranium–238	0.00E+00	0.00E+00
Inorganics and Organics (g/s/m^2):		
Antimony	0.00E+00	0.00E+00
Aroclor 1254	0.00E+00	0.00E+00
Aroclor 1260	0.00E+00	0.00E+00
Arsenic	0.00E+00	0.00E+00
Benzo(a)anthracene	0.00E+00	0.00E+00
Benzo(a)pyrene	0.00E+00	0.00E+00
Benzo(b)fluoranthene	0.00E+00	0.00E+00
Benzo(k)fluoranthene	0.00E+00	0.00E+00
Beryllium	0.00E+00	0.00E+00
Carbazole	0.00E+00	0.00E+00
Dibenzo(a,h)anthracene	0.00E+00	0.00E+00
Dieldrin	0.00E+00	0.00E+00
Indeno(1,2,3–cd)pyrene	0.00E+00	0.00E+00
Uranium (total)	1.20E–06	2.40E–06

ATTACHMENT D.2-III.1

RAECOM MODEL INPUT PARAMETERS

Table D.2-III-1

RAECOM Input Parameters and Results
Private Ownership - On-Property Resident Farmer - 10^{-6}
Alternative: On-Site Disposal Cell

Layer	Ra-226 Conc. Above Bckgrd (pCi/g)	Soil Bulk Density (g/cm^3)	Rn-222 Emanation Coefficient	Rn-222 Decay Constant (1/s)	Layer Thickness (cm)	Soil Porosity	Soil Moisture Content (dry Wt%)	Rn-222 Water/ Air Partition Coefficient	Rn-222 Emission Rate ($pCi/s/m^2$)
Disposal Cell:									
Waste Material	4.559	1.44	0.22	2.1E-06	900.	0.457	16.9	0.26	---
Contouring Fill	0	1.44	NA	NA	30.	0.457	16.9	0.26	---
Clay Barrier	0	1.44	NA	NA	60.	0.430	28.5	0.26	---
Gravel	0	1.44	NA	NA	30.	0.417	2.95	0.26	---
Sand Filter	0	1.44	NA	NA	60.	0.417	2.95	0.26	---
Vegetative Soil	0	1.44	NA	NA	50.	0.457	16.9	0.26	---
Cover (Top) Soil	0	1.44	NA	NA	15.	0.457	16.9	0.26	3.64E-07

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Table D.2-III-2

RAECOM Input Parameters and Results
Administrative Controls - Expanded Trespasser/Off-Property Resident Farmer - 10^{-6}
Alternative: On-Site Disposal Cell or Offsite Disposal

Layer	Ra-226 Conc. Above Bckgrd (pCi/g)	Soil Bulk Density (g/cm^3)	Rn-222 Emanation Coefficient	Rn-222 Decay Constant (1/s)	Layer Thickness (cm)	Soil Porosity	Soil Moisture Content (dry Wt%)	Rn-222 Water/ Air Partition Coefficient	Rn-222 Emission Rate (pCi/s/m^2)
Residual Soil:									
AFP Till	0.01	1.44	0.22	2.1E-06	300.	0.457	16.9	0.26	4.70E-03
SF Till	0.38	1.44	0.22	2.1E-06	300.	0.457	16.9	0.26	1.93E-01
SF Fill	0.38	1.44	0.22	2.1E-06	300.	0.457	16.9	0.26	1.93E-01
Disposal Cell:									
Waste Material	8.81	1.44	0.22	2.1E-06	900.	0.457	16.9	0.26	---
Contouring Fill	0	1.44	NA	NA	30.	0.457	16.9	0.26	---
Clay Barrier	0	1.44	NA	NA	60.	0.430	28.5	0.26	---
Gravel	0	1.44	NA	NA	30.	0.417	2.95	0.26	---
Sand Filter	0	1.44	NA	NA	60.	0.417	2.95	0.26	---
Vegetative Soil	0	1.44	NA	NA	50.	0.457	16.9	0.26	---
Cover (Top) Soil	0	1.44	NA	NA	15.	0.457	16.9	0.26	7.06E-07

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Table D.2-III-3

RAECOM Input Parameters and Results
Federal Ownership - Expanded Trespasser/Off-Property Resident Farmer - 10^{-6}
Alternative: Consolidation and Capping

Layer	Ra-226 Conc. Above Bckgrd (pCi/g)	Soil Bulk Density (g/cm^3)	Rn-222 Emanation Coefficient	Rn-222 Decay Constant (1/s)	Layer Thickness (cm)	Soil Porosity	Soil Moisture Content (dry Wt%)	Rn-222 Water/ Air Partition Coefficient	Rn-222 Emission Rate ($pCi/s/m^2$)
Residual Soil:									
AFP Till	0.31	1.44	0.22	2.1E-06	300.	0.457	16.9	0.26	1.61E-01
SF Till	0.57	1.44	0.22	2.1E-06	300.	0.457	16.9	0.26	2.58E-01
Consolidation Area (SF):									
Waste Material	11.62	1.44	0.22	2.1E-06	900.	0.457	16.9	0.26	---
Contouring Fill	0	1.44	NA	NA	30.	0.457	16.9	0.26	---
Clay Barrier	0	1.44	NA	NA	60.	0.430	28.5	0.26	---
Gravel	0	1.44	NA	NA	30.	0.417	2.95	0.26	---
Vegetative Soil	0	1.44	NA	NA	45.	0.457	16.9	0.26	---
Cover (Top) Soil	0	1.44	NA	NA	15.	0.457	16.9	0.26	1.74E-06

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Table D.2-III-3 (Continued)

Layer	Ra-226 Conc. Above Bckgrd (pCi/g)	Soil Bulk Density (g/cm^3)	Rn-222 Emanation Coefficient	Rn-222 Decay Constant (1/s)	Layer Thickness (cm)	Soil Porosity	Soil Moisture Content (dry Wt%)	Rn-222 Water/ Air Partition Coefficient	Rn-222 Emission Rate ($pCi/s/m^2$)
SWL Cap:									
Waste Material	0.88	1.44	0.22	2.1E-06	300.	0.457	16.9	0.26	---
Contouring Fill	0	1.44	0.22	2.1E-06	30.	0.457	16.9	0.26	---
Clay Barrier	0	1.44	0.22	2.1E-06	60.	0.430	28.5	0.26	---
Gravel	0	1.44	0.22	2.1E-06	30.	0.417	2.95	0.26	---
Vegetative Soil	0	1.44	0.22	2.1E-06	45.	0.457	16.9	0.26	---
Cover (Top) Soil	0	1.44	0.22	2.1E-06	15.	0.457	16.9	0.26	1.94E-07
LSP Cap:									
Waste Material	0.63	1.44	0.22	2.1E-06	15.	0.457	16.9	0.26	---
Contouring Fill	0	1.44	NA	NA	30.	0.457	16.9	0.26	---
Clay Barrier	0	1.44	NA	NA	60.	0.430	28.5	0.26	---
Vegetative Soil	0	1.44	NA	NA	15.	0.457	16.9	0.26	---
Cover (Top) Soil	0	1.44	NA	NA	15.	0.457	16.9	0.26	7.95E-08

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ATTACHMENT D.2-III.2

RAECOM MODEL OUTPUT FILES

5860

OU2 DISPOSAL CELL: PRIVATE OWNERSHIP (ON-SITE FARMER)

********** INPUT PARAMETERS **********

NUMBER OF LAYERS: 7
RADON FLUX INTO LAYER 1: .000 pCi/m2/sec
SURFACE RADON CONCENTRATION: .000 pCi/LITER

LAYER 3 EXCEEDS SATURATION. MOISTURE CHANGED FROM .285 TO .277

BARE SOURCE FLUX (Jo) FROM LAYER 1: 2.126 pCi/m2/sec

LAYER	THICKNESS (cm)	DIFF COEFF (cm2/SEC)	POROSITY	SOURCE (pCi/cm3/sec)	MOISTURE (dry wt. %)
1	900.	.1044E-01	.4570	.6600E-05	16.90
2	30.	.1044E-01	.4570	.0000E+00	16.90
3	60.	.6184E-04	.4300	.0000E+00	27.66
4	30.	.4845E-01	.4170	.0000E+00	2.95
5	60.	.4845E-01	.4170	.0000E+00	2.95
6	50.	.1044E-01	.4570	.0000E+00	16.90
7	15.	.1044E-01	.4570	.0000E+00	16.90

***** RESULTS OF RADON DIFFUSION CALCULATION*****

LAYER	THICKNESS (cm)	EXIT FLUX (pCi/m2/sec)	EXIT CONC. (pCi/liter)	MIC
1	900.	.6377E+00	.2200E+05	.5988
2	30.	.4353E-01	.1989E+05	.5988
3	60.	.1355E-05	.3733E-02	.2674
4	30.	.1043E-05	.1104E-01	.9176
5	60.	.5302E-06	.8729E-02	.9176
6	50.	.3724E-06	.1154E-02	.5988
7	15.	.3642E-06	.0000E+00	.5988

001758

OU2 DISPOSAL CELL: ADMIN. CONTROLS (EXPANDED TRESPASSER)

********** INPUT PARAMETERS **********

NUMBER OF LAYERS: 7
RADON FLUX INTO LAYER 1: .000 pCi/m2/sec
SURFACE RADON CONCENTRATION: .000 pCi/LITER

LAYER 3 EXCEEDS SATURATION. MOISTURE CHANGED FROM .285 TO .277

BARE SOURCE FLUX (Jo) FROM LAYER 1: 4.124 pCi/m2/sec

LAYER	THICKNESS (cm)	DIFF COEFF (cm2/SEC)	POROSITY	SOURCE (pCi/cm3/sec)	MOISTURE (dry wt. %)
1	900.	.1044E-01	.4570	.1280E-04	16.90
2	30.	.1044E-01	.4570	.0000E+00	16.90
3	60.	.6184E-04	.4300	.0000E+00	27.66
4	30.	.4845E-01	.4170	.0000E+00	2.95
5	60.	.4845E-01	.4170	.0000E+00	2.95
6	50.	.1044E-01	.4570	.0000E+00	16.90
7	15.	.1044E-01	.4570	.0000E+00	16.90

***** RESULTS OF RADON DIFFUSION CALCULATION*****

LAYER	THICKNESS (cm)	EXIT FLUX (pCi/m2/sec)	EXIT CONC. (pCi/liter)	MIC
1	900.	.1237E+01	.4267E+05	.5988
2	30.	.8441E-01	.3858E+05	.5988
3	60.	.2628E-05	.7240E-02	.2674
4	30.	.2022E-05	.2140E-01	.9176
5	60.	.1028E-05	.1693E-01	.9176
6	50.	.7223E-06	.2238E-02	.5988
7	15.	.7063E-06	.0000E+00	.5988

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OU2 AFP EXPOSED TILL: ON/OFF-SITE DISPOSAL, EXP. TRESPASSER

********** INPUT PARAMETERS **********

NUMBER OF LAYERS:	1	
RADON FLUX INTO LAYER 1:	.000	pCi/m2/sec
SURFACE RADON CONCENTRATION:	.000	pCi/LITER
BARE SOURCE FLUX (Jo) FROM LAYER 1:	0.005	pCi/m2/sec

LAYER	THICKNESS (cm)	DIFF COEFF (cm2/SEC)	POROSITY	SOURCE (pCi/cm3/sec)	MOISTURE (dry wt. %)
1	300.	.1044E-01	.4570	.1460E-07	16.90

***** RESULTS OF RADON DIFFUSION CALCULATION*****

LAYER	THICKNESS (cm)	EXIT FLUX (pCi/m2/sec)	EXIT CONC. (pCi/liter)	MIC
1	300.	.4702E-02	.0000E+00	.5988

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OU2 SF EXPOSED TILL OR FILL: ON/OFF-SITE DISPOSAL, EXP. TRESPASSER

********** INPUT PARAMETERS **********

NUMBER OF LAYERS:	1	
RADON FLUX INTO LAYER 1:	.000	pCi/m2/sec
SURFACE RADON CONCENTRATION:	.000	pCi/LITER
BARE SOURCE FLUX (Jo) FROM LAYER 1:	.1932	pCi/m2/sec

LAYER	THICKNESS (cm)	DIFF COEFF (cm2/SEC)	POROSITY	SOURCE (pCi/cm3/sec)	MOISTURE (dry wt. %)
1	300.	.1044E-01	.4570	.6000E-06	16.90

***** RESULTS OF RADON DIFFUSION CALCULATION*****

LAYER	THICKNESS (cm)	EXIT FLUX (pCi/m2/sec)	EXIT CONC. (pCi/liter)	MIC
1	300.	.1932E+00	.0000E+00	.5988

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OU2 SF CONSOLIDATION AREA: CONSOLIDATION/CAPPING (EXPANDED TRESPASSER)

********** INPUT PARAMETERS **********

NUMBER OF LAYERS: 6
RADON FLUX INTO LAYER 1: .000 pCi/m2/sec
SURFACE RADON CONCENTRATION: .000 pCi/LITER

LAYER 3 EXCEEDS SATURATION. MOISTURE CHANGED FROM .285 TO .277

BARE SOURCE FLUX (Jo) FROM LAYER 1: 5.445 pCi/m2/sec

LAYER	THICKNESS (cm)	DIFF COEFF (cm2/SEC)	POROSITY	SOURCE (pCi/cm3/sec)	MOISTURE (dry wt. %)
1	900.	.1044E-01	.4570	.1690E-04	16.90
2	30.	.1044E-01	.4570	.0000E+00	16.90
3	60.	.6184E-04	.4300	.0000E+00	27.66
4	30.	.4845E-01	.4170	.0000E+00	2.95
5	45.	.1044E-01	.4570	.0000E+00	16.90
6	15.	.1044E-01	.4570	.0000E+00	16.90

***** RESULTS OF RADON DIFFUSION CALCULATION*****

LAYER	THICKNESS (cm)	EXIT FLUX (pCi/m2/sec)	EXIT CONC. (pCi/liter)	MIC
1	900.	.1633E+01	.5634E+05	.5988
2	30.	.1115E+00	.5093E+05	.5988
3	60.	.3456E-05	.1227E-01	.2674
4	30.	.2411E-05	.3776E-01	.9176
5	45.	.1781E-05	.5517E-02	.5988
6	15.	.1741E-05	.0000E+00	.5988

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OU2 AFP EXPOSED TILL: CONSOLIDATION/CAPPING, EXP. TRESPASSER

********** INPUT PARAMETERS **********

NUMBER OF LAYERS:	1	
RADON FLUX INTO LAYER 1:	.000	pCi/m2/sec
SURFACE RADON CONCENTRATION:	.000	pCi/LITER
BARE SOURCE FLUX (Jo) FROM LAYER 1:	.1610	pCi/m2/sec

LAYER	THICKNESS (cm)	DIFF COEFF (cm2/SEC)	POROSITY	SOURCE (pCi/cm3/sec)	MOISTURE (dry wt. %)
1	300.	.1044E-01	.4570	.5000E-06	16.90

***** RESULTS OF RADON DIFFUSION CALCULATION*****

LAYER	THICKNESS (cm)	EXIT FLUX (pCi/m2/sec)	EXIT CONC. (pCi/liter)	MIC
1	300.	.1610E+00	.0000E+00	.5988

001763

5860

OU2 SF EXPOSED TILL: CONSOLIDATION/CAPPING, EXP. TRESPASSER

********** INPUT PARAMETERS **********

NUMBER OF LAYERS:	1	
RADON FLUX INTO LAYER 1:	.000	pCi/m2/sec
SURFACE RADON CONCENTRATION:	.000	pCi/LITER
BARE SOURCE FLUX (Jo) FROM LAYER 1:	.2576	pCi/m2/sec

LAYER	THICKNESS (cm)	DIFF COEFF (cm2/SEC)	POROSITY	SOURCE (pCi/cm3/sec)	MOISTURE (dry wt. %)
1	300.	.1044E-01	.4570	.8000E-06	16.90

***** RESULTS OF RADON DIFFUSION CALCULATION*****

LAYER	THICKNESS (cm)	EXIT FLUX (pCi/m2/sec)	EXIT CONC. (pCi/liter)	MIC
1	300.	.2576E+00	.0000E+00	.5988

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OU2 SWL CAP: CONSOLIDATION/CAPPING, EXP. TRESPASSER

********** INPUT PARAMETERS **********

NUMBER OF LAYERS: 6
RADON FLUX INTO LAYER 1: .000 pCi/m2/sec
SURFACE RADON CONCENTRATION: .000 pCi/LITER

LAYER 3 EXCEEDS SATURATION. MOISTURE CHANGED FROM .285 TO .277

BARE SOURCE FLUX (Jo) FROM LAYER 1: .4187 pCi/m2/sec

LAYER	THICKNESS (cm)	DIFF COEFF (cm2/SEC)	POROSITY	SOURCE (pCi/cm3/sec)	MOISTURE (dry wt. %)
1	300.	.1044E-01	.4570	.1300E-05	16.90
2	30.	.1044E-01	.4570	.0000E+00	16.90
3	60.	.6184E-04	.4300	.0000E+00	27.66
4	30.	.4845E-01	.4170	.0000E+00	2.95
5	15.	.1044E-01	.4570	.0000E+00	16.90
6	15.	.1044E-01	.4570	.0000E+00	16.90

***** RESULTS OF RADON DIFFUSION CALCULATION*****

LAYER	THICKNESS (cm)	EXIT FLUX (pCi/m2/sec)	EXIT CONC. (pCi/liter)	MIC
1	300.	.1256E+00	.4333E+04	.5988
2	30.	.8573E-02	.3918E+04	.5988
3	60.	.2672E-06	.6655E-03	.2674
4	30.	.2121E-06	.1929E-02	.9176
5	15.	.1986E-06	.6154E-03	.5988
6	15.	.1942E-06	.0000E+00	.5988

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OU2 LSP CAP: CONSOLIDATION/CAPPING, EXP. TRESPASSER

********** INPUT PARAMETERS **********

NUMBER OF LAYERS: 5
RADON FLUX INTO LAYER 1: .000 pCi/m2/sec
SURFACE RADON CONCENTRATION: .000 pCi/LITER

LAYER 3 EXCEEDS SATURATION. MOISTURE CHANGED FROM .285 TO .277

BARE SOURCE FLUX (Jo) FROM LAYER 1: .6078E-01pCi/m2/sec

LAYER	THICKNESS (cm)	DIFF COEFF (cm2/SEC)	POROSITY	SOURCE (pCi/cm3/sec)	MOISTURE (dry wt. %)
1	15.	.1044E-01	.4570	.9000E-06	16.90
2	30.	.1044E-01	.4570	.0000E+00	16.90
3	60.	.6184E-04	.4300	.0000E+00	27.66
4	15.	.1044E-01	.4570	.0000E+00	16.90
5	15.	.1044E-01	.4570	.0000E+00	16.90

***** RESULTS OF RADON DIFFUSION CALCULATION*****

LAYER	THICKNESS (cm)	EXIT FLUX (pCi/m2/sec)	EXIT CONC. (pCi/liter)	MIC
1	15.	.4081E-01	.1408E+04	.5988
2	30.	.2786E-02	.1273E+04	.5988
3	60.	.8677E-07	.2300E-03	.2674
4	15.	.8127E-07	.2518E-03	.5988
5	15.	.7946E-07	.0000E+00	.5988

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ATTACHMENT D.2-IV

FIVE-YEAR COMPOSITE JOINT FREQUENCY DISTRIBUTION FOR THE FEMP

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Table D.2-IV-1
FEMP Standard Joint Frequency Distribution (8/30/93)

Stability Class	Wind Direction	Wind Speed (kts) ≤3	≤6	≤10	≤16	≤21	≥21
A	N	0.000263	0.000904	0.000904	0.000058	0.000000	0.000000
	NNE	0.000292	0.001546	0.000671	0.000000	0.000000	0.000000
	NE	0.000817	0.002888	0.001196	0.000029	0.000000	0.000000
	ENE	0.001430	0.004434	0.002042	0.000117	0.000000	0.000000
	E	0.001050	0.002013	0.000204	0.000146	0.000000	0.000000
	ESE	0.000700	0.000817	0.000058	0.000000	0.000000	0.000000
	SE	0.000467	0.000438	0.000000	0.000000	0.000000	0.000000
	SSE	0.000583	0.000554	0.000000	0.000000	0.000000	0.000000
	S	0.000700	0.001575	0.001196	0.000000	0.000000	0.000000
	SSW	0.001021	0.004347	0.003793	0.000146	0.000000	0.000000
	SW	0.001284	0.005076	0.004755	0.000554	0.000000	0.000000
	WSW	0.001750	0.004755	0.003647	0.000204	0.000000	0.000000
	W	0.000992	0.003880	0.003267	0.000467	0.000000	0.000000
	WNW	0.000613	0.001809	0.002626	0.000525	0.000000	0.000000
	NW	0.000583	0.001575	0.001400	0.000117	0.000000	0.000000
	NNW	0.000350	0.001313	0.001284	0.000058	0.000000	0.000000
B	N	0.000029	0.000817	0.000700	0.000117	0.000000	0.000000
	NNE	0.000117	0.000525	0.000496	0.000058	0.000000	0.000000
	NE	0.000350	0.000963	0.000613	0.000058	0.000000	0.000000
	ENE	0.000321	0.001459	0.000554	0.000146	0.000000	0.000000
	E	0.000467	0.000671	0.000175	0.000029	0.000000	0.000000
	ESE	0.000263	0.000263	0.000029	0.000000	0.000000	0.000000
	SE	0.000233	0.000204	0.000029	0.000000	0.000000	0.000000
	SSE	0.000263	0.000467	0.000088	0.000029	0.000000	0.000000
	S	0.000408	0.001138	0.000321	0.000000	0.000000	0.000000
	SSW	0.000525	0.001546	0.001313	0.000175	0.000000	0.000000
	SW	0.000613	0.002042	0.002071	0.000233	0.000000	0.000000
	WSW	0.000613	0.001692	0.001284	0.000175	0.000000	0.000000
	W	0.000671	0.001167	0.001225	0.000146	0.000000	0.000000
	WNW	0.000233	0.000788	0.000875	0.000204	0.000000	0.000000
	NW	0.000263	0.000671	0.001021	0.000204	0.000000	0.000000
	NNW	0.000146	0.000642	0.000904	0.000088	0.000000	0.000000

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Table D.2-IV-1
FEMP Standard Joint Frequency Distribution (8/30/93)

Stability Class	Wind Direction	Wind Speed (kts) ≤3	≤6	≤10	≤16	≤21	≥21
C	N	0.000204	0.000846	0.001079	0.000233	0.000000	0.000000
	NNE	0.000175	0.001313	0.000729	0.000058	0.000000	0.000000
	NE	0.000408	0.001488	0.001021	0.000088	0.000000	0.000000
	ENE	0.000700	0.001721	0.000438	0.000263	0.000000	0.000000
	E	0.001050	0.000875	0.000204	0.000058	0.000000	0.000000
	ESE	0.000671	0.000583	0.000058	0.000000	0.000000	0.000000
	SE	0.000321	0.000467	0.000088	0.000000	0.000000	0.000000
	SSE	0.000146	0.000467	0.000058	0.000058	0.000000	0.000000
	S	0.000321	0.001167	0.000554	0.000058	0.000000	0.000000
	SSW	0.000554	0.001750	0.001575	0.000058	0.000029	0.000000
	SW	0.000904	0.002742	0.001750	0.000175	0.000000	0.000000
	WSW	0.000759	0.002421	0.001254	0.000204	0.000000	0.000000
	W	0.000788	0.001284	0.001138	0.000321	0.000000	0.000000
	WNW	0.000321	0.001342	0.001254	0.000204	0.000000	0.000000
	NW	0.000233	0.001342	0.001138	0.000117	0.000029	0.000000
	NNW	0.000233	0.001079	0.000963	0.000029	0.000000	0.000000
D	N	0.002101	0.008723	0.009219	0.001079	0.000000	0.000000
	NNE	0.002830	0.010532	0.008256	0.001138	0.000000	0.000000
	NE	0.004464	0.013420	0.007498	0.000496	0.000000	0.000000
	ENE	0.006331	0.017825	0.009161	0.002042	0.000000	0.000000
	E	0.004493	0.006127	0.001079	0.000088	0.000000	0.000000
	ESE	0.003238	0.002976	0.000117	0.000000	0.000000	0.000000
	SE	0.002626	0.002626	0.000350	0.000000	0.000000	0.000000
	SSE	0.002801	0.003618	0.001109	0.000204	0.000000	0.000000
	S	0.003063	0.006593	0.002888	0.000321	0.000000	0.000000
	SSW	0.005806	0.014091	0.007439	0.001809	0.000000	0.000000
	SW	0.007848	0.014470	0.008023	0.001050	0.000058	0.000000
	WSW	0.008373	0.011203	0.006272	0.001167	0.000000	0.000000
	W	0.007060	0.011553	0.009482	0.001430	0.000000	0.000000
	WNW	0.004785	0.010415	0.010619	0.001546	0.000000	0.000000
	NW	0.003734	0.009044	0.007264	0.000963	0.000088	0.000000
	NNW	0.002976	0.008840	0.005631	0.001050	0.000058	0.000000

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Table D.2-IV-1 (Continued)

Stability Class	Wind Direction	Wind Speed (kts) ≤3	≤6	≤10	≤16	≤21	≥21
E	N	0.003618	0.003880	0.000759	0.000029	0.000000	0.000000
	NNE	0.002596	0.003092	0.000788	0.000175	0.000000	0.000000
	NE	0.002976	0.003472	0.000438	0.000000	0.000000	0.000000
	ENE	0.008694	0.009219	0.001809	0.000000	0.000000	0.000000
	E	0.008198	0.002742	0.000233	0.000000	0.000000	0.000000
	ESE	0.004785	0.001254	0.000146	0.000000	0.000000	0.000000
	SE	0.004843	0.001721	0.000292	0.000000	0.000000	0.000000
	SSE	0.005572	0.003413	0.001284	0.000204	0.000000	0.000000
	S	0.006973	0.007673	0.003355	0.000642	0.000000	0.000000
	SSW	0.011582	0.014033	0.006798	0.001692	0.000000	0.000000
	SW	0.018496	0.018263	0.007410	0.000671	0.000000	0.000000
	WSW	0.017796	0.010328	0.003297	0.000642	0.000000	0.000000
	W	0.012486	0.010007	0.004143	0.000146	0.000000	0.000000
	WNW	0.009482	0.007614	0.003297	0.000583	0.000000	0.000000
	NW	0.008344	0.004668	0.001109	0.000175	0.000000	0.000000
	NNW	0.006214	0.003822	0.001079	0.000263	0.000000	0.000000
F	N	0.004988	0.000117	0.000000	0.000000	0.000000	0.000000
	NNE	0.005251	0.000088	0.000029	0.000000	0.000000	0.000000
	NE	0.005076	0.000117	0.000000	0.000000	0.000000	0.000000
	ENE	0.009102	0.001605	0.000117	0.000000	0.000000	0.000000
	E	0.013361	0.000904	0.000000	0.000000	0.000000	0.000000
	ESE	0.008927	0.000058	0.000000	0.000000	0.000000	0.000000
	SE	0.005922	0.000321	0.000000	0.000000	0.000000	0.000000
	SSE	0.005456	0.000175	0.000000	0.000000	0.000000	0.000000
	S	0.007002	0.000467	0.000000	0.000000	0.000000	0.000000
	SSW	0.011815	0.001196	0.000263	0.000000	0.000000	0.000000
	SW	0.019576	0.002101	0.000029	0.000000	0.000000	0.000000
	WSW	0.026811	0.001867	0.000058	0.000000	0.000000	0.000000
	W	0.029757	0.000671	0.000029	0.000000	0.000000	0.000000
	WNW	0.029319	0.000233	0.000029	0.000000	0.000000	0.000000
	NW	0.022785	0.000758	0.000058	0.000000	0.000000	0.000000
	NNW	0.011523	0.000876	0.000058	0.000000	0.000000	0.000000

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ATTACHMENT D.2-V

CONTAMINANT CONCENTRATIONS IN AIR

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LIST OF TABLES

ATTACHMENT D.2-V

CONTAMINANT CONCENTRATIONS IN AIR

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D.2-V-3	Particulate-Phase Contaminant Concentrations in Air (Above Background) - Solid Waste Landfill - Expanded Trespasser/Off-Property Farmer - 10^{-6} Alternatives: On-Property Disposal Cell; Off-Site Disposal	D-2-V-3
D.2-V-4	Particulate-Phase Contaminant Concentrations in Air (Above Background) - Lime Sludge Ponds - Expanded Trespasser/Off-Property Farmer - 10^{-6} Alternatives: On-Property Disposal Cell; Off-Site Disposal	D-2-V-4
D.2-V-5	Particulate-Phase Contaminant Concentrations in Air (Above Background) - South Field Area (SF/AFP/IFP) - On-Property Farmer - 10^{-6} Alternatives: On-Property Disposal Cell; Off-Site Disposal	D-2-V-5
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D.2-V-8	Radon-222 Concentration in Air - Alternatives: On-Property Disposal Cell; Off-Site Disposal	D.2-V-8
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Table D.2-V-1
Particulate-Phase Contaminant Concentrations in Air (Above Background)
South Field Area (SF/AFP/IFP) - Expanded Trespasser/Off-Property Farmer - 10^{-6}
Alternatives: Consolidation/Capping

	Maximum On-Property		Maximum Off-Property	
Contaminant	Concentration	Deposition Rate	Concentration	Deposition Rate
Radionuclides (pCi/m^3 or pCi/m^2/s):				
Cesium-137	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Neptunium-237	2.84E-06	1.02E-08	1.75E-07	6.29E-10
Plutonium-238	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Radium-226	3.65E-06	1.32E-08	1.90E-07	6.84E-10
Radium-228	1.16E-06	4.16E-09	6.12E-08	2.20E-10
Strontium-90	2.29E-05	8.24E-08	1.12E-06	4.02E-09
Technetium-99	5.06E-06	1.82E-08	2.34E-07	8.41E-10
Thorium-228	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Thorium-230	1.67E-05	6.02E-08	8.64E-07	3.11E-09
Thorium-232	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Uranium-234	9.12E-05	3.28E-07	4.24E-06	1.53E-08
Uranium-235/236	1.45E-05	5.22E-08	6.69E-07	2.41E-09
Uranium-238	9.47E-05	3.41E-07	4.55E-06	1.64E-08
Inorganics and Organics (ug/m^3 or ug/m^2/s):				
Antimony	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aroclor 1254	2.31E-07	8.30E-10	1.06E-08	3.83E-11
Aroclor 1260	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Arsenic	6.09E-05	2.19E-07	2.84E-06	1.02E-08
Benzo(a)anthracene	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzo(b)fluoranthene	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzo(k)fluoranthene	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Beryllium	4.59E-06	1.65E-08	2.12E-07	7.62E-10
Carbazole	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dibenzo(a,h)anthracene	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dieldrin	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Indeno(1,2,3-cd)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Uranium (total)	1.06E-03	3.83E-06	5.15E-05	1.85E-07

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Table D.2–V–2
Particulate–Phase Contaminant Concentrations in Air (Above Background)
South Field Area (SF/AFP/IFP) – Expanded Trespasser/Off–Property Farmer – 10^{-6}
Alternatives: On–Property Disposal Cell; Off–site Disposal

Contaminant	Maximum On–Property Concentration	Maximum On–Property Deposition Rate	Maximum Off–Property Concentration	Maximum Off–Property Deposition Rate
Radionuclides (pCi/m^3 or pCi/m^2/s):				
Cesium–137	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Neptunium–237	3.62E–06	1.30E–08	2.50E–07	9.01E–10
Plutonium–238	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Radium–226	3.67E–06	1.32E–08	1.89E–07	6.79E–10
Radium–228	5.93E–06	2.13E–08	2.44E–07	8.80E–10
Strontium–90	2.99E–05	1.08E–07	1.62E–06	5.85E–09
Technetium–99	8.67E–06	3.12E–08	4.44E–07	1.60E–09
Thorium–228	2.73E–06	9.84E–09	9.82E–08	3.54E–10
Thorium–230	9.28E–05	3.34E–07	3.89E–06	1.40E–08
Thorium–232	1.03E–06	3.72E–09	3.72E–08	1.34E–10
Uranium–234	3.10E–05	1.12E–07	1.66E–06	5.97E–09
Uranium–235/236	2.93E–05	1.06E–07	1.44E–06	5.18E–09
Uranium–238	1.97E–05	7.08E–08	1.08E–06	3.89E–09
Inorganics and Organics (ug/m^3 or ug/m^2/s):				
Antimony	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aroclor 1254	3.26E–06	1.17E–08	1.23E–07	4.45E–10
Aroclor 1260	2.81E–07	1.01E–09	1.01E–08	3.63E–11
Arsenic	8.22E–05	2.96E–07	4.26E–06	1.53E–08
Benzo(a)anthracene	8.13E–06	2.93E–08	2.92E–07	1.05E–09
Benzo(a)pyrene	1.33E–05	4.79E–08	4.78E–07	1.72E–09
Benzo(b)fluoranthene	1.18E–05	4.26E–08	4.25E–07	1.53E–09
Benzo(k)fluoranthene	1.18E–05	4.26E–08	4.25E–07	1.53E–09
Beryllium	6.31E–06	2.27E–08	3.21E–07	1.15E–09
Carbazole	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dibenzo(a,h)anthracene	3.25E–06	1.17E–08	1.17E–07	4.20E–10
Dieldrin	7.17E–08	2.58E–10	2.57E–09	9.27E–12
Indeno(1,2,3–cd)pyrene	4.58E–06	1.65E–08	1.65E–07	5.92E–10
Uranium (total)	7.00E–05	2.52E–07	5.73E–06	2.06E–08

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Table D.2-V-3
Particulate-Phase Contaminant Concentrations in Air (Above Background)
Solid Waste Landfill - Expanded Trespasser/Off-Property Farmer - 10^{-6}
Alternatives: On-Property Disposal Cell; Off-site Disposal

Contaminant	Maximum On-Property Concentration	Maximum On-Property Deposition Rate	Maximum Off-Property Concentration	Maximum Off-Property Deposition Rate
Radionuclides (pCi/m^3 or pCi/m^2/s):				
Cesium-137	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Neptunium-237	9.36E-07	3.37E-09	2.55E-08	9.19E-11
Plutonium-238	4.68E-07	1.68E-09	1.28E-08	4.59E-11
Radium-226	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Radium-228	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Strontium-90	1.71E-06	6.15E-09	4.66E-08	1.68E-10
Technetium-99	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Thorium-228	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Thorium-230	2.64E-06	9.52E-09	7.21E-08	2.59E-10
Thorium-232	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Uranium-234	6.08E-07	2.19E-09	1.66E-08	5.97E-11
Uranium-235/236	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Uranium-238	5.57E-06	2.00E-08	1.52E-07	5.47E-10
Inorganics and Organics (ug/m^3 or ug/m^2/s):				
Antimony	5.29E-05	1.90E-07	1.44E-06	5.19E-09
Aroclor 1254	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aroclor 1260	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Arsenic	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzo(a)anthracene	6.78E-07	2.44E-09	1.85E-08	6.66E-11
Benzo(a)pyrene	6.78E-07	2.44E-09	1.85E-08	6.66E-11
Benzo(b)fluoranthene	6.08E-07	2.19E-09	1.66E-08	5.97E-11
Benzo(k)fluoranthene	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Beryllium	9.36E-07	3.37E-09	2.55E-08	9.19E-11
Carbazole	4.91E-07	1.77E-09	1.34E-08	4.82E-11
Dibenzo(a,h)anthracene	2.57E-07	9.26E-10	7.02E-09	2.53E-11
Dieldrin	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Indeno(1,2,3-cd)pyrene	4.91E-07	1.77E-09	1.34E-08	4.82E-11
Uranium (total)	1.01E-05	3.62E-08	2.74E-07	9.87E-10

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Table D.2-V-4
Particulate-Phase Contaminant Concentrations in Air (Above Background)
Lime Sludge Ponds - Expanded Trespasser/Off-Property Farmer - 10^{-6}
Alternatives: On-Property Disposal Cell; Off-site Disposal

Contaminant	Maximum On-Property Concentration	Maximum On-Property Deposition Rate	Maximum Off-Property Concentration	Maximum Off-Property Deposition Rate
Radionuclides (pCi/m^3 or pCi/m^2/s):				
Cesium-137	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Neptunium-237	4.33E-07	1.56E-09	6.19E-09	2.23E-11
Plutonium-238	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Radium-226	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Radium-228	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Strontium-90	1.80E-06	6.48E-09	2.57E-08	9.26E-11
Technetium-99	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Thorium-228	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Thorium-230	1.73E-06	6.24E-09	2.48E-08	8.91E-11
Thorium-232	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Uranium-234	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Uranium-235/236	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Uranium-238	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inorganics and Organics (ug/m^3 or ug/m^2/s):				
Antimony	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aroclor 1254	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aroclor 1260	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Arsenic	2.23E-05	8.02E-08	3.19E-07	1.15E-09
Benzo(a)anthracene	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzo(b)fluoranthene	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzo(k)fluoranthene	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Beryllium	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Carbazole	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dibenzo(a,h)anthracene	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dieldrin	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Indeno(1,2,3-cd)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Uranium (total)	3.63E-05	1.31E-07	5.19E-07	1.87E-09

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Table D.2-V-5
Particulate-Phase Contaminant Concentrations in Air (Above Background)
South Field Area (SF/AFP/IFP) - On-Property Farmer - 10^{-6}
Alternatives: On-Property Disposal Cell; Off-site Disposal

	Maximum On-Property		Maximum Off-Property	
Contaminant	Concentration	Deposition Rate	Concentration	Deposition Rate
Radionuclides (pCi/m^3 or pCi/m^2/s):				
Cesium-137	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Neptunium-237	4.28E-06	1.54E-08	3.26E-07	1.17E-09
Plutonium-238	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Radium-226	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Radium-228	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Strontium-90	3.10E-06	1.12E-08	2.17E-07	7.81E-10
Technetium-99	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Thorium-228	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Thorium-230	6.59E-05	2.37E-07	2.76E-06	9.92E-09
Thorium-232	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Uranium-234	1.30E-05	4.67E-08	1.00E-06	3.61E-09
Uranium-235/236	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Uranium-238	1.14E-05	4.11E-08	8.83E-07	3.18E-09
Inorganics and Organics (ug/m^3 or ug/m^2/s):				
Antimony	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aroclor 1254	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aroclor 1260	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Arsenic	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzo(a)anthracene	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzo(b)fluoranthene	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzo(k)fluoranthene	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Beryllium	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Carbazole	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dibenzo(a,h)anthracene	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dieldrin	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Indeno(1,2,3-cd)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Uranium (total)	2.48E-04	8.94E-07	1.52E-05	5.48E-08

Table D.2-V-6
Particulate-Phase Contaminant Concentrations in Air (Above Background)
Solid Waste Landfill - On-Property Farmer - 10^{-6}
Alternatives: On-Property Disposal Cell; Off-site Disposal

Contaminant	Maximum On-Property Concentration	Maximum On-Property Deposition Rate	Maximum Off-Property Concentration	Maximum Off-Property Deposition Rate
Radionuclides (pCi/m^3 or pCi/m^2/s):				
Cesium-137	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Neptunium-237	1.32E-06	4.76E-09	3.60E-08	1.30E-10
Plutonium-238	6.15E-06	2.21E-08	1.68E-07	6.03E-10
Radium-226	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Radium-228	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Strontium-90	4.92E-07	1.77E-09	1.34E-08	4.83E-11
Technetium-99	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Thorium-228	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Thorium-230	2.37E-05	8.52E-08	6.45E-07	2.32E-09
Thorium-232	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Uranium-234	2.46E-06	8.85E-09	6.71E-08	2.41E-10
Uranium-235/236	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Uranium-238	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inorganics and Organics (ug/m^3 or ug/m^2/s):				
Antimony	4.09E-05	1.47E-07	1.11E-06	4.00E-09
Aroclor 1254	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aroclor 1260	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Arsenic	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzo(a)anthracene	7.07E-07	2.55E-09	1.93E-08	6.94E-11
Benzo(a)pyrene	4.61E-08	1.66E-10	1.26E-09	4.53E-12
Benzo(b)fluoranthene	4.30E-07	1.55E-09	1.17E-08	4.22E-11
Benzo(k)fluoranthene	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Beryllium	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Carbazole	1.98E-07	7.12E-10	5.39E-09	1.94E-11
Dibenzo(a,h)anthracene	1.41E-08	5.09E-11	3.86E-10	1.39E-12
Dieldrin	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Indeno(1,2,3-cd)pyrene	2.24E-07	8.08E-10	6.12E-09	2.20E-11
Uranium (total)	0.00E+00	0.00E+00	0.00E+00	0.00E+00

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Table D.2–V–7
Particulate–Phase Contaminant Concentrations in Air (Above Background)
Lime Sludge Ponds – On–Property Farmer – 10^{-6}
Alternatives: On–Property Disposal Cell; Off–site Disposal

Contaminant	Maximum On–Property Concentration	Maximum On–Property Deposition Rate	Maximum Off–Property Concentration	Maximum Off–Property Deposition Rate
Radionuclides (pCi/m^3 or pCi/m^2/s):				
Cesium–137	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Neptunium–237	2.23E–07	8.04E–10	3.19E–09	1.15E–11
Plutonium–238	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Radium–226	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Radium–228	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Strontium–90	2.45E–07	8.83E–10	3.50E–09	1.26E–11
Technetium–99	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Thorium–228	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Thorium–230	2.28E–05	8.20E–08	3.25E–07	1.17E–09
Thorium–232	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Uranium–234	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Uranium–235/236	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Uranium–238	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inorganics and Organics (ug/m^3 or ug/m^2/s):				
Antimony	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aroclor 1254	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Aroclor 1260	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Arsenic	2.93E–04	1.05E–06	4.19E–06	1.51E–08
Benzo(a)anthracene	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzo(a)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzo(b)fluoranthene	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzo(k)fluoranthene	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Beryllium	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Carbazole	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dibenzo(a,h)anthracene	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dieldrin	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Indeno(1,2,3–cd)pyrene	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Uranium (total)	0.00E+00	0.00E+00	0.00E+00	0.00E+00

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Table D.2–V–8
Radon–222 Concentration in Air
Alternatives: On–Property Disposal Cell; Off–site Disposal

Subunit or Source	Maximum On–Property Concentration (pCi/m3)	Maximum Off–Property Concentration (pCi/m3)
Private Ownership, On–Property Farmer:		
Disposal Cell (On–Property Disposal Alternative only)	2.90E–06	1.05E–06
Administrative Controls, Expanded Trespasser:		
Disposal Cell (On–Property Disposal Alternative only)	5.62E–06	2.03E–06
South Field Area (SF/AFP/IFP)	1.68E+00	8.70E–02

Table D.2–V–9
Radon–222 Concentration in Air
Alternatives: Consolidation and Capping

Subunit or Source	Maximum On–Property Concentration (pCi/m3)	Maximum Off–Property Concentration (pCi/m3)
Administrative Controls, Expanded Trespasser:		
South Field Area (SF/AFP/IFP Consolidaiton Area)	1.55E+00	8.00E–02
Solid Waste Landfill	4.07E–07	1.12E–08
Lime Sludge Ponds	2.37E–07	3.42E–09

APPENDIX D.3

URANIUM PARTITION COEFFICIENT EVALUATION STUDY

D.3.0 URANIUM PARTITION COEFFICIENT EVALUATION STUDY

This appendix documents the results of the Uranium Partition Coefficient Evaluation Study carried out in support of the Remedial Investigation/Feasibility Study (RI/FS) for Operable Unit 2 - Other Waste Units at the U.S. Department of Energy (DOE), Fernald Environmental Management Project (FEMP) at Fernald, Ohio. The study consisted of laboratory analyses conducted to determine the partition coefficients (K_d) for waste, soils, and geologic formations in Operable Unit 2 as an input in fate and transport modeling. This appendix will focus on the K_d for total uranium, which is prevalent throughout the Operable Unit 2 waste units. The K_d results are based on both adsorption and desorption tests conducted at the FEMP laboratory.

To identify Operable Unit 2-specific K_d values, a laboratory study was conducted on Operable Unit 2 waste and soil. Waste and soil samples were collected from the waste units and associated geological layers for each of the subunits. These waste or soil samples underwent laboratory tests in which they were mixed with a leachate solution in a batch-type reactor. Two separate tests were conducted: one test evaluated the amount of uranium that was leached from the waste and soil, and the other test evaluated the amount of uranium that was adsorbed by the waste or soil. The first test was conducted on samples (collected in the subunits where the media was contaminated) that were considered to be contaminated. The second test was conducted on samples which analysis showed had little or no contamination.

D.3.1 Soil Sample Selection

Table D.3-1 is a summary of the samples which were used to develop K_d values and the location where they were sampled. The samples were collected from the ongoing field sampling activities or retrieved from the FEMP sample archives. The contaminated samples were identified by the beta-gamma field readings conducted during the field sampling program. Samples with beta-gamma field readings above background were considered contaminated. Once the appropriate sample(s) were located, sample numbers were identified for retrieval from FEMP archives. Since the RI field sampling program was in progress at the time, some soil samples were collected directly from the field.

TABLE D.3-1

SUMMARY OF K_d STUDY SAMPLES FOR OPERABLE UNIT 2

Waste Subunits	Waste Material Samples	Glacial Overburden Samples	Sand and Gravel Samples	Great Miami Aquifer Samples
Solid Waste Landfill	Boring 1985 (depth 0-3 ft.) Boring 1986 (depth 5-7.5 ft.)	Boring 1986 (depth 12.5-15 ft.) Boring 11037 (depth 20-22.5 ft.)	Boring 2953 (depth 46 ft.)	Boring 2953 (depth 70 ft.)
Lime Sludge Ponds	LSP-SS-03 (depth 0-12 in.) LSP-SS-05 (depth 0-6 in.) LSP-SS-06 (depth 0-6 in.)	N/S[a]	N/S	N/S
Inactive Flyash Pile	Boring 11001 (depth 0.5-2.5 ft.) Boring 11003 (depth 3.5-5.5 ft.)	N/S	N/S	N/S
Active Flyash Pile	Boring 1980 (depth 4-5.5 ft.)	N/S	N/S	N/S
South Field	Trench No. 1 (depth 2 ft.)	Boring 11187 (depth 6.5-7 ft.) Trench No. 4 (depth 7 ft.)	Boring 2944 (depth 25-51 ft.)	Boring 2944 (depth 50-65 ft.)

[a]N/S = no sample collected.

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The main purpose for collecting samples directly from the field was to ensure that samples with significant levels of contamination were used. The field samples included both Trench Nos. 1 and 4 samples in the South Field; Boring No. 1985 in the Solid Waste Landfill; and the sand and gravel samples from Boring No. 2944 in the South Field and Boring No. 2953 in the Solid Waste Landfill. The samples with the highest contamination based on hand-held beta-gamma measurements were found in the South Field trench locations and at Boring No. 1985 in the Solid Waste Landfill. The sand and gravel samples from Boring Nos. 2944 and 2953 were collected because the samples were the last two borings to be drilled in the RI sampling program, and all the previous borings contained low concentrations in the sand and gravel zones. After collection, however, these samples also showed no or little contamination.

The sample volume required for the test was approximately two liters; however, the archive samples were usually in 500 milliliter (mL) jars. Therefore, three to four archive samples were required at slightly different depths to make one K_d sample. However, all of the samples were from the same split spoon interval, with the exception of samples from Boring No. 2944. Samples from Boring No. 2944 in the South Field were collected over a 7.9 m (26 ft) interval and a 4.6 m (15 ft) interval for the unsaturated and saturated sand and gravel, respectively. These samples were composited in the field, whereas the archive samples were combined and homogenized in the FEMP laboratory.

D.3.1.1 Waste Samples

A waste material sample was collected from each subunit. All were identified as containing elevated levels of uranium, except the Active Flyash Pile sample. The waste material was considered the flyash for the Active Flyash Pile and the Inactive Flyash Pile. One sample from each pile was collected. A second sample at the Inactive Flyash Pile was collected for the earthen cover material overlying the flyash. The waste material at the Lime Sludge Pond was the lime sludge. Two samples were taken at the north Lime Sludge Pond and composited into one. Another sample of the earthen berm material was also collected.

Two waste samples were collected for the Solid Waste Landfill. Both were in the boundaries of the waste cells and were taken at different depths. Two waste material samples were collected for the South Field. The samples were collected during the RI trenching at the South Field; visual inspection identified the samples as fill material. Sample No. 113721 was taken at a depth of approximately 1.8 m (6 ft) in Trench No. 4 where the fill appeared to transition to natural till.

D.3.1.2 Glacial Overburden Layer

The glacial overburden was characterized using soil samples collected from two separate areas composed of Operable Unit 2 subunits. The areas were the Solid Waste Landfill/Lime Sludge Ponds and the Active Flyash Pile/Inactive Flyash Pile/South Field. This approach was based on similarities in lithologic descriptions taken from boring logs from each collection area. Additionally, the South Field and the Solid Waste Landfill were considered to have the greatest potential for future impact to the Great Miami Aquifer. All of the glacial overburden samples collected for the study were contaminated.

Two samples were collected from Solid Waste Landfill: one in a blue clay just below the bottom of the Solid Waste Landfill at a depth of 3.8 to 4.6 m (12.5 to 15.0 ft) and the other in an olive clay area below the blue clay at a depth of 6.1 to 6.9 m (20 to 22.5 ft). One sample was collected from the South Field at Boring No. 1974 in a light olive brown silty clay at a depth of 21 m (7 ft).

D.3.1.3 Sand and Gravel Layer

The sand and gravel samples were considered to be similar at all the subunits. This approach was based on the Great Miami Aquifer being continuous over the site. All the sand and gravel samples collected for the K_d study were relatively free of contamination. The samples were collected at two locations. One set of samples (saturated and unsaturated) was collected at the Solid Waste Landfill/Lime Sludge Ponds in an area between the two units. The other set of samples was collected in the South Field.

D.3.2 Laboratory Procedures

Two types of batch tests were used to perform the laboratory K_d studies. One was a desorption test used on the contaminated samples and was based on determining the amount of total uranium that leached into solution. The other was an adsorption test used on the samples which contained low concentrations of total uranium and was based on determining the total uranium adsorbed by the soil/waste from a uranium spiked water solution. The desorption and adsorption tests meet the same objectives but operate in reverse of one another. Both tests will determine the equilibrium uranium concentrations of the soil and liquid solution. The selection of the appropriate K_d test was based on the soil sample's initial total uranium concentration. A total of 19 tests were performed on the soil samples, which consisted of 11 desorption tests and 8 adsorption tests.

The desorption test was performed for all of the samples that had a total uranium concentration above background. The adsorption test was performed on the remaining soil samples. For some samples, both the adsorption and desorption tests were performed for comparison purposes. A total uranium analysis on the initial waste/soil samples was performed by both the FEMP and International Technology Corporation Analytical Services (ITAS), which participates in the U.S. Environmental Protection Agency's (EPA) Contract Laboratory Program (CLP).

The American Society for Testing and Materials (ASTM) D 4319-83 Standard Test Method for Distribution Ratios by the Short-Term Batch Method was evaluated and used as guidance in the preparation of the procedure used in the K_d evaluation. Where appropriate, specific preparatory procedures of the ASTM were used. The K_d evaluation procedure is provided in Attachment D.3-I.

D.3.2.1 Desorption Test

In general, the desorption test consisted of placing a 400-gram portion of the sample into a 1-gallon Nalgene plastic jar/reactor with 3,500 mL of a water solution. This equated to a liquid-to-soil ratio of 8.75. The soil and liquid mixture was tumbled continuously at approximately 29 revolutions per minute until the total uranium concentration in the water solution reached equilibrium.

Soil preparation started with compositing several archive samples for the same boring and depth (due to the small volumes archived) into a 600-gram sample. The 600-gram sample was then filtered to remove any free liquids. No drying was performed. The only samples requiring filtering were the saturated sand and gravel samples. After filtering, a 400-gram sample was weighed and placed in a reactor with the water.

The remaining portion of the waste/soil sample that was not placed in the jar was prepared for laboratory analysis on total uranium and moisture content. A 200-gram sample was oven dried at 103°C for 24 hours. The moisture content was calculated by using the weight of the sample before oven drying and the weight of the sample after oven drying. A 10-gram portion of the oven dried sample was used for the FEMP total uranium analysis and a 135-gram portion was used for the off-site laboratory analysis.

In the desorption tests, three different water solutions were used with the soils to determine the K_d and were based on the location/type of the soil sample. For the waste material samples, a

distilled-water solution adjusted to 5.6 pH with a 60/40 mixture of sulfuric acid to nitric acid solution was used. This water solution was used to represent the rainwater percolating through the waste material. The glacial overburden soil samples used a distilled-water solution with no pH adjustment. The unsaturated and saturated sand and gravel samples were mixed with FEMP groundwater from a 3000- series background well. The groundwater was considered to have a uranium concentration that was representative of the background level at the site.

The time period for the desorption test samples to reach equilibrium was approximately 2 weeks. During each test, a sample of the water solution was periodically analyzed for total uranium to verify when the sample reached equilibrium. This was performed by drawing off 20 mL of leachate and filtering the sample through a 0.45 micron size membrane filter to remove any solids. The sampling frequency for some of the water samples was adjusted on occasion because of holidays or weekends. All of the intermediate water samples were analyzed for total uranium at the FEMP laboratory to allow quick turnaround times which were required during the test. The final samples from each test were split between the ITAS and FEMP laboratory.

Other parameters such as pH, oxidation/reduction potential (E_h), and specific conductivity can effect the "sorption" process and K_d value (ASTM D-4319). Therefore, during each adsorption/desorption test, periodic measurements were made for temperature, pH, E_h, and specific conductivity. The measurements were made at the same time that samples of the water solutions were collected for total uranium analysis during the test.

All of the subunits' waste samples and glacial overburden samples underwent the desorption test, except for the Active Flyash Pile flyash. The Active Flyash Pile flyash was not contaminated above background concentrations. Also, the Inactive Flyash Pile flyash sample did not leach uranium at concentrations which were detectable, and, therefore, was discontinued after ten days. Attachment D.3.II provides the laboratory desorption test results.

D.3.2.2 Adsorption Test

In the adsorption test, the same type of water solutions were prepared as in the desorption tests, depending on the location of the sample. The exception in the preparation activities between the two tests was that the water solutions were spiked with uranium for the adsorption test. The spiked solution was a 1.0 mg/mL concentration of uranium nitrate in 2 percent nitric acid. The water was

spiked with 7 mL of the uranium nitrate solution. The addition of the uranium nitrate solution resulted in a uranium concentration of 2 mg/L for the initial water solution in all of the adsorption tests.

The testing period on the adsorption of non-contaminated samples focused more on the first 72 hours of the test. During this period, a sample was collected each day. Literature review indicates most adsorption tests reach equilibrium within that time period (ASTM D-4319). If equilibrium was not reached, periodic sampling would continue after the 72-hour period until equilibrium was reached. Equilibrium was determined by evaluating results from two consecutive samples. If the samples were within 5 percent (+ or -) or less, the sample was considered at equilibrium, and the test was stopped.

All of the sand and gravel samples underwent the adsorption test, since they were not contaminated. The soil samples from the glacial overburden at Boring No. 1986 in the Solid Waste Landfill, flyash at both the Active Flyash Pile and Inactive Flyash Pile, and Trench No. 4 in the South Field were also tested. These soil samples, except for the Active Flyash Pile flyash, had total uranium concentrations which were considered too low to leach into solution under the desorption test. The desorption test was performed on these three samples, with the adsorption test performed for comparison purposes. The flyash sample from the Inactive Flyash Pile (Sample No. 114068) did not leach any measurable quantity of uranium during the desorption test. The other two glacial overburden samples (Sample Nos. 111457 and 113721) had detectable uranium concentrations in the leachate. Attachment D.3.III provides the laboratory adsorption test results.

D.3.2.3 Analytical Methods/Procedures

The total uranium analysis was performed by both the FEMP laboratory and the ITAS. The FEMP analysis was at an analytical support level B and the ITAS analysis was at an analytical support level C. The FEMP laboratory used calorimetric analysis for the soil analysis and laser phosphorimetry for the water analysis. The volume requirements were 5 grams for the soils and 10 mL for the water. The FEMP Analytical Laboratory Services methods used were 3002 and 3062 for soils and water, respectively, which is consistent with the FEMP Site-Wide Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) Quality Assurance Project Plan requirements.

The ITAS used gamma spectrometry for the soil analysis and pulsed laser phosphorimetry for the water analysis. The volume requirements were 135 grams for the soils and 210 mL for the water. The standard operating procedures used were OR7003 and OR7127 for soils and water, respectively, and was consistent with the EPA-approved CLP operating procedures.

The pH, E_h, conductivity, and temperature were measured by placing the instrument probe directly into the jar/reactor. The instrument was calibrated each day for E_h, conductivity, and pH. The E_h and conductivity calibration was performed by zeroing the meter. The pH was calibrated by using a 4.0 and 7.0 pH buffer. Also, when using the probe, the jars were organized to be sampled in increasing aqueous uranium concentrations; the probe was also raised with deionized water between samples to avoid cross-contamination of the samples.

D.3.3 Partition Coefficient Calculations

The K_d values for both the adsorption and desorption tests were calculated by dividing the concentration of uranium in the test media or soil (at equilibrium) by the concentration of uranium in the test liquid or groundwater (at equilibrium), as follows:

$$K_d = \frac{C_s'}{C_l} \qquad \text{(D.3-1)}$$

where

C_s' = concentration of uranium in soil or test media (minus background)

C_l = concentration of uranium in liquid (at equilibrium)

The concentration of uranium in the liquid (at equilibrium) was obtained directly from laboratory analytical results; however, the concentration of uranium in the soil was calculated.

Desorption Calculations:

In order to calculate the concentration of uranium in the soil (at equilibrium), the mass of uranium in the water (at equilibrium) must first be determined. The mass of uranium was calculated by multiplying the concentration of uranium in the liquid (at equilibrium) by the total volume of the test liquid used during the desorption test, as follows:

$$m_l = C_l \times V \qquad \text{(D.3-2)}$$

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where

m_l = mass of uranium in liquid (at equilibrium)

V = volume of liquid used during desorption testing

The initial mass of uranium in the soil was calculated by multiplying the initial concentration of uranium in the soil by the mass of the soil, as follows:

$$m_s = C_o \times M \qquad \text{(D.3-3)}$$

where

m_s = initial mass of uranium in soil or test media

C_o = initial concentration of uranium in soil or test media

M = mass of soil or test media

Once these two values were determined, the concentration of uranium in the soil (at equilibrium) was calculated by subtracting the mass of uranium in the liquid (at equilibrium) from the initial mass of uranium in the soil and dividing the difference by the mass of the soil, as follows:

$$C_s = \frac{m_s - m_l}{M} \qquad \text{(D.3-4)}$$

where

C_s = concentration of uranium in soil or test media (at equilibrium)

In calculating the K_d values, the liquid source has an impact on determining the total uranium concentration in the soil. The background uranium concentration in soil was assumed to be in equilibrium with groundwater. In tests where groundwater was used as the desorption test liquid, the background uranium concentration was not subtracted from the concentration of uranium in the soil (at equilibrium); therefore, C_s' equals C_s. However, in tests where groundwater was not used as the adsorption test liquid, the background uranium concentration was subtracted from the concentration of uranium in the soil (at equilibrium), as follows:

$$C_s' = C_s - C_b \qquad \text{(D.3-5)}$$

where

C_b = background concentration of uranium

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The background total uranium concentration in soil was calculated to be 3.7 micrograms per gram (μg/g) by using the FEMP background activity for uranium isotopes. The equation used for the calculation is found in Data Validation Program, Rev. 0, DOE Oak Ridge Operations Office, 1991, pages D-3 through D-5.

The K_d calculations for the desorption tests were based on the analytical results for the ITAS laboratory and can be found in Attachment D.3-IV. A summary of the off-site analytical results and the K_d values for the desorption tests are provided in Table D.3-2.

Desorption Test Calculation Example:

The following is an example of desorption testing calculations for Sample No. 111457 to determine the K_d value.

C_o = 18.3 μg/g
C_l = 10.6 μg/L
M = 400 g
V = 3.5 L
C_b = 3.7 μg/g
m_l = C_l x V = 10.6 μg/L x 3.5 l = 37.1 μg
m_s = C_o x M = 18.3 μg/g x 400 g = 7,320 μg

$$C_s = \frac{m_s - m_l}{M} = \frac{7{,}320\ \mu g - 37.1\ \mu g}{400\ g} = \frac{7282.9\ \mu g}{400\ g} = 18.2\ \mu g/g$$

$$C_s' = C_s - C_b = 18.2\ \mu g/g - 3.7\ \mu g/g = 14.5\ \mu g/g$$

$$K_d = \frac{C_s'}{C_l} = \frac{14.5\ \mu g/g}{10.6\ \mu g/L} = 1.37\ L/g = 1370\ L/kg$$

$$K_d = 1370\ L/kg$$

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TABLE D.3-2
OPERABLE UNIT 2 K_d VALUES FOR DESORPTION TEST

Sample No.	Location[a]	Total Uranium			K_d Values (L/kg)
		Initial Soil Concentration (μg/g)	Equilibrium Soil Concentration (μg/g)	Equilibrium Water Concentration (μg/L)	
111455	Solid Waste Landfill/1986 - Waste Material	146.0	127.4	1700.0	75
111440	Solid Waste Landfill/1985 - Waste Material	74.0	63.9	726.0	88
111457	Solid Waste Landfill/1986 - Glacial Overburden	18.3	14.5	10.6	1370
115370	Solid Waste Landfill/11037 - Glacial Overburden	9.0/2.65[b]	2.0	10.0	200
114472	Lime Sludge Pond/SS03 - Waste/Berm Material	18.9	14.8	41.6	360
114494	Lime Sludge Pond/SS05&06 - Lime Sludge	14.3	10.6	4.0	2650
114067	Inactive Flyash Pile/11001 - Cover Material	147.0	127.5	1810.0	70
114068	Inactive Flyash Pile/11003 - Flyash	16.9	---[c]	---	---
114070	South Field/11187 - Glacial Overburden	308.0	304	32.5	9350
113717	South Field/Trench No. 1 - Waste Material	278.0	261.4	1480.0	180
113721	South Field/Trench No. 4 - Waste Material	4.34	0.6	2.16	280

[a]Identifies subunit and boring number

[b]Used average of FEMP and IT soil concentration

[c]Concentration below detection limit

Adsorption Calculations:

In order to calculate the concentration of uranium in the soil (at equilibrium), the amount of uranium adsorbed to the soil must first be calculated. The mass of uranium adsorbed was calculated by multiplying the initial concentration of uranium spiked in the liquid by the volume of the liquid used during adsorption testing, as follows:

$$m_i = S \times V \qquad \text{(D.3-6)}$$

where

m_i = initial mass of uranium spiked in liquid

S = initial concentration of uranium spiked in liquid

V = volume of liquid used during adsorption testing

Then, the mass of uranium in the solution (at equilibrium) was calculated by multiplying the concentration of uranium in the liquid (at equilibrium) by the volume of the liquid used during adsorption testing, as follows:

$$m_f = C_l \times V \qquad \text{(D.3-7)}$$

where

m_f = mass of uranium in liquid (at equilibrium)

C_l = concentration of uranium in liquid (at equilibrium)

The concentration of uranium adsorbed in the soil was calculated by subtracting the mass of uranium in the liquid (at equilibrium) from the initial mass of uranium spiked in the liquid and dividing the difference by the total soil mass, as follows:

$$C_a = \frac{m_i - m_f}{M} \qquad \text{(D.3-8)}$$

where

C_a = concentration of uranium adsorbed in soil or test media

M = mass of soil or test media

The final concentration of uranium in the soil (at equilibrium) was calculated by adding the concentration of uranium adsorbed in the soil to the initial concentration of uranium in the soil, as follows:

$$C_s = C_a + C_o \qquad \text{(D.3-9)}$$

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where

C_s = concentration of uranium in soil or test media (at equilibrium)
C_o = initial concentration of uranium in soil or test media

The background uranium concentration in the soil was assumed to be in equilibrium with the groundwater concentrations; therefore, in tests where groundwater was used as the adsorption test liquid, the background uranium concentration was not subtracted from the concentration of uranium in the soil (at equilibrium); therefore, Cs' equals Cs. In tests where groundwater was not used as the adsorption test liquid, the background uranium concentration was subtracted from the concentration of uranium in the soil (at equilibrium), as follows:

$$C_s' = C_s - C_b \qquad \text{(D.3-10)}$$

where

C_b = background concentration of uranium

The K_d calculations for the adsorption tests were based on the analytical results for the ITAS laboratory and can be found in Attachment D.3-V. A summary of the off-site analytical results and the K_d values for the adsorption test are provided in Table D.3-3.

Adsorption Test Calculation Example:

The following is an example of adsorption testing calculations for Sample No. 11457 to determine the K_d values.

Given:

C_o = 18.3 μg/g V = 3.5 L
C_l = 357 μg/L S = 2000 μg/L
M = 400 g

Calculations:

m_i = S x V = 2000 μg/L x 3.5 L = 7000 μg
m_f = C_l x V = 357 μg/L x 3.5 L = 1249.5 μg

$$C_a = \frac{m_i - m_f}{M} = \frac{7000\ \mu g - 1249.5\ \mu g}{400\ g} = \frac{5750.5\ \mu g}{400\ g} = 14.4\ \mu g/g$$

TABLE D.3-3
OPERABLE UNIT 2 K_d VALUES FOR ADSORPTION TEST

Sample No.	Location[a]	Total Uranium			K_d Values (L/kg)
		Initial Soil Concentration (μg/g)	Equilibrium Soil Concentration (μg/g)	Equilibrium Water Concentration (μg/L)	
115445	Solid Waste Landfill/2953 - Unsaturated Sand and Gravel	1.63	11.1	918.0	12.0
115454	Solid Waste Landfill/2953 - Saturated Sand and Gravel	1.17	10.1	982.0	10.0
111457	Solid Waste Landfill/1986 - Glacial Overburden	18.3	29.0	357.0	81
114068	Inactive Flyash Pile/11003 - Flyash	16.9	30.7	3.0[b]	10,230
114069	Active Flyash Pile/1980 - Flyash	12.2	21.1	564.0	37.0
113721	South Field/Trench No. 4 - Waste Material	4.34	10.4	876.0	12.0
113755	South Field/2944 - Unsaturated Sand and Gravel	1.43	11.7	826.0	14.0
113770	South Field/2944 - Saturated Sand and Gravel	2.86	9.9	1190.0	8.0

[a]Identifies subunit and boring number

[b]Used FEMP average water analysis result

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$$C_s = C_a + C_o = 14.4\ \mu g/g + 18.3\ \mu g/g = 32.7\ \mu g/g$$

$$C_{s'} = C_s - C_b = 32.7\ \mu g/g - 3.7\ \mu g/g = 29.0\ \mu g/g$$

$$K_d = \frac{C_{s'}}{C_l} = \frac{29.0\ \mu g/g}{357\ \mu g/L} = 0.081\ L/g = 81.0\ L/kg$$

$$K_d = 81.0\ L/kg$$

The off-site results were used, because they were performed by a laboratory using EPA CLP procedures.

D.3.4 Summary and Conclusions

This section presents the K_d values that were calculated for all tests, and discusses the significance of these test results.

D.3.4.1 Desorption Versus Adsorption

A summary of K_d values for desorption and adsorption tests is provided in Table D.3-4. Two values were provided wherever there were two samples from the same area, and for the sand and gravel samples since they were similar. The K_d values, based on desorption values, were significantly higher then the adsorption test based K_d values. Results for Solid Waste Landfill Sample No. 111457 and South Field Sample No. 113721 provide a direct comparison between the two tests. Measurement of the Solid Waste Landfill sample yielded a K_d of 1,370.0 L/kg from the desorption test and a K_d of 81.0 L/kg from the adsorption test. On the South Field sample, the desorption test showed a K_d value of 280.0 L/kg and the adsorption test showed a K_d value of 12.0 L/kg.

The results between the adsorption and desorption tests were different and can be attributed to the difference in the tests. One difference was the generation or presence of uranium in the leachate. In the adsorption test, uranium was added to the leachate at the beginning of the test. In the desorption test, the uranium was leached, during the test, from the soil sample in the leachate.

The uranium in the leachate was also different between the tests. In the adsorption test, the uranium was in the form of uranium nitrate. In the desorption test, the uranium varied chemically depending on the source and/or chemical changes that may have occurred during its presence in the soil. In addition, the desorption test was different than the adsorption test by the process. The desorption test

TABLE D.3-4

SUMMARY OF K_d VALUES FOR OPERABLE UNIT 2

Sample Location	Desorption Test K_d (L/Kg)	Adsorption Test K_d (L/Kg)
Solid Waste Landfill - Waste Material	75.0/88.0	
Solid Waste Landfill - Glacial Overburden	200.0/1370.0	81.0
Inactive Flyash Pile - Cover Material	70.0	
Inactive Flyash Pile/Active Flyash Pile - Flyash		37.0/10,230.0
Lime Sludge Pond - Berm Material	360.0	
Lime Sludge Pond - Lime Sludge	2650.0	
South Field - Waste Material	180.0/280	12.0
South Field - Glacial Overburden	9350.0	
South Field/Solid Waste Landfill - Unsaturated Sand and Gravel		12.0/14.0
South Field/Solid Waste Landfill - Saturated Sand and Gravel		8.0/10.0

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worked on the process of removing absorbed uranium from the soil. The adsorption test used the process of soil particles absorbing uranium from solution.

The desorption test is considered more representative for the fill and till layers of the subunits, because it depicts the behavior of the uranium migration in the contaminated soil layers upon contact with infiltration and perched groundwater. Whereas the adsorption test better depicts the sand and gravel layers since, in these layers, the media is free of uranium contamination and would act in an adsorption fashion on contaminated groundwater moving through the media. The adsorption values were mainly used in the unsaturated and saturated sand and gravel zones where the desorption test was not practical, because the soils were not contaminated or not contaminated to a level that would leach at detectable concentrations.

D.3.4.2 Operable Unit 2 K_d Values Versus Literature Values

Several literature reviews were performed to evaluate the range of K_d values for uranium. One reference (Thibault et al. 1990) provided a range of K_d values from 46 to 395,100 L/kg for clay-rich soils and 0.03 to 2,200 L/kg for sandy soils. For agriculture soils or the soil layer where plants and roots uptake nutrients, the K_d value for uranium ranged from 10.5 to 4,400 L/kg (Baes et al. 1984).

Both the waste layer and glacial overburden layer soils at the Solid Waste Landfill and South Field were clay-rich soil with K_d values from 12 to 180 L/Kg for the waste layer and 9,350 L/kg for the glacial overburden layer. In comparison with the literature values, the Operable Unit 2 K_d values were on the low end of the range. Likewise, for the sand and gravel at the Solid Waste Landfill and South Field, the K_d values ranged from 8.0 to 14.0 L/kg, which was on the low end of the literature values for sandy soils. No literature values were obtained for the flyash and lime sludge.

D.3.4.3 Operable Unit 2 K_d Values Versus In Situ Values

A final assessment of the Operable Unit 2 K_d values was made by comparison with in situ samples. The in situ K_d determination was conducted by Operable Unit 5 and was determined by analyzing a soil and water sample at the same location in 1000-series wells. Because the perched water flow velocities are low in the glacial overburden, it was assumed the measured soil and liquid phase concentrations were in equilibrium.

Before the in situ K_ds were calculated, the soil concentration was corrected for the uranium contained in the soil moisture. Approximately 25 percent of the soil uranium concentration was subtracted to adjust for the soil moisture. The Operable Unit 5 in situ K_d values ranged from 16 to 235 L/kg, which were similar to the range of Operable Unit 2 K_d values for the Solid Waste Landfill and South Field in the glacial overburden (12 to 280 L/kg) when the high K_d values are deleted from the Solid Waste Landfill (1,370 L/kg) and South Field (9,350 L/kg).

The Operable Unit 2 RI sampling program collected a soil (silty sand) and water sample from Inactive Flyash Pile Boring No. 11003 at 7.9 m (26 ft), which produced an in situ K_d value of 525 L/kg. Also, a K_d value was calculated for the South Field saturated sand and gravel layer by removing the free liquid from the sample and analyzing the free liquid and sand and gravel material. The sand and gravel were considered to be in equilibrium with the groundwater. A K_d value of 64 L/kg resulted. These two Operable Unit 2 in situ K_d values were much higher then the Operable Unit 2 laboratory K_d values for the sand and gravel layer. The in situ K_d at Boring No. 11003 was believed to be high due to the uranium contamination not being soluble and was probably specific to that area of contamination.

APPENDIX D.3
ATTACHMENT D.3-I
LABORATORY PROCEDURES

ATTACHMENT D.3-1
LABORATORY PROCEDURES

D.3-I.1 Procedure A (Contaminated Samples for Uranium K_d Determination)

D.3-I.1.1 Sample Homogenization

The sample will be thoroughly homogenized using a stainless steel mixing spoon in a stainless steel mixing bowl.

D.3-I.1.2 Sample Filtration

If the sample has any free liquid, it should be vacuum filtered through a .45 micron filter paper. (Note that it may be necessary to use several filtration steps.) Any filtrate should be collected and analyzed for total uranium.

D.3-I.1.3 Initial Characterization of Soil Sample

Samples for the total uranium soil analysis should be split between the FEMP laboratory and the off-site laboratory if adequate sample is available. If there is inadequate sample for the off-site analysis, then samples should only be analyzed at the FEMP laboratory. Sample volumes should be collected for total uranium and placed in the containers as shown in Table D.3-I-1. Additionally, a 10-gram sample should be analyzed for moisture content at the FEMP laboratory.

D.3-I.1.4 Sample Preparation

Place 400 grams (dry weight) of soil sample in the 4.0 liter reactor and add 3,500 ml of the appropriate leachate solution to the reactor. For soil samples collected in the subunits, the leachate solution will be 3,500 ml of deionized (DI) water adjusted to a pH of 5.6 using a mixture of sulfuric acid and nitric acid at a 60/40 ratio. For soil samples collected from the glacial overburden below the subunits, use DI water with no pH adjustment. For soil samples from the sand and gravel zone (unsaturated or saturated) below the subunits, the leachate solution will be clean groundwater from a background well. A sample of the background groundwater must be submitted for total uranium analysis to the off-site laboratory and the FEMP laboratory according to the volumes and container requirements shown in Table D.3-I-1. This analysis will serve as a background concentration for the groundwater used for the testing. (Note: Background groundwater only requires one analysis to establish a baseline concentration.)

D.3-I.1.5 Sample Mixing

The samples should be placed in the rotating tumbler and mixed continuously until completion of the testing. The extractor must be operated at 29 +/- 2 rpm.

D.3-I.1.6 Sample Collection

Samples of the leachate should be collected by stopping the tumbler for a sufficient time period (minimum of 10 minutes) to allow the solids to settle. An appropriate volume of the leachate (see Table D.3-I-1 for sample volumes required for analysis) should then be decanted from the reactor and filtered through a .45 micron filter paper or separated with a constant temperature centrifuge capable of separating greater than 0.1 micron particles. Any solids from the separation step should be returned to the reactor.

Intermediate samples should be collected at 72, 144, 168, 240, 288, 360, and 384 hours and analyzed at the FEMP laboratory for total uranium. The study may be stopped earlier if the data indicates that uranium is in equilibrium with the soil and liquid. Equilibrium will be determined by plotting each concentration (Y-axis) versus time (X-axis) to determine when the curve begins to flatten, which indicates that an equilibrium concentration is achieved. Prior to stopping the test earlier or collecting intermediate samples for one of the radionuclides, confirm with the Operable Unit 2 representative that the contaminant is in equilibrium.

The final sample will be collected after the results indicate that uranium is in equilibrium and will be split between the FEMP laboratory and the off-site laboratory. The final sample will be collected and analyzed for total uranium. If a sample does not reach equilibrium after 384 hours, then the Operable Unit 2 representative (Bert Crapse at extension 6974) should be notified to determine the appropriate action to be taken. (Note: The final water samples should only be split with the FEMP and off-site laboratories if the soil samples were initially split between the two laboratories.)

At the completion of the study, the soil will be stored for possible future leaching tests to determine the extractable concentrations of the radionuclides. Prior to storing the sample, the sample will be vacuum filtered through a .45 micron filter paper to remove all free liquid. The Operable Unit 2 representative will identify which samples will be used to determine the extractable portion.

D.3-I.2 Procedure A1 (Non-Contaminated Samples for Uranium K_d Determination)

D.3-I.2.1 Sample Homogenization

The sample will be thoroughly homogenized using a stainless steel mixing spoon in a stainless steel mixing bowl.

D.3-I.2.2 Sample Filtration

If the sample has any free liquid, it should be vacuum filtered through a .45 micron filter paper. (Note that it may be necessary to use several filtration steps.)

D.3-I.2.3 Initial Characterization of Soil Sample

Samples for the total uranium soil analysis should be split between the FEMP laboratory and the off-site laboratory if an adequate sample is available. If there is inadequate sample for the off-site analysis, then samples should only be analyzed at the FEMP laboratory. Sample volumes should be collected for total uranium and placed in the containers as shown in Table D.3-I-1. Additionally, a 10-gram sample should be analyzed for moisture content at the FEMP laboratory.

D.3-I.2.4 Sample Preparation

Place 400 grams (dry weight) of soil sample in the 4.0 liter reactor and add 3,500 ml of the appropriate leachate solution to the reactor. For soil samples collected in the subunits, the leachate solution will be 3,500 ml of DI water adjusted to a pH of 5.6 using a mixture of sulfuric acid and nitric acid at a 60/40 ratio. For soil samples from the sand and gravel zone (unsaturated or saturated) below the subunits, the leachate solution will be clean groundwater from a background well. If baseline concentration is not established for groundwater, then a sample must be submitted for total uranium analysis to the off-site laboratory and the FEMP laboratory according to the volumes and container requirements shown in Table D.3-I-1.

Once the proper leaching solution has been prepared, the proper mass of radionuclides must be added to obtain a liquid concentration of approximately 100 times the MCL concentration. The following is the MCL (proposed) for uranium:

Radionuclide	MCL	Mass of Radionuclide to be Spiked
Uranium	20 μg/L	7.0 mg Uranium 238

Place 400 grams (dry weight) of soil/waste in the 4.0 liter reactor, and add 3,500 ml of the appropriate leachate solution to the reactor.

D.3-I.2.5 Sample Mixing

The samples should be placed in the rotating tumbler and mixed continuously until completion of the testing. The extractor must be operated at 29 +/- 2 rpm.

D.3-I.2.6 Sample Collection

Samples of the leachate should be collected by stopping the tumbler for a sufficient time period (minimum of 10 minutes) to allow the solids to settle. An appropriate volume of the leachate (see Table D.3-I-1 for sample volumes required for analysis) should then be decanted from the reactor and filtered through a .45 micron filter paper or separated with a constant temperature centrifuge capable of separating greater than 0.1 micron particles. Any solids from the separation step should be returned to the reactor.

Intermediate samples should be collected at 4, 24, 48, and 72 hours. After the 72 hour data point is obtained, verify that the uranium is at an equilibrium concentration between the soil and the leachate solution. Equilibrium will be determined by plotting each concentration (Y-axis) versus time (X-axis) to determine when the curve begins to flatten, which indicates that an equilibrium concentration is achieved. If a sample does not reach equilibrium after 72 hours, then the Operable Unit 2 representative contact person (Bert Crapse at extension 6974) should be notified to determine the appropriate action to be taken.

All of the intermediate samples will be analyzed for total uranium at the FEMP laboratory. The final sample will be collected after the results indicate that uranium is in equilibrium. The final sample will be split between the FEMP laboratory and the off-site laboratory and analyzed for total uranium. (Note: The final water samples should only be split with the FEMP and off-site laboratories if the soil samples were split.)

Table D.3-I-1

SAMPLE VOLUMES/DETECTION LIMIT

Chemical	Media	Method	Volume	Sample Container	Instrument	Detection Limit
Off-Site Laboratory						
Total - Uranium	Water Soil	OR 7127 OR 7003	210 ml 135 g (dry)	250 ml glass 250 ml glass	Laser Phosphorimetry Gamma Spectrometry	1 ug/l 1 ppm
FEMP laboratory						
Total - Uranium	Water Soil	3062 3002	10 ml 5 g	-[a]	Laser Phosphorimetry Color Metric	1 ug/l 0.1 ppm

[a]To be determined by laboratory personnel.

Note: Water samples to be preserved with HNO_3.

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APPENDIX D.3

ATTACHMENT D.3-II

LABORATORY RESULTS FOR DESORPTION TESTS

DESORPTION TEST FOR
SOLID WASTE LANDFILL BORING 1986
WASTE MATERIAL
SAMPLE #111455

	SAMPLING PERIOD (DAYS)									
LEACHATE ANALYTICAL PARAMETERS	Start 6/18/93	3	6	7	10	12	14	18	20	28 Final[1]
Total-U Conc. (ug/l)	N/A	1300	1685	1667	1762	1626	1619	1300	1500	1768/ 1700
Percent Concentration Change	-	-	+29.6	-1.1	+5.7	-7.7	-0.4	-19.7	+15.4	+17.9
Ratio Change of Liquid	8.75	8.70	8.65	8.60	8.55	8.50	8.45	8.40	8.35	-
pH	5.60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Specific Conductivity (uMHOS)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Temp. (°C)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Initial Soil Uranium Concentration = 146 ppm (IT) & 94 ppm (FEMP)
Soil Sample Wt. = 400 g
Initial Liquid to Soil Ratio = 8.75
[1] - final sample split and analyzed for total-U by FEMP/IT Oak Ridge
N/A - Not Analyzed

001807

5860

DESORPTION TEST FOR
SOLID WASTE LANDFILL BORING 1985
WASTE MATERIAL
SAMPLE #111440

LEACHATE ANALYTICAL PARAMETERS	SAMPLING PERIOD (DAYS)									
	Start 7/19/93	1	3	4	7	10	11	15	17	18 Final[1]
Total-U Conc. (ug/l)	N/A	360	579	465	476	489	507	555	549	551/52.5
Percent Concentration Change	-	-	+61	-19.7	+2.4	+2.7	+3.7	+9.5	-1.1	0.4
Ratio Change of Liquid	8.75	8.70	8.65	8.60	8.55	8.50	8.45	8.40	8.35	-
pH	5.60	8.54	8.42	8.42	8.32	8.04	7.98	7.89	7.85	N/A
Specific Conductivity (uMHOS)	N/A	185	220	234	275	300	310	325	322	N/A
Temp. (°C)	N/A	30.1	31.2	32.0	33.0	32.1	32.0	30.5	28.8	N/A

Initial Soil Uranium Concentration = 74 ppm (IT) & 64 ppm (FEMP)
Moisture Content = 86.5% solid
Soil Wt. = 400g
Initial Liquid to Soil Ratio = 8.75
[1] - final sample split and analyzed for total-U by FEMP/IT Oak Ridge
N/A - Not analyzed

001808

DESORPTION TEST FOR
SOLID WASTE LANDFILL BORING 1986
GLACIAL OVERBURDEN LAYER
SAMPLE #111457

LEACHATE ANALYTICAL PARAMETERS	SAMPLING PERIOD (DAYS)								
	Start 7/27/93	1	3	6	8	10	13	15	16 Final[1]
Total-U Conc. (ug/l)	N/A	6.6	12.1	9.9	9.9	14.0	10.1	14.5	11.6/10.6
Percent Concentration Change	-	-	+83.3	-18.2	0.0	+41.4	-27.9	43.6	-20
Ratio Change of Liquid	8.75	8.70	8.65	8.60	8.55	8.50	8.45	8.40	-
pH	5.60	7.32	7.36	7.23	7.31	7.34	7.26	7.32	7.31
Specific Conductivity (uMHOS)	N/A	170	205	230	248	249	260	265	265
Temp. (°C)	N/A	32.4	30.8	29.6	31.1	28.4	29.4	29.0	28.7

Initial Soil Uranium Concentration = 18.3 ppm (IT) & 6 ppm (FEMP)
Soil Sample Wt. = 400g
Liquid to Soil Ratio = 8.75
Moisture Content = 74.9% solid
[1] - final sample split and analyzed for total-U by FEMP/IT Oak Ridge
N/A - Not analyzed

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DESORPTION TEST FOR
SOLID WASTE LANDFILL BORING 11037
GLACIAL OVERBURDEN LAYER
SAMPLE #115370

	SAMPLING PERIOD (DAYS)								
LEACHATE ANALYTICAL PARAMETERS	Start 7/27/93	1	3	6	8	10	13	15	16 Final[1]
Total-U Conc. (ug/l)	N/A	5.4	10.0	8.6	13.6	7.5	10.8	11.5	10.1/10.0
Percent Concentration Change	-	-	+85.2	-14.0	+58.1	-44.8	+44.0	+6.5	-12.2
Ratio Change of Liquid									
pH	5.60	7.94	7.82	7.80	7.72	7.80	7.76	7.69	7.75
Specific Conductivity (uMHOS)	N/A	300	380	420	430	440	455	467	470
Temp. (°C)	N/A	32.9	31.9	31.3	30.9	28.2	29.0	29.3	28.6

Initial Soil Uranium Concentration = 2.65 ppm (IT) & 9 ppm (FEMP)
Soil sample Wt. = 400g
Liquid to Soil Ratio = 8.75
Moisture Content = 80.9% solid
[1] - final sample split and analyzed for total-U by FEMP/IT Oak Ridge
N/A = Not Analyzed

DESORPTION TEST FOR
LIME SLUDGE PONDS SURFACE SOIL #03
LIME SLUDGE
SAMPLE #114472

Analytical Parameters	SAMPLING PERIOD (DAYS)								
	Start	1	3	6	8	10	13	15	16 Final[1]
Total-U Conc. (ug/l)	0	18.1	34.0	24.9	30.0	31.1	36.1	37.9	40.0/41.6
Percent Concentration Change	-	-	87.8	-26.8	20.5	3.7	16.1	5.0	5.5
Ratio Change of Liquid	8.75	8.70	8.65	8.60	8.55	8.50	8.45	8.40	-
pH	5.60	7.60	7.47	7.28	7.17	7.16	7.08	7.00	7.05
Specific Conductivity (uMHOS)	0	191	257	320	357	380	420	449	455
Temp. (°C)	N/A	33.0	31.7	30.4	31.0	28.6	29.1	29.1	28.8

Initial Soil Uranium Concentration = 18.9 ppm (IT) & 17 ppm (FEMP)
Soil Sample Wt. = 400g
Liquid to Soil Ratio = 8.75
Moisture Content = 80.6% solid
[1] - final sample split and analyzed for total-U by FEMP/IT Oak Ridge
N/A - Not analyzed

001811

5860

DESORPTION TEST FOR
INACTIVE FLYASH PILE BORING 11001
COVER MATERIAL LAYER (FLYASH)
SAMPLE #114067

	SAMPLING PERIOD (DAYS)									
LEACHATE ANALYTICAL PARAMETERS	Start 7/19/93	1	3	4	7	10	11	15	17	18 Final [1]
Total-U Conc. (ug/l)	N/A	1557	2240	2111	1634	1505	1506	1472	1470	1696/ 1810
Percent Concentration Change	-	-	+43.9	-5.8	-22.6	-7.9	+0.1	-2.3	+0.1	+15.4
Ratio Change of Liquid	8.75	8.70	8.65	8.60	8.55	8.50	8.45	8.40	8.35	-
pH	5.60	8.50	8.47	8.52	8.44	8.27	8.15	8.18	8.20	N/A
Specific Conductivity (uMHOS)	N/A	175	200	213	239	249	264	255	252	N/A
Temp. (°C)	N/A	30.1	31.2	32.2	33.6	31.9	32.2	30.9	28.8	N/A

Initial Soil Uranium Concentration = 147 ppm (IT) & 150 ppm (FEMP)
Soil Sample Wt. = 400g
Liquid to Soil Ratio = 8.75
Moisture Content = 97.9% solid (air-dried)
[1] - Final sample split and analyzed for total-U by FEMP/IT Oak Ridge
N/A - Not analyzed

001812

DESORPTION TEST FOR
INACTIVE FLYASH PILE BORING 11003
WASTE MATERIAL (FLYASH)
SAMPLE #114068

LEACHATE ANALYTICAL PARAMETERS	SAMPLING PERIOD (DAYS)					
	Start 7/29/93	1	3	6	8	10 Final[1]
Total-U Conc. (ug/l)	N/A	<0.2	0.7	<0.2	<0.2	0.5
Percent Concentration Change	-	-	-	-	-	-
Ratio Change of Liquid	8.75	8.70	8.65	8.60	8.55	8.50
pH	5.60	5.95	6.02	5.96	5.95	6.00
Specific Conductivity (uMHOS)	N/A	123	160	178	184	190
Temp. (°C)	N/A	32.5	32.1	29.9	30.9	28.7

Initial Soil Uranium Concentration = 16.9 ppm (IT) & 6 ppm (FEMP)
Soil Sample Wt. = 400g
Liquid to Soil Ratio = 8.75
Moisture Content = 98.8% (air-dried)
N/A - Not Analyzed
Note: Test was stopped due to leachate being below detection limit

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DESORPTION TEST FOR
SOUTH FIELD BORING 1974
GLACIAL OVERBURDEN
SAMPLE # 114070

	SAMPLING PERIOD (DAYS)								
LEACHATE ANALYTICAL PARAMETERS	Start 7/27/93	1	3	6	8	10	13	15	16 Final[1]
Total-U Conc. (ug/l)	N/A	15.3	13.6	15.5	32.0	14.7	13.3	18.3	28.0/32.5
Percent Concentration Change	-	-	-11.1	+14.0	+106.5	-54.1	-9.5	+37.6	+53.0
Ratio Change of Liquid	8.75	8.70	8.65	8.60	8.55	8.50	8.45	8.40	-
pH	5.60	7.11	7.28	7.26	7.31	7.29	7.30	7.30	7.41
Specific Conductivity (uMHOS)	N/A	53	60	60	60	60	60	60	65
Temp. (°C)	N/A	33.2	31.1	30.7	30.6	28.7	29.1	28.7	28.8

Initial Soil Uranium Concentration = 308 ppm (IT) & 140 ppm (FEMP)
Soil Sample Wt. = 400g
Liquid to Soil Ratio = 8.75
Moisture Content = 83.3%
[1] - final sample split and analyzed for total-U by FEMP/IT Oak Ridge
N/A - Not analyzed

001814

DESORPTION TEST FOR SOUTH FIELD TRENCH #1 WASTE MATERIAL SAMPLE # 113717

LEACHATE ANALYTICAL PARAMETERS	SAMPLING PERIOD (DAYS)									
	Start 7/19/93	1	3	4	7	10	11	15	17	18 Final[1]
Total-U Conc. (ug/l)	N/A	1621	1831	1314	946	865	1168	1221	1253	1526/ 1480
Percent Concentration Change	-	-	+13.0	-28.2	28.0	-8.6	+35.0	+4.5	+2.6	+21.8
Ratio Change in Liquid	8.75	8.70	8.65	8.60	8.55	8.50	8.45	8.40	8.35	-
pH	5.60	8.85	8.86	8.90	8.90	8.67	8.60	8.47	8.45	N/A
Specific Conductivity (uMHOS)	N/A	170	185	183	211	239	245	260	260	N/A
Temp. (°C)	N/A	30.3	31.3	31.7	33.6	32.2	32.6	31.1	28.9	N/A

Initial Soil Uranium Concentration = 278 ppm (IT) & 96 ppm (FEMP)
Soil Sample Wt. = 400g
Liquid to Soil Ratio = 8.75
Moisture Content = 88.7%
[1] - final sample split and analyzed for total-U by FEMP/IT Oak Ridge
N/A - Not analyzed

001815

5860

DESORPTION TEST FOR
SOUTH FIELD TRENCH #4
GLACIAL OVERBURDEN LAYER
SAMPLE #113721

	SAMPLING PERIOD (DAYS)									
LEACHATE ANALYTICAL PARAMETERS	Start 7/19/93	1	3	4	7	10	11	15	17	18 Final[1]
Total-U Conc. (ug/l)	N/A	30.1	7.3	2.6	8.0	14.0	10.6	12.1	5.6	2.4/2.16
Percent Concentration Change	-	-	-75.7	-64.4	+207.7	+75.0	-24.3	14.2	-53.7	-57.1
Ratio Chnage of Liquid	8.75	8.70	8.65	8.60	8.55	8.50	8.45	8.40	8.35	-
pH	5.60	8.44	8.42	8.63	8.60	8.29	8.15	8.10	8.09	N/A
Specific Conductivity (uMHOS)	N/A	103	120	130	143	157	159	165	163	N/A
Temp. (°C)	N/A	30.4	31.4	31.7	33.0	32.3	32.1	30.5	29.0	N/A

Initial Soil Uranium Concentration = 4.34 ppm (IT) & 15 ppm (FEMP)
Soil Sample Wt. = 400g
Liquid to Soil Ratio = 8.75
Moisture Content = 79.7%
[1] - final sample split and analyzed for total-U by FEMP/IT Oak Ridge
N/A - Not analyzed

001816

DESORPTION TEST FOR
LIME SLUDGE POND SURFACE SOIL #05/06
LIME SLUDGE
SAMPLE #114494

LEACHATE ANALYTICAL PARAMETERS	SAMPLING PERIOD (DAYS)										
	Start 8/19/93	1	4	6	8	11	12	13	14	15	19 Final[1]
Total-U Conc. (ug/l)	N/A	8.2	5.4	5.7	276^	3934^	39	48	1.8	3.8	6.4
Percent Concentration Change	-	-	-34.1	+3.7	>1000	>1000	-99	+23.0	-96.3	+111	+40.6
Ratio Change of Liquid	8.75	8.70	8.65	8.60	8.55	8.50	8.45	8.40	8.35	8.30	-
pH	8.90	8.81	8.77	8.84	8.86	8.81	8.85	8.74	8.75	8.74	8.70
Specific Conductivity (uMHOS)	152	202	216	218	232	239	240	238	236	247	270
Temp. (°C)	23.8	25.3	24.9	23.7	25.8	25.1	25.4	24	22.6	25.1	24.6

Initial Soil Uranium Concentration = ? ppm (IT) & 15 ppm (FEMP)
Moisture Content = 56.66% solid
Soil Sample Wt. = 400g
Liquid to Soil Ratio = 8.75
[1] - final sample split and analyzed for total-U by FEMP/IT Oak Ridge
^ - samples were contaminated
N/A - Not Analyzed

APPENDIX D.3

ATTACHMENT D.3-III

LABORATORY RESULTS FOR ADSORPTION TESTS

ADSORPTION TEST FOR
SOLID WASTE LANDFILL BORING 2953
UNSATURATED SAND AND GRAVEL LAYER
SAMPLE # 115445

LEACHATE ANALYTICAL PARAMETERS	SAMPLING PERIOD (DAYS)											
	Start 7/20/93	1/6 (4 hr)	1	2	3	6	8	9	13	15	16	17 Final[1]
Total-U Conc. (ug/l)	2000	1697	1354	1262	1492	1361	897	948	839	736	888	793/918
Percent Concentration Change	-	+15.2	+20.2	+6.8	-18.2	+8.8	+34.1	-5.7	+11.5	+12.3	-20.7	+10.7
Ratio Change of Liquid	8.75	8.7	8.65	8.6	8.55	8.50	8.45	8.40	8.35	8.30	8.25	-
pH	6.70	6.95	6.82	6.86	7.00	7.03	7.07	7.20	7.27	7.29	7.35	N/A
Specific Conductivity (uMHOS)	700	1480	1470	1470	1470	1500	1440	1420	1400	1380	1340	N/A
Temp. (°C)	N/A	28.8	30.2	30.0	31.2	33.1	31.0	32.3	30.6	30.5	28.2	N/A

Initial Soil Uranium Concentration = 1.63 ppm (IT) & 4 ppm (FEMP)
Soil Sample Wt. = 400g
Liquid to Soil Ratio = 8.75
Moisture Content = 96.8% solids
[1] - final sample split and analyzed for total-U by FEMP/IT Oak Ridge
N/A - Not analyzed

001819

5860

ADSORPTION TEST FOR
SOLID WASTE LANDFILL BORING 2953
SATURATED SAND AND GRAVEL LAYER
SAMPLE # 115454

	SAMPLING PERIOD (DAYS)											
LEACHATE ANALYTICAL PARAMETERS	Start 7/20/93	1/6 (4 hr.)	1	2	3	6	8	9	13	15	16	17 Final[1]
Total-U Conc. (ug/l)	2000	1258	1282	1247	1240	1172	969	1035	873	851	900	752/982
Percent Concentration Change	-	+37.1	-1.9	+2.7	+0.6	+5.5	+17.3	-6.8	+15.6	+2.5	-5.8	+16.4
Ratio Change in Liquid	8.75	8.70	8.65	8.60	8.55	8.50	8.45	8.40	8.35	8.30	8.25	
pH	6.70	7.12	7.09	7.11	7.30	7.25	7.20	7.40	7.45	7.45	7.52	N/A
Specific Conductivity (uMHOS)	700	900	900	900	920	980	920	900	920	900	880	N/A
Temp. (°C)	N/A	28.6	30.2	30.3	31.5	33.1	31.1	31.1	30.6	30.5	28.1	N/A

Initial Soil Uranium Concentration = 1.17 ppm (IT) & 4 ppm (FEMP)
Soil Sample Wt. = 400g
Liquid to Soil Ratio = 8.75
Moisture Content = 86.3% solid
[1] - final sample split and analyzed for total-U by FEMP/IT Oak Ridge
N/A - Not analyzed

001820

ADSORPTION TEST FOR
SOLID WASTE LANDFILL BORING 1986
GLACIAL OVERBURDEN LAYER
SAMPLE # 111457

LEACHATE ANALYTICAL PARAMETERS	SAMPLING PERIOD (DAYS)								
	Start 7/27/93	1/6 (4 hr)	1	2	3	7	8	10	10 Final[1]
Total-U Conc. (ug/l)	2000	506	334	367	343	295	283	288	318/357
Percent Concentration Change	-	+74.7	+34.0	-9.9	+6.5	+14.0	+4.1	-1.8	-10.4
Ratio Change in Liquid	8.75	8.70	8.65	8.6	8.55	8.5	8.45	8.4	-
pH	6.70	7.49	6.84	6.92	6.99	6.95	6.96	7.13	N/A
Specific Conductivity (uMHOS)	700	830	810	810	800	790	780	750	N/A
Temp. (°C)	N/A	32.1	32.7	31.8	32.0	30.1	30.8	28.3	N/A

Initial Soil Uranium Concentration = 18.3 ppm (IT) & 6 ppm (FEMP)
Soil Sample Wt. = 400g
Liquid to Soil Ratio = 8.75
Moisture Content = 74.9% solid
[1] - final sample split and analyzed for total-U by FEMP/IT Oak Ridge
N/A - Not analyzed

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ADSORPTION TEST FOR
ACTIVE FLYASH PILE BORING 1980
WASTE MATERIAL (FLYASH)
SAMPLE # 114069

	SAMPLING PERIOD (DAYS)									
LEACHATE ANALYTICAL PARAMETERS	Start 7/20/93	1/6 (4 hr.)	1	2	3	6	8	9	10	10 Final[1]
Total-U Conc. (ug/l)	2000	668	612	564	556	450	431	507	449	493/564
Percent Concentration Change	-	+66.6	+8.4	+7.8	+1.4	+19.1	+4.2	-17.6	+11.4	-9.8
Ratio Change in Liquid	8.75	8.7	8.65	8.6	8.55	8.50	8.45	8.4	8.35	-
pH	6.70	6.81	6.85	6.86	6.95	6.90	6.80	6.96	7.00	N/A
Specific Conductivity (uMHOS)	700	1380	1400	1400	1400	1450	1400	1400	1280	N/A
Temp. (°C)	N/A	28.4	28.9	30.3	30.9	32.5	31.4	30.6	27.9	N/A

Initial Soil Uranium Concentration = 12.2 ppm(IT) & 6 ppm (FEMP)
Moisture Content = 99.3% solid (air-dried)
Soil Sample Wt. = 400g
Liquid to Soil Ratio = 8.75
[1] - final sample split and analyzed for total-U by FEMP/IT Oak Ridge
N/A - Not analyzed

001822

ADSORPTION TEST FOR
SOUTH FIELD TRENCH #4
GLACIAL OVERBURDEN LAYER
SAMPLE #113721

LEACHATE ANALYTICAL PARAMETERS	SAMPLING PERIOD (DAYS)											
	Start 7/20/93	1/6 (4 hrs.)	1	2	3	6	8	9	13	15	16	17 Final[1]
Total-U Conc. (ug/l)	2000	1072	1282	1122	1015	878	748	854	718	714	785	724/876
Percent Concentration Change	-	+46.4	-19.6	+12.5	+9.5	+13.5	+14.8	-14.2	+15.9	+0.6	-9.9	+7.7
Ratio Change in Liquid	8.75	8.7	8.65	8.6	8.55	8.5	8.45	8.4	8.35	8.3	8.25	-
pH	6.70	7.10	7.14	7.20	7.30	7.21	7.00	7.25	7.26	7.22	7.34	N/A
Specific Conductivity (uMHOS)	700	810	810	820	830	800	780	790	800	780	720	N/A
Temp. (°C)	N/A	28.7	29.1	30.3	31.0	32.4	31.6	30.6	30.4	30.7	27.8	N/A

Initial Soil Uranium Concentration = 1.63 ppm (IT) & 15 ppm (FEMP)
Soil Sample Wt. = 400g
Liquid to Soil Ratio = 8.75
Moisture Content = 79.7%
[1] - final sample split and analyzed for total-U by FEMP/IT Oak Ridge
N/A - Not analyzed

001823

5860

ADSORPTION TEST FOR
SOUTH FIELD BORING 2944
UNSATURATED SAND AND GRAVEL LAYER
SAMPLE #113755

	SAMPLING PERIOD (DAYS)									
LEACHATE ANALYTICAL PARAMETERS	Start 7/20/93	1/6 (4 hrs.)	1	2	3	6	8	9	10	10 Final[1]
Total-U Conc. (ug/l)	2000	1564	1080	1285	1209	898	791	777	609	651/826
Percent Concentration Change	-	+21.8	+30.9	-19.0	+5.9	+25.7	+11.9	+17.7	+21.6	-6.9
Ratio Change in Liquid	8.75	8.7	8.65	8.6	8.55	8.5	8.45	8.4	8.35	-
pH	6.70	7.03	7.14	7.20	7.35	7.37	7.22	7.46	7.50	N/A
Specific Conductivity (uMHOS)	700	850	880	880	890	900	880	850	800	N/A
Temp. (°C)	N/A	28.6	29.7	30.0	31.0	33.0	31.0	32.0	29.8	N/A

Initial Soil Uranium Concentration = 1.43 ppm (IT) & 2 ppm (FEMP)
Soil Sample Wt. = 400g
Liquid to Soil Ratio = 8.75
Moisture Content = 93.1% solid
[1] - final sample split and analyzed for total-U by FEMP/IT Oak Ridge
N/A - Not analyzed

001824

ADSORPTION TEST #1 FOR
SOUTH FIELD BORING 2944
SATURATED SAND AND GRAVEL
SAMPLE #113770

LEACHATE ANALYTICAL PARAMETERS	SAMPLING PERIOD (DAYS)									
	Start 7/20/93	1/6 (4 hours)	1	2	3	6	8	9	10	10 Final[1]
Total-U Conc. (ug/l)	2000	1593	1598	1423	1417	1310	1290	1326	1219	958/1190
Percent Concentration Change	-	+20.4	-0.3	+11.0	+0.4	+7.6	+1.5	-2.8	+8.1	+21.4
Ratio Change in Liquid	8.75	8.7	8.65	8.6	8.55	8.5	8.45	8.4	8.35	-
pH	6.70	7.09	7.21	7.26	7.40	7.36	7.17	7.49	7.50	N/A
Specific Conductivity (uMHOS)	700	850	900	900	900	900	890	840	800	N/A
Temp. (°C)	N/A	28.6	30.0	30.4	30.8	32.5	31.4	31.1	28.4	N/A

Initial Soil Uranium Concentration = 2.86 ppm (IT) & 6 ppm (FEMP)
Soil Sample Wt. = 400g
Liquid to Soil Ratio = 8.75
Moisture Content = 98.8% solid (air-dried)
[1] - final sample split and analyzed for total-U by FEMP/IT Oak Ridge
N/A - Not analyzed

001825

5860

ADSORPTION TEST FOR
INACTIVE FLYASH PILE BORING 11003
WASTE MATERIAL (FLYASH)
SAMPLE #114068

	SAMPLING PERIOD (DAYS)						
LEACHATE ANALYTICAL PARAMETERS	Start 8/11/93	1/6 (4 hours)	1	2	5	6	7 Final[1]
Total-U Conc. (ug/l)	2000	3.2	4.0	1.2	4.0	2.6	3.1/ <1.0
Percent Concentration Change	-	+99.8	-25.0	+70.0	-233.3	+35.0	-19.2
Ratio Change to LIquid	8.75	8.70	8.65	8.60	8.55	8.50	-
pH	N/A	5.71	5.76	5.79	5.81	5.83	5.79
Specific Conductivity (uMHOS)	N/A	287	286	255	260	268	269
Temp. (°C)	N/A	29.9	29.5	23.3	24.3	25.0	25.1

Initial Soil Uranium Concentration = 16.9 ppm (IT) & 6 ppm (FEMP)
Moisture Content = 98.8% solid (air-dried)
Soil Sample Wt. = 400g
Liquid to Soil Ratio = 8.75
[1] - final sample split and analyzed for total-U by FEMP/IT Oak Ridge
N/A - Not analyzed

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APPENDIX D.3

ATTACHMENT D.3-IV

K_d CALCULATIONS FOR DESORPTION TESTS

10/15/93
B. Crapse

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April 29, 1994

Symbols and Units

$$K_d = \frac{C_s'}{C_L}$$

V = volume of liquid used during equilibrium tests always ~~[illegible]~~ $\approx$ 3.5 liters

M = mass of soil or test media; ~~[illegible]~~ $\approx$ 400 grams

C_o = initial concentration of uranium in soil or test media ($\mu g/g$)

C_s = concentration of uranium in soil or test media at equilibrium ($\mu g/g$)

C_b = background concentration of uranium in soil ~~[illegible]~~; calculated $\approx$ 3.7 $\mu g/g$

C_L = concentration of uranium in liquid at equilibrium ($\mu g/\ell$)

C_s' = final concentration of uranium in soil or test media above background ($\mu g/g$)

m_L = mass of uranium leached from soil (μg)

m_s = mass of uranium in soil at equilibrium (μg)

---

① Sample # 111457 (Glacial Overburden)

C_o = 18.3 $\mu g/g$

C_L = 10.6 $\mu g/\ell$

uranium mass leached from soil

$$m_\ell = C_L V = (10.6\ \mu g/\ell)(3.5\ \ell) = 37.1\ \mu g$$

uranium mass remaining in soil

$$m_s = C_o M - 37.1\ \mu g = (18.3\ \mu g/g)(400\ g) - 37.1\ \mu g$$

$$= 7282.9\ \mu g$$

$$C_s = \frac{m_s}{M} = \frac{7282.9\ \mu g}{400\ g} = 18.2\ \mu g$$

10/15/93

subtract background concentration from sample

$$C_s' = C_s - C_b = 18.2\ \mu g/g - 3.7\ \mu g/g$$

$$= 14.5\ \mu g/g$$

so, $$K_d = \frac{C_s'}{C_L} = \frac{14.5\ \mu g/g}{10.6\ \mu g/\ell} = 1.37\ \ell/g = 1370\ \ell/kg$$

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April 29, 1994

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(2) Sample # 111440 (Waste Material)

$C_o = 74.0\ \mu g/g$

$C_L = 726.0\ \mu g/\ell$

uranium mass leached from soil

$$m_\ell = C_L V = (726.0\ \mu g/\ell)(3.5\ \ell)$$

$$= 2541.0\ \mu g$$

uranium mass remaining in soil

$$m_s = C_o M - 2541.0\ \mu g = (74.0\ \mu g/g)(400\ g) - 2541.0\ \mu g$$

$$= 27{,}059\ \mu g$$

$$C_s = \frac{m_s}{M} = \frac{27{,}059\ \mu g}{400\ g} = 67.6\ \mu g/g$$

subtract background concentration from sample

$$C_s' = C_s - C_b = 67.6\ \mu g/g - 3.7\ \mu g/g$$

$$= 63.9\ \mu g/g$$

so, $$K_d = \frac{C_s'}{C_L} = \frac{63.9\ \mu g/g}{726.0\ \mu g/\ell} = 0.088\ \ell/g = 88\ \ell/kg$$

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22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
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April 29, 1994

③ Sample # 111455 (waste material)

$C_o = 146.0\ \mu g/g$

$C_L = 1700\ \mu g/\ell$

$$C_s = \frac{(C_o \times M) - (C_L \times V)}{M} = \frac{[(146.0\ \mu g/g)(400g) - (1700\ \mu g/\ell)(3.5$$

$$= 131.1\ \mu g/g$$

$$C_s' = 131.1\ \mu g/g - 3.7\ \mu g/g = 127.4\ \mu g/g$$

$$K_d = \frac{C_s'}{C_L} = \frac{127.4\ \mu g/g}{1700} = 0.075\ \ell/g = 75\ \ell/kg$$

---

④ Sample # 115370 (Glacial Overburden)

$$C_o = \frac{9.0\ \mu g/g + 2.65\ \mu g/g}{2} = 5.83\ \mu g/g$$ {average of both IT + FEMP analysis}

$C_L = 10.0\ \mu g/\ell$

$$C_s = \frac{(C_o \times M) - (C_L \times V)}{M} = \frac{[(5.83\ \mu g/g)(400g) - (10.0\ \mu g/\ell)(3.5\ell)]}{400g}$$

$$= 5.7\ \mu g/g$$

$$C_s' = C_s - C_b = 5.7\ \mu g/g - 3.7\ \mu g/g = 2.0\ \mu g/g$$

$$K_d = \frac{C_s'}{C_L} = \frac{2.0\ \mu g/g}{10.0\ \mu g/\ell} = 0.2\ \ell/g = 200\ \ell/kg$$

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(5) Sample # 114472 (Waste Material)

$C_o = 18.9\ \mu g/g$
$C_L = 41.6\ \mu g/l$

$$C_s = \frac{(C_o \times M) - (C_L \times V)}{M} = \frac{[(18.9\ \mu g/g)(400g) - (41.6\ \mu g/l)(3.5l)]}{400g}$$

$$= 18.5\ \mu g/g$$

$$C_s' = 18.5\ \mu g/g - 3.7\ \mu g/g = 14.8\ \mu g/g$$

$$K_d = \frac{C_s'}{C_L} = \frac{14.8\ \mu g/g}{41.6\ \mu g/l} = 0.36\ l/g = 360\ l/kg$$

---

(6) Sample # 114067 (Cover Material)

$C_o = 147.0\ \mu g/g$
$C_L = 1810.0\ \mu g/l$

$$C_s = \frac{(147.0\ \mu g/g)(400g) - (1810.0\ \mu g/l)(3.5l)}{400g} = 131.2\ \mu g/g$$

$$C_s' = 131.2\ \mu g/g - 3.7\ \mu g/g = 127.5\ \mu g/g$$

$$K_d = \frac{C_s'}{C_L} = \frac{127.5\ \mu g/g}{1810\ \mu g/l} = 0.07\ l/g = 70\ l/kg$$

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April 29, 1994

(7) Sample # 114070 (Glacial overburden)

$C_o = 308\ \mu g/g$

$C_L = 32.5\ \mu g/l$

$$C_s = \frac{(308.0\ \mu g/g)(400\ g) - (32.5\ \mu g/l)(7.5\ l)}{400\ g} = 307.7\ \mu g/g$$

$$C_s' = C_s - C_b = 307.7\ \mu g/g - 3.7\ \mu g/g$$

$$= 304\ \mu g/g$$

$$K_d = \frac{C_s'}{C_L} = \frac{304\ \mu g/g}{32.5\ \mu g/l} = 9.35\ l/g = 9350\ l/kg$$

(8) Sample # 113717 (Waste Material)

$C_o = 278.0\ \mu g/g$

$C_L = 1480.0\ \mu g/l$

$$C_s = \frac{(278.0\ \mu g/g)(400\ g) - (1480\ \mu g/l)(3.5\ l)}{400\ g} = 265.1\ \mu g/g$$

$$C_s' = 265.1\ \mu g/g - 3.7\ \mu g/g = 261.4\ \mu g/g$$

$$K_d = \frac{C_s'}{C_L} = \frac{261.4\ \mu g/g}{1480\ \mu g/l} = .18\ l/g = 180\ l/kg$$

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22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
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(9) Sample # 113721 (Glacial Overburden)

$C_o = 4.34\ \mu g/g$

$C_L = 2.16\ \mu g/\ell$

$$C_s = \frac{(4.34\ \mu g/g)(400g) - (2.16\ \mu g/\ell)(3.5\ell)}{400g} = 4.3\ \mu g/g$$

$$C_s' = 4.3\ \mu g/g - 3.7\ \mu g/g = 0.6\ \mu g/g$$

$$K_d = \frac{C_s'}{C_L} = \frac{0.6\ \mu g/g}{2.16\ \mu g/\ell} = .28\ \ell/g = 280\ \ell/kg$$

---

(10) Sample # 114494 (Lime Sludge)

$C_o = 14.3\ \mu g/g$

$C_L = 4.0\ \mu g/\ell$

$$C_s = \frac{(14.3\ \mu g/g)(400g) - (4.0\ \mu g/\ell)(3.5\ell)}{400g} = 14.3\ \mu g/g$$

$$C_s' = 14.3\ \mu g/g - 3.7\ \mu g/g = 10.6\ \mu g/g$$

$$K_d = \frac{C_s'}{C_L} = \frac{10.6\ \mu g/g}{4.0\ \mu g/\ell} = 2.65\ \ell/g$$

$$= 2650\ \ell/kg$$

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22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
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APPENDIX D.3

ATTACHMENT D.3-V

K_d CALCULATIONS FOR ADSORPTION TESTS

10-15-93
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April 29, 1994

Symbols and units

V = volume of liquid used during equilibrium testing always [redacted] ≈ 3.5 liters

M = mass of soil or test media; [redacted] approximately 400 grams

S = initial concentration of uranium in spiked solution ≈ 2000 μg/ℓ

C_o = initial concentration of uranium in soil or test media (μg/g)

C_s = concentration of uranium in soil or test media at equilibrium (μg/g)

C_b = background concentration of uranium in soil; calculated ≈ 3.7 μg/g

C_L = concentration of uranium in liquid at equilibrium (μg/ℓ)

C_s' = final concentration of uranium in soil or test media above background μg/g

C_a = concentration of uranium adsorbed in soil or test media above background (μg/g)

m_a = mass of uranium adsorbed in soil or test media [redacted] (μg)

$$K_d = \text{adsorption coefficient} \left(\frac{\ell}{kg}\right) = \frac{C_s'}{C_L}$$

Assumption: The mass of soil prior to the leachate testing is approximately equal to the mass of soil after the leachate testing.

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① Sample # 115445 (Unsaturated sand + gravel)

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$C_o = 1.63\ \mu g/g$

$C_L = 918.0\ \mu g/l$

mass of uranium adsorbed

$$m_a = SV - C_L V = (2000\ \mu g/l)(3.5\ l) - (918.0\ \mu g/l)(3.5\ l)$$

$$= 3787.0\ \mu g$$

Concentration of uranium adsorbed

$$C_a = \frac{m_a}{M} = \frac{3787.0\ \mu g}{400\ g} = 9.5\ \mu g/g$$

Concentration of uranium in soil at equilibrium

$$C_s = C_o + C_a = 1.63\ \mu g/g + 9.5\ \mu g/g = 11.1\ \mu g/g$$

$$C_s' = C_s$$ [background concentration not subtracted]

Note: The background concentration was not subtracted because site groundwater was used for the water solutions. When groundwater is used, the background concentration in the soil is assumed to be in equilibrium with groundwater background concentration.

$$K_d = \frac{C_s'}{C_L} = \frac{11.1\ \mu g/g}{918.0\ \mu g/l} = 0.012\ l/g$$

$$= 12.0\ l/kg$$

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22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
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April 29, 1994

(2) Sample # 115454 (Saturated sand + gravel)

$C_o = 1.17\ \mu g/g$

$C_L = 982.0\ \mu g/l$

mass of uranium adsorbed

$m_a = SV - C_L V = (2000\ \mu g/l)(3.5\ l) - (982.0\ \mu g/l)(3.5\ l)$

$= 3563.0\ \mu g$

Concentration of uranium adsorbed

$C_a = \frac{m_a}{M} = \frac{3563.0\ \mu g}{400\ g} = 8.9\ \mu g/g$

Concentration of uranium in soil at equilibrium

$C_s = C_o + C_a = 1.17\ \mu g/g + 8.9\ \mu g/g = 10.1\ \mu g/g$

$C_s' = C_s$

$K_d = \frac{C_s'}{C_L} = \frac{10.1\ \mu g/g}{982\ \mu g/l} = 0.010\ l/g$

$= 10\ l/kg$

(3) Sample # 111457 (Glacial Overburden)

$C_o = 18.3\ \mu g/g$

$C_L = 357.0\ \mu g/l$

amount of uranium adsorbed

$m_a = SV - C_L V = (2000\ \mu g/l)(3.5\ l) - (357.0\ \mu g/l)(3.5\ l)$

$= 5750.5\ \mu g$

Concentration adsorbed

$C_a = \frac{m_a}{M} = \frac{5750.5\ \mu g}{400\ g} = 14.4\ \mu g/g$

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22-144 200 SHEETS
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concentration in soil at equilibrium

$C_s = 14.4\ \mu g/g + 18.3\ \mu g/g$

$C_s = 32.7\ \mu g/g$

subtract background concentration for soil

$C_s' = C_s - C_b = 32.7\ \mu g/g - 3.7\ \mu g/g$

$= 29.0\ \mu g/g$

$K_d = \frac{C_s'}{C_L} = \frac{29.0\ \mu g/g}{357.0\ \mu g/l} = 0.081\ l/g$

$K_d = 81\ l/kg$

(+) Sample # 113721 (Glacial Overburden)

$C_o = 4.34\ \mu g/g$

$C_L = 876.0\ \mu g/l$

Concentration adsorbed

$C_a = \frac{(2000\ \mu g/l)(3.5\ l) - (876.0\ \mu g/l)(3.5\ l)}{400\ g}$

$= 9.84\ \mu g/g$

concentration at equilibrium

$C_s = 9.84\ \mu g/g + 4.34\ \mu g/g = 14.2\ \mu g/g$

$C_s' = 14.2\ \mu g/g - 3.7\ \mu g/g = 10.4\ \mu g/g$

$K_d = \frac{10.4\ \mu g/g}{876.0\ \mu g/l} = 0.012\ l/g = 12\ l/kg$

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Adsorption Test Calculations

10-15-93
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April 29, 1994

(5) Sample # 113755 (Unsaturated sand and gravel)

$C_o = 1.43$ µg/g

$C_L = 826.0$ µg/l

concentration adsorbed

$$C_a = \frac{(2000\ \mu g/l)(3.5\ l) - (826\ \mu g/l)(3.5\ l)}{400\ g}$$

$$= 10.3\ \mu g/g$$

Concentration at equilibrium

$$C_s = 10.3\ \mu g/g + 1.43\ \mu g/g = 11.7\ \mu g/g$$

$$C_s' = C_s$$

$$K_d = \frac{C_s'}{C_L} = \frac{11.7\ \mu g/g}{826.0\ \mu g/l} = 0.014\ l/g$$

$$= 14\ l/kg$$

(6) Sample # 113770 (Saturated sand + gravel)

$C_o = 2.86$ µg/g

$C_L = 1190$ µg/l

$$C_a = \frac{(2000\ \mu g/l)(3.5\ l) - (1190\ \mu g/l)(3.5\ l)}{400\ g} = 7.088\ \mu g/g$$

$$C_s = 7.09\ \mu g/g + 2.86\ \mu g/g = 9.95\ \mu g/g$$

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$$C_s' = C_s$$

$$K_d = \frac{9.95\ \mu g/g}{1190\ \mu g/l} = 0.0084\ l/g$$

$$k_d = \text{[redacted]} = 8.4\ l/kg$$

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10-15-93
B. Cooper

FEMP-OU02-4 DRAFT
April 29, 1994

(7) Sample # 114068 (Flyash)

$C_o = 16.9\ \mu g/g$

$C_L = 3.0\ \mu g/l$

$$C_a = \frac{(2000\ \mu g/l)(3.5\ l) - (3.0\ \mu g/l)(3.5\ l)}{400\ g} = 17.5\ \mu g/g$$

$$C_s = 17.5\ \mu g/g + 16.9\ \mu g/g = 34.4\ \mu g/g$$

$$C_s' = 34.7\ \mu g/g - 3.7\ \mu g/g = 30.7\ \mu g/g$$

$$K_d = \frac{C_s'}{C_L} = \frac{30.7\ \mu g/g}{3.0\ \mu g/l} = 10.23\ l/g$$

$$K_d = 10{,}230\ l/kg$$

---

(8) Sample # 114069 (Flyash Material)

$C_o = 12.2\ \mu g/g$

$C_L = 564.0\ \mu g/l$

$$C_a = \frac{(2000\ \mu g/l)(3.5\ l) - (564.0\ \mu g/l)(3.5\ l)}{400\ g} = 12.6\ \mu g/g$$

$$C_s = 12.6\ \mu g/g + 12.2\ \mu g/g = 24.8\ \mu g/g$$

$$C_s' = 24.8\ \mu g/g - 3.7\ \mu g/g = 21.1\ \mu g/g$$

$$K_d = \frac{C_s'}{C_L} = \frac{21.1\ \mu g/g}{564.0\ \mu g/l} = 0.037\ l/g$$

$$= 37\ l/kg$$

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Checked by: [illegible]

22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
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D.4

APPENDIX D.4

OPERABLE UNIT 5 GEOCHEMICAL STUDY

D.4.0 OPERABLE UNIT 5 GEOCHEMICAL STUDY

The attached study was originally published as part of Appendix F.3 in the Operable Unit 5 Remedial Investigation (RI) Report. It is included here without any changes from the original. Cross-references in the study refer to sections of the Operable Unit 5 RI, rather than to this Feasibility Study.

APPENDIX F.3

ATTACHMENT I

HISTORICAL AIRBORNE RELEASE OF URANIUM
AND
GEOCHEMICAL CONCEPTS OF THE SUBSURFACE URANIUM DISTRIBUTION
AT THE FERNALD SITE

F.3.I.1.0 INTRODUCTION

Remediation of uranium-contaminated soil is considered a high priority at the Fernald Environmental Management Project (FEMP). The concepts of leaching and subsequent transport of uranium must be understood for predicting the environmental impact this soil could potentially have on the underlying groundwater quality in the Great Miami Aquifer. This report was prepared to summarize historical airborne uranium releases, type of deposition, form of uranium, and the geochemical conditions which have and will affect uranium migration through the soil column. Finally, this report relates these concepts to the leaching and distribution coefficients (K_l and K_d) used in the uranium fate and transport model for the Operable Unit 5 Remedial Investigation (RI) Report.

Historical releases of uranium are covered in Section F.3.I.2.0 to introduce the forms of uranium present in the existing source areas. In general, uranium releases from the process plants at the site have occurred in the past either as repetitive emissions or as singular, and in some instances, episodic, well-documented events. An example of a singular airborne release is the 1966 UF_6 tank leak at the pilot plant. Episodic UF_6 releases occurred at Plant 7 in the mid-1950s and repetitive airborne releases of various forms of uranium oxide have been emitted from Plants 2/3, 4, and 5. Examples of former repetitive point source releases to the soil are acid bath spills at Plants 2/3, 6, and 8.

In Section F.3.I.3.0, the mobilization of the various uranium forms in the source will be examined from a geochemical perspective. Rainwater will leach the various uranium forms and both dissolved and particulate forms will migrate downward through the soil column with infiltrating rainwater. In general, the soil column is dominated by carbonate minerals in the glacial overburden which is predominently highly fractured and weathered (brown) glacial overburden in the upper 8 to 15 feet of the column underlain by dense gray glacial overburden to a depth of 20 to 50 feet across most of the site. Fractured glacial overburden has a brown appearance due to the oxidation of iron, as this sediment and groundwater are in contact with oxygen in the atmosphere. The gray glacial overburden has not been oxidized because the absence of fractures eliminates the principal atmospheric pathway for oxygen exchange. Dissolution reactions between rainwater and carbonate minerals are the primary control on the porewater and groundwater compositions, resulting in carbonate-rich waters that is effective at complexing and transporting uranium. Adsorption of uranium by the weathered

and unweathered glacial overburden is not significantly different, as the aqueous form of uranium is homogenous throughout the glacial overburden. The surface of the water table in the glacial overburden is about 3 to 5 feet below land surface.

Below the glacial overburden is the highly permeable sand and gravel that contain the Great Miami Aquifer. Due to the high hydraulic conductivity contrast between the glacial overburden and the upper portion of the sand and gravel is unsaturated and the Great Miami Aquifer exists as a second unconfined water table as much as 45 feet below the bottom of the glacial overburden. The composition of groundwater in the Great Miami Aquifer is very similar to groundwater in the glacial overburden. Therefore, the nature and mobility of uranium species in these groundwaters is similar.

Airborne releases of uranium particles have been deposited site wide on the surface of the soil as both highly soluble uranium fluorides and less soluble uranium oxides. Over the 1951 to 1989 period of operation, the uranium fluoride forms in this air-deposited source have been leached and transported into the soil column by infiltrating rainfall. Additionally, uranium oxide particles may have been suspended and carried into the subsurface by infiltrating rainwater. The aqueous uranium derived primarily from dissolution of the uranum fluoride forms migrated into the soil first and the less soluble uranium oxide particles remained at or near the surface. As time progresses, the uranium fluoride forms are depleted from the source and uranium concentrations in the infiltrating rainfall begin to decrease, as the less soluble uranium oxide particles become the primary source for leaching. The nature and extent of these migrating fronts with respect to past, present, and future distribution of uranium is evaluated in Section F.3.I.4.0.

Section F.3.I.5.0 of this report will relate the historical releases and geochemical concepts to the leaching and distribution coefficients (K_l and K_d) used in the uranium fate and transport model for the Operable Unit 5 RI Report. Leaching coefficients are used to determine the input uranium loading as a function of time, and the large range in observed and calculated values (about 1 to 3500 L/kg) reflects the heterogeneity of uranium forms in the source. In contrast, the large range in distribution coefficients (about 1 to 2400 L/kg) reflects the kinetics of adsorption versus desorption, rather than a variety of uranium forms. Adsorption distribution coefficients are well constrained to the range of 11 to 40 L/kg, while desorption coefficients vary from 75 to 2433 L/kg. The lower adsorption values are used to model uranium migration when the source is present, and desorption coefficients are applicable once the source has been removed.

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F.3.I.2.0 AIRBORNE RELEASE HISTORY

Uranium releases at the FEMP (known until 1991 as the Feed Materials Production Center [FMPC]) are addressed in this section through discussions of the release mechanism, routine discharges from production operations, significant episodal releases from plant operations, and nonproduction source releases of primary contamination.

F.3.I.2.1 AIRBORNE RELEASE MECHANISMS

The major features of the FEMP are illustrated in Figure F.3.I.2-1. Plant process operations were limited to a fenced, 136-acre tract known as the production area. Liquid and solid wastes that were generated by the various chemical and metallurgical processes were stored or disposed of in the waste storage area located west of the production area. The cessation of production operations in 1989 essentially eliminated further primary releases to environmental media; secondary release mechanisms and resultant contaminant migration are continuing.

Several mechanisms of airborne release exist for the transport of radiological contaminants to environmental media primarily from process operations and waste management practices. Secondary releases, such as air resuspension of contaminated soil, contributed to further migration and likely transport to other media as outlined in Table F.3.I.2-1.

F.3.I.2.1.1 Primary Discharges From Production Operations

Uranium processing operations within the FEMP production cycle resulted in both routine and episodal primary releases of airborne radiological contaminants to environmental media. Airborne particles and gases were generated during most production, storage and handling operations over some 38 years of processing uranium materials. The principal sources of routine airborne emissions from process operations were dust collector discharges, wet scrubber discharges, and acid-pickling fume stacks. Episodal releases resulted from unplanned incidents arising from either human error, equipment malfunctions, procedures, or situational conditions.

F.3.I.2.1.2 Secondary Releases From Nonproduction Sources

Emissions of uranium from nonproduction sources included those from waste management storage practices, incinerator operations and building exhausts. Fugitive dust generated from the waste

storage pits can be attributed to load-in/load-out operations, wind erosion of stored materials, and vehicle movement in the storage area. Five nonproduction solid/liquid waste incinerators supported the general site operations. Exhausts from buildings located within the production area and the laboratory contributed uranium releases.

F.3.I.2.2 ROUTINE DISCHARGES FROM PRODUCTION OPERATIONS

Routine operations at the FEMP resulted in occasional discharges from the process stacks and by-products, which were handled in a variety of ways. Figure F.3.I.2-2 is a schematic flow diagram of the FEMP process and identifies the major products by each plant. Contamination of environmental media resulted from releases during process operations and from handling and disposition of the by-products that were treated as waste streams. Descriptions of process operations and waste management practices are presented from a broad perspective of how these activities contaminated the environmental media.

The total airborne emissions since operations began in 1951 amount to 179,058 kilograms of uranium (kg U), and are compiled in Table F.3.I.2-2. The total releases are determined by summing the estimated and measured uranium emissions from a number of process stacks, and vents. For the purpose of analysis, releases through 1984 were considered inasmuch as airborne emissions beyond that time were relatively insignificant. Uranium discharges from monitored stacks were the only measured emissions. Table F.3.I.2-2 summarizes the annual airborne emissions from all sources at the FEMP since operations were started in the 1950s.

F.3.I.2.2.1 Description of Plant-by-Plant Operations and History

The FEMP began operations in 1951 upon completion of the pilot plant, the site's first operational facility. This plant served as the prototype for the entire FEMP process during the design and construction of the other plants. Plant 6 began operations in 1952, followed by Plants 1, 2/3, 4, 5 and 8 in 1953. Plants 7 and 9 became operational in 1954. Production peaked in 1960 at approximately 12,000,000 kg U. A product decline began in 1964 and reached a low of 1,230,000 kg U in 1975.

The following paragraphs provide a highlight overview of the chemical and metallurgical processes used at the FEMP for the manufacture of uranium metal products (Figure F.3.I.2-3). In general, these processes occurred in seven of the FEMP's more than 50 production, storage and support

buildings. Emphasis is placed on the process chemistry, equipment and uranium species discharged as primary airborne releases during different periods of operation.

F.3.I.2.2.1.1 Plant 1 (Sampling Plant)

Operations began in 1951 for the sampling of impure uranium feed materials. The plant received large quantities of natural, enriched and depleted uranium materials which were sampled and analyzed for uranium assay and isotopic enrichment. Drummed K-65 materials were temporarily stored on the Plant 1 pad in the early 1950s. The plant had 15 dust collectors; dust particles were generally 8 to 24 microns in size and in the form of uranium ores concentrates, and oxides.

F.3.I.2.2.1.2 Plant 2/3 (Refinery)

Operations began in 1953 for the conversion of impure feed materials (received from Plant 1) to pure uranium trioxide (UO_3). This was accomplished by dissolving the feeds in nitric acid; purification by solvent extraction; and thermal decomposition of the purified uranyl nitrate (UNH) solution to produce UO_3, commonly called orange oxide.

Plant 2/3 processed three classes of materials: pitchblende ores as they were mined and shipped to the FEMP; domestic uranium concentrates that had undergone a preliminary refining process at the mill sites; and residues recovered at various stages of FEMP operations. Pitchblende ores contained elevated levels of radium and were processed from 1953 to 1955.

Beginning in 1962, Plant 2/3 was used for processing quantities of residues that were generated by the FEMP processing plants along with those received from several DOE facilities. Residing within the residues received from off site were trace quantities of fission products and transuranics. These feed streams generally contained less than 3 parts per billion (ppb) of transuranics such as plutonium (Pu)-239 and less than 10 parts per million (ppm) of fission products such as technetium (Tc)-99. Plant 2/3 contained four dust collectors and two scrubbers. Releases included small UO_3 particles which penetrated the scrubbers, uranyl nitrate hexahydrate, and radium (Ra)-226.

F.3.I.2.2.1.3 Plant 4 (Green Salt Plant)

Operations began in 1953 for the conversion of pure UO_3 (received from Plant 2/3) to pure uranium tetrafluoride (UF_4), commonly called green salt. This was accomplished by a two-step process that reduced UO_3 with hydrogen to form uranium dioxide (UO_2), which was then converted to UF_4 by

reaction with anhydrous hydrogen fluoride. Plant 4 contained 12 dust collectors. Dust particles were 2 to 22 microns in size and ranged from 50 to 81 percent uranium (UO_2, UO_3, U_3O_8, and UF_4). Discharges of UF_4 are estimated to contain 2 percent UO_2F_2, a uranium species side product from the Plant 4 process.

F.3.I.2.2.1.4 Plant 5 (Metals Production Plant)

Operations began in 1953 for the conversion of pure UF_4 (received from Plant 4) to uranium metal derbies by high-temperature reduction using magnesium metals granules. After heating for 3 to 4 hours at approximately 1200°F, the UF_4 and the magnesium would initiate an exothermic reaction. The resulting product was a 300- to 375-pound piece of pure uranium metal and a by-product, magnesium fluoride slag. The resultant piece of uranium metal had the shape of a gentleman's hat, or derby; therefore, these pieces were called derbies. Most of the derbies were recast to form ingots for further processing at the FEMP, but some were shipped directly or cast into flat billets. Graphite crucibles were machined and the magnesium fluoride slag milled for reuse in reduction pots. Plant 5 contained 17 dust collectors. Dusts in the reduction area were mostly UF_4 and U_3O_8 in magnesium fluoride slag. Remelt area dusts were mostly U_3O_8. Dust particles were 0.5 to >44 microns in size.

F.3.I.2.2.1.5 Plant 6 (Metals Fabrication Plant)

Operations began in 1952 for the fabrication of finished cores from normal uranium cylindrical ingots received from Plant 5 via rolling mill, heat treat and machining operations. Later, enriched and depleted uranium ingots were machined in Plant 9 and heat treated in Plant 6 for shipment to Reactive Metals, Inc. (RMI) Company located in Ashtabula, Ohio. At RMI, uranium ingots were extruded into tubes for return to Plant 6 at the FEMP where they were cut into sections, heat treated, machined to final dimensions, and inspected for final product quality. The completed target element cores were shipped to the Savannah River Plant. Ingots consisting of slightly enriched uranium were upset forged, machined, and shipped from RMI to the Hanford site. Scrap metal that was generated during the various metal production and fabrication steps was pickled in nitric acid to remove oxide contamination and progeny products before recycling via remelt casting operations. Chips and lathe turnings were crushed, pickled, rinsed, dried, briquetted, and recycled to remelt casting operations. Plant 6 contained three dust collectors and three electrostatic precipitators. The principal airborne emission path from Plant 6 was the acid-vapor exhaust from the stack that ventilated the pickling tank, two wash tanks, and the exhaust from the briquetting operations.

F.3.I.2.2.1.6 Plant 7 (Hex Reduction Plant)

Operations began in 1954 for the conversion of UF_6 received from the gaseous diffusion plants to produce high purity UF_4 as a supplement to the Plant 4 production. Actual production ran from 1954 to 1956; the plant contained four dust collectors.

F.3.I.2.2.1.7 Plant 8 (Scrap Recovery Plant)

Operations began in 1953. Plant 8 processed impure metals and residues including off-specification UO_3 and UF_4, magnesium fluoride slag, crucible burnout, ingot top crops, sump cakes, chips, and sawdust received from nearly all the production plants. High-grade scrap, such as machining chips and turnings, were oxidized to U_3O_8 in an oxidation furnace or burned in a box furnace. Fine material (<8 mesh) was sent to Plant 2/3; coarse material (>8 mesh) was further oxidized in a muffle furnace. The furnaces were vented to wet scrubbers before gases were discharged to the atmosphere.

F.3.I.2.2.1.8 Plant 9 (Special Products Plant)

Uranium operations began in 1957. Plant 9 originally conducted casting and cropping of ingots from Plant 5. Cropped billets from Plant 5 were drilled and machined for further processing in Plant 6. Beginning in 1961, the Zirnlo process was used to recover rejected coextrusion sections from the fuel fabrication operation at Hanford. The process used dilute hydrofluoric acid to remove zirconium followed by nitric acid for copper removal from uranium cores. The decladded cores were then recycled through Plant 5 remelt casting operations. The acid tanks had an exhaust stack with a blower. Core pickling was used from 1961 to 1963; briquetting of uranium and thorium was performed from 1953 to 1963.

F.3.I.2.2.1.9 Pilot Plant

Operations began in 1951. During the early years, the pilot plant produced limited quantities of enriched uranium metal. Box furnaces were used to process U_3O_8, enriched uranium turnings and "sawdust" generated in the production of enriched uranium cores. Crucibles were plasma coated in the pilot plant. Material up to 3.85 percent enrichment was processed to metal via the UF_6 reduction process. Most uranium operations were suspended during the thorium production that occurred between 1967 and 1975.

Conversion of UF_6 to uranium tetrafluoride (UF_4) began by heating the UF_6 in an autoclave to transform the solid into a gas. The gaseous UF_6 was then reduced with hydrogen to form UF_4. The UF_4 was feed material for Plants 5 and 9. The offgas from the production of UF_4 consisted of hydrogen, nitrogen, hydrogen fluoride, uranium tetrafluoride, a carbon trap to remove unreacted uranium hexafluoride, a two-stage refrigerated condenser system to remove anhydrous hydrogen fluoride, and a water scrubber to remove trace aqueous hydrofluoric acid before being vented to the atmosphere. Equipment in the pilot plant was used for a variety of special production operations. The dust from the collectors in the pilot plant was 9 to 44 microns in size and assayed approximately 80 percent uranium in the form of UO_3, U_3O_8, and UF_4.

F.3.I.2.2.2 Time/Form Characterization of Plant Discharges

The principal sources of airborne emissions from FEMP processing operations were:

- Dust collector stack discharges
- Wet scrubber discharges
- Acid-pickling fume stacks

Airborne releases from these sources totaled 169,147 kg U through 1984, and are characterized in the following subsections.

When combined with the release of 8891 kg U from nonproduction sources (Sections F.3.I.2.3 and F.3.I.2.4), the FEMP total comes to 178,038 kg U through 1984 (see Table F.3.I.2-2).

F.3.I.2.2.2.1 Dust Collector Stack Discharges

Dust collector stack discharges were the principal sources of airborne emissions during the span of FEMP operations from 1951 to 1984. Airborne releases of uranium from plant stacks totaled 94,590 kg U (Table F.3.I.2-2) and are characterized, as follows:

Plant	Stacks (kg U)	Percent	Principal U Species
1	985	1	U Ores, U_3O_8
2/3	3219*	3	U Ores, U_3O_8, UO_3
4	33,217	35	UO_3, U_3O_8, UF_4/UO_2F_2
5	26,189	28	U_3O_8, UF_4/UO_2F_2
6	1204	1	U_3O_8

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Plant	Stacks (kg U)	Percent	Principal U Species
7	13,272	14	UF_4
8	10,773	12	U_3O_8, UAP, UCl_4
9	2599	3	U_3O_8, UF_4/UO_2F_2
Pilot	3132	3	U_3O_8, UF_4
Total	94,590	100	

*Estimated releases due to gulping operations (38179.3 kg U) have been subtracted from the Table F.3.I.2-2 total for Plant 2/3 and will be covered in Section F.3.I.2.2.2.2.

The Plant 8 scrubbers discharged another 36,378 kg U, primarily in the form of uranyl ammonium phosphate (UAP) and urannous tetrachloride from the dissolution of U-metal in hydrochloric acid. Each plant discharged dust as uranium residues from processing operations. Plants 4, 5, and 9 discharged UO_2F_2 as a companion side-product contained in UF_4. Estimates of dust collector discharges from all FEMP processing plants categorized by U species follow:

Uranium Species	kg U	Percent of Total
Ores	3590	4
U_3O_8, UO_2	66,649	70
UO_3	149	< 1
UF_4	23,387	25
UO_2F_2	194	< 1
UCl_4	28	< 1
UAP*, ADU**	593	< 1
Total	94,590	

*Uranyl ammonium phosphate
**Diammonium diuranate

Ninety-five percent of the discharges were oxides and green salt. Stack discharges from Plants 4 and 5 comprised 63 percent of the total discharged from the FEMP processing plants. It should be noted that dust collector discharges from Plants 2/3 and 8, when combined with emissions from gulping operations and the wet scrubber discharges, together accounted for 52 percent, (88,549 kg U), as discussed in Section F.3.I.2.2.2.2. Also, Plant 7 discharged 14 percent of the FEMP total in just three years of its operation between 1954-56. Most of the FEMP releases

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occurred during the first 20 years of plant operations (Section F.3.I.2.2.2.3). A breakdown of uranium stack discharges by plant, species and time is summarized in Table F.3.I.2-3.

F.3.I.2.2.2.2 Wet Scrubber and Acid-Pickling Discharges

Wet scrubber discharges over the four decades of FEMP operations resulted from Plant 2/3 gulping operations and wet scrubbers in Plant 8. Acid-pickling operations in Plants 6 and 9 further contributed to these uranium emissions. Releases of 38,179 kg U as uranyl nitrate are estimated from the Plant 2/3 gulping operations (Table F.3.I.2-4) and 36,378 kg U from the Plant 8 wet scrubbers (Table F.3.I.2-2). Emissions from the Plant 6 and 9 acid-pickling sources are judged to be relatively insignificant. The impact of these emissions to the environmental media is in the discharge of acidic vapors that are conducive to promoting solubilization of particulate uranium species released from other sources.

F.3.I.2.2.2.3 Historical Discharges of FEMP Dust Collector and Wet Scrubbers

Historical discharges of FEMP dust collector and wet scrubbers are listed below:

	Discharges (kg U)				
Plant	1950s	1960s	1970s	1980s	Total
1	642	252	57	34	985
2/3	14,556	13,249	12,804	789	41,398
4	27,861	4350	336	670	33,217
5	22,978	2407	332	472	26,189
6	449	751	2	2	1204
7	13,272	0	0	0	13,272
8	12,251	21,675	1952	273	47,151
9	1096	1159	168	176	2599
Pilot	1934	1179	13	6	3132
Total	95,039	56,022	15,664	2422	169,147
Percent	37	33	9	1	100

The significance of the time characterization is that the substantial quantities of uranium discharged during the initial years of operation have had ample opportunity to come into solubility equilibrium with environmental media, undergo slow hydrolysis to other uranium species, or have migrated by transport to other media.

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F.3.I.2.2.3 Dose Reconstruction Project Release Estimates

In November 1993 a draft report entitled "The Fernald Dosimetry Reconstruction Project – Radionuclide Source Terms and Uncertainties" was issued for review by the Radiological Assessments Corporation (RAC) under contract to the Centers for Disease Control (CDC). The report was prepared to support an initiative being undertaken by the CDC to reconstruct the potential radiological doses received by members of the public residing around the FEMP as a result of environmental discharges during the facility's 38-year operational history.

Within the draft CDC report, RAC evaluated the projected quantities and characteristics of radiological contaminants released to the environment from facility operations. Existing FEMP historical release estimates, as presented in the U.S. Department of Energy's (DOE's) remedial investigation/feasibility study (RI/FS) documents, were based upon an evaluation of historical stack monitoring data and production records by FEMP scientific staff members. The RAC estimates employed a probabilistic approach to projecting these same historical release levels.

The probabilistic-based estimates completed by RAC included use of Monte Carlo methods to evaluate the propagation of uncertainty in the estimating process. These Monte Carlo simulations were completed for total site dust collector emissions, Plant 8 scrubber emissions, Plant 2/3 scrubber discharges, and radon released from the site. In general, the best estimate of the mass of releases from these sources, as projected by RAC, were, on average, approximately 250 percent higher than similar estimates completed by the FEMP. The primary differences reside in the estimation of releases from the Plant 8 scrubbers (385 percent higher release estimates) and the site-wide dust collection systems (265 percent higher emission estimates).

No attempt has been made to reconcile the differences between the two estimates of total mass of historical site emissions. For the purposes of this report, it is the types of uranium chemical forms (species) that are of significance to the report's findings, not the total mass of contaminants released. The differences in projected total quantities of emissions is not considered significant to the identification of geochemical parameters for fate and transport modeling, which is dependent on the species of uranium forms historically released.

F.3.I.2.3 SIGNIFICANT EPISODAL RELEASES FROM PLANT OPERATIONS

F.3.I.2.3.1 Plant 7 Releases of UF_6 in 1954-55

Eyewitness accounts have stated frequent releases of UF_6 during the start-up and early operation of Plant 7 in the 1954 period. During these incidents, building windows were closed and laboratory ventilation hoods were shutdown until the visible white plume of UF_6 dissipated from cylinders placed on-line for operations. Quantities released as UF_6 have been estimated to be 252 kg U during the operation of Plant 7.

F.3.I.2.3.2 Pilot Plant Releases of UF_6 in 1966

On February 14, 1966, an unmonitored release of 1195 kg U as UF_6 occurred during a one-hour period, beginning at 8:40 a.m. At that time winds were from the north/northwest at 5 mph. The release point was about six feet above the ground and resulted from a valve being inadvertently removed. Releases of another 264 kg U have been estimated for other intermittent periods of operation.

F.3.I.2.3.3 Plant 2/3 Releases of UNH/Nitric Acid Vapor

Quantities of uranium were emitted from the Plant 2/3 gulping system as a vapor mist of UNH solution in nitric acid. These emissions occur when UO_3 was removed by vacuum gulping from denitration pots. Estimates of 38,179 kg U discharged were based on uranium production records; measurements of U content in acid mists; and collection efficiency expected from the entire particulate control system. Releases totaling 272 kg U have been estimated based on two specifically documented incidents.

F.3.I.2.3.4 Other Nonroutine Production Discharges

Emissions of uranium from metal fires and solid spills occurring outdoors have been estimated to be 907 kg U and 1059 kg U, respectively, over the period of FEMP operations through 1984. Uranium metal fires generally occurred on the east storage pads of Plants 6 and 8, where drums of machining chips and turnings were stored for the pickling and briquetting operations. Outdoor spills amounting to 37 kg U occurred during the interplant shipment of uranium compounds, usually from a drum falling from a transport trailer.

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F.3.I.2.4 NONPRODUCTION SOURCE RELEASES OF PRIMARY CONTAMINATION

F.3.I.2.4.1 Incineration

Five non-production incinerators supported the general site operations. Discharges (Table F.3.I.2-2) from these incinerators were as follows;

- Old solid waste incinerator at the sewage treatment plant (2480 kg U)
- Oil burner (463 kg U)
- Graphite burner (125 kg U)
- New solid waste incinerator (12 kg U)
- Liquid organic waste incinerator (17 kg U)

Uranium releases from these sources are estimated to be 3087 kg U for the FEMP's operational period. The likely form of release is U_3O_8.

F.3.I.2.4.2 Storage

Up to 1984, on-property disposal of solid and slurried wastes at the FEMP occurred in pits and silos. Transport of solid wastes to the pits was dependent on the type of wastes generated and the type of storage containers. In general, drummed wastes were transported on flat-bed trailers; metal dumpsters were carried by dumpster vehicles; bulk wastes were transported by dump trucks and trailers; and drummed pyrophoric metal was conveyed on four-wheeled flat-bed trailers pulled by two tractors. At the waste storage area, dump trucks, dump trailers, dumpster units, and drummed wastes were emptied directly onto the pits' edges. The material was then pushed into the pits by either a bulldozer or a dragline scraper. Loose contamination was washed from bulldozers, the dragline scraper, vehicles, dumpsters, and fork trucks with water at the pits. Fugitive airborne uranium emissions at the waste pits have been estimated to be 1371 kg U for the FEMP operational period through 1984 (Table F.3.I.2-4).

F.3.I.2.4.3 Other Emissions

Estimates of uranium releases from building exhausts and laboratory emissions have been estimated to be 379 kg U and 68 kg U, respectively, for the FEMP operational period through 1984 (columns numbered 4 and 5, Table F.3.I.2-4). The likely form of release is U_3O_8 or intermediate uranium compounds specific to each processing plant.

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TABLE F.3.I.2-1

SUMMARY OF SITE CONTAMINATION

Potential Source	Release Mechanisms	Affected Media/Pathways
Process Operations (OU3) Dust collectors Scrubbers Fugitive emissions Wastewater discharges Storm water discharges Process material handling Underground storage tanks Process piping Sewage treatment plant	Air emissions Process emissions Building exhausts Fugitive emissions	Air Suspended particulates Radon gas
	Wastewater/storm water discharges	Soil → Direct radiation → Air resuspension → Groundwater via leaching → Storm water runoff ↓ Surface water/sediment ↓ Groundwater recharge
Waste Management OU1 OU2 OU4 Regulated units Soil/debris piles Scrap metal piles	Land disposal/storage practices	Surface water/sediment ↓ Groundwater recharge
	Spills/Leaks Process materials Wastewater	Direct radiation

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TABLE F.3.1.2-2

URANIUM EMISSIONS FROM FEMP AIRBORNE RELEASES*
Uranium Discharges (kg)

Calendar Year	Dust Collectors: Plant 1	Plant 2/3[a]	Plant 4	Plant 5	Plant 6	Plant 7	Plant 8	Plant 9	Pilot Plant	Plant 8 Wet Scrubbers[b]	Non-Production Sources[c]	Other Sources[d]	Total Emissions	Percent of Total 1951-1984
1951	--	--	--	--	--	--	--	--	123	--	--	2	125	0.1
1952	--	--	--	--	6	--	--	--	493	--	--	44	543	0.3
1953	3.8	6	1,473	90	12	--	--	--	493	--	--	105	2,182.8	1.2
1954	46.2	281	5,890	4,119	28	4,261	201	0	271	217	15	157	15,486.2	8.7
1955	46.2	1,113	12,450	10,410	53	7,268	877	0	443	948	118	167	33,893.2	19.0
1956	43.4	1,978	5,145	3,501	27	1,743	1,316	0	32	1,442	118	174	15,519.4	8.7
1957	49.4	3,730	814	3,664.4	35	--	791	0.4	18	1,575	118	230	11,025.2	6.2
1958	407.4	3,520	661	715	161	--	875	679	27	1,650	118	242	9,055.4	5.1
1959	46	3,929	1,428	478.4	127	--	260	417	34	2,100	118	240	9,177.4	5.2
1960	20	4,233	212	202.8	268	--	298	219	718	2,604	118	260	9,152.8	5.1
1961	52.8	3,707	262	76.2	119	--	209	67.4	174	2,271	118	271	7,427.4	4.2
1962	14	2,137	703	356	59	--	618	135	174	2,304	138	304	6,942	3.9
1963	82.6	0	1,469	783	181	--	994	159	51.8	2,171	145	339	6,375.4	3.6
1964	18	0	545	330.4	34	--	1,051	252	13	2,865	145	330	5,583.4	3.1
1965	4.1	192.7	334.7	226.5	42.6	--	390	68	10	5,810	146.2	269	7,493.8	4.2
1966	12.2	514	227.7	76.7	11.3	--	327	48.5	18.1+1,195[e]	926	152	222	3,730.5	2.1
1967	20.4	646.8	279.9	147.9	2.7	--	417	76.2	11.8	1,790	152	181	3,725.7	2.1
1968	0.5	1,119.5	267.2	88	30.4	--	901	121.0	3.6	3,082	152	120	5,885.2	3.3
1969	27.2	698.2	49.4	119.3	2.7	--	424	12.7	3.6	3,123	128	120	4,708.1	2.6
1970	4.5	356.7	29.9	53.1	0	--	569	13.6	0	666	105	185	1,982.8	1.1
1971	9	306	0	0	0	--	91	0	0	541	105	40	1,092	0.6
1972	28.4	1,360	9	33	0	--	5	24	0	--	105	37	1,601.4	0.9
1973	1	1,396	57	79	0	--	14	15	0	39	105	33	1,739	1.0
1974	1.4	2,445	24.4	40	0	--	11	38	0	--	105	32	2,696.8	1.5
1975	5.6	2,844.7	119.8	19	0	--	3.5	0	0.4	--	105	40	3,138	1.8
1976	2.7	3,339.2	26.1	13.7	2.4	--	7.2	2.8	0	--	105	40	3,539.1	2.0
1977	0.6	756.2	11.8	53.3	0	--	4.6	0	10.4	--	105	36	977.9	0.5

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TABLE F.3.1.2-2 (Continued)

Calendar Year	Dust Collectors: Plant 1	Plant 2/3[a]	Plant 4	Plant 5	Plant 6	Plant 7	Plant 8	Plant 9	Pilot Plant	Plant 8 Wet Scrubbers[b]	Non-Production Sources[c]	Other Sources[d]	Total Emissions	Percent of Total 1951-1984
1978	1.8	0	11.9	29.1	0	--	0	72	2.2	--	105	39	261.0	0.1
1979	0.8	0	46.3	12.3	0	--	0	2.3	0	--	93	45	199.7	0.1
1980	13.4	2.7	133.8	89.5	0	--	5.1	0	3.3	11	7.7	50	316.5	0.2
1981	1.3	30	432.1	135.6	0	--	0	0	0	10	8.2	60	677.2	0.4
1982	2.1	52.3	21	121.8	0.5	--	81.2	5.1	0	37	8.8	65	394.8	0.2
1983	6.4	130	42.9	41.4	0	--	24.7	0	0	58	7.8	65	376.2	0.2
1984	12.1	574.3	39.6	83.9	1.0	--	8.1	170.9	2,8	38	16.8	66	1,013.5	0.6
Total 1951-1984	985.3	41,398.3	33,216.5	26,189.3	1,203.6	13,272	10,773.4	2,598.9	4,326.0	36,378	3,086.5	4,610	178,037.8	100.0
% of Total	0.6	23.3	18.7	14.7	0.7	7.5	6.1	1.5	2.4	20.4	17.4	2.6	100	
1985												64	315.3	
1986												68	130.2	
1987												60	302.3	
Total 1951-1987												5,074[f]	179,057.6	

[a]Includes gulping emissions.
[b]Data are on a fiscal year basis:
- 1952-1976, July 1 - June 30
- 1976 transition
- 1977 and after, October 1 - September 30

[c]Consists of:

Old solid waste incinerator (1954 - 1979)	2474.7 kg
Old burner (1962-1979)	462.9 kg
Graphite burner (1965-1984)	124.6 kg
New solid waste incinerator (1980-1984)	<20 kg
Liquid organic waste incinerator (1983-1984)	<20 kg
	3086.5 kg

[d]Includes other process emissions, buildings exhausts, laboratory emissions, fugitive emissions from waste pits, and nonroutine events.
[e]Unmonitored UF_6 release on February 14, 1966.
[f]Includes an additional 272 kg from nonroutine events (concentrated liquid uvanyl nitrate hexahydrate releases).
*Boback, et al., 1987, "History of FMPC Radiological Discharges," FMPC-2082, prepared for DOE, Oak Ridge Operations Office, Oak Ridge, TN.
Clark, et al., 1989, "History of FMPC Radionuclide Discharges - Revised Estimates of uranium and Thorium Air Emissions from 1951-1987," Addendum to FMPC-2082, prepared for DOE, Oak Ridge Operations Office, Oak Ridge, TN.

TABLE F.3.1.2-3

ESTIMATE OF TIME/FORM URANIUM STACK DISCHARGES

Plant	Species	Uranium Discharged (kg) 1950s	1960s	1970s	1980s	Species Total	Plant Total
1	ORES	642	149	0	0	791	
	U_3O_8	0	103	57	34	194	985
2/3	ORES	1,788	414	597	0	2,799	
	U_3O_8	199	45	105	6	355	
	UO_8	0	0	62	3	65	3,219
4	UO_3	0	75	0	8	83	
	U_3O_8	21,349	3,468	29	18	24,864	
	UF_4	6,382	791	301	631	8,105	
	UO_2F_2	130	16	6	13	165	33,217
5	U_3O_8	22,185	2,230	322	436	25,173	
	UF_4	777	176	10	36	999	
	UO_2F_2	16	0	0	0	16	26,188
6	U_3O_8	449	751	2	2	1,204	1,204
7	UF_4	13,272	0	0	0	13,272	13,272
8	U_3O_8	4,089	5,239	706	119	10,153	
	UAP	222	371	0	0	593	
	UCl_4	9	19	0	0	28	10,774
9	U_3O_8	672	696	168	176	1,712	
	UF_4	416	371	0	0	874	
	UO_2F_2	8	5	0	0	13	2,599
Pilot	U_3O_8	1,912	1,064	13	5	2,994	
	UF_4	22	115	0	1	138	3,132
Total		74,537	16,187	2,378	1,488	94,590	

TABLE F.3.1.2-4

FMPC AIRBORNE EMISSIONS SUMMARY IN KILOGRAMS

Year	1 Uranium FMPC-2082 Totals	2 Uranium Gulping Emissions	3 Other Uranium Process Emissions	4 Uranium Emissions Building Exhausts	5 Uranium Estimated Laboratory Emissions	6 Uranium Fugitive Emissions Waste Pits	7 Uranium Emissions Non-Routine Events	8 Total Uranium Emissions*
1951	123.0	0	0	0	2	0	0	125
1952	499.0	0	0	0	2	0	42	543
1953	2,077.8	0	3	1	2	0	99	2,183
1954	15,119.2	210	8	5	2	0	142	15,486
1955	32,976.2	750	11	11	2	1	142	33,893
1956	13,595.4	1,750	12	16	2	2	142	15,519
1957	8,045.2	2,750	12	26	2	48	142	11,025
1958	5,513.4	3,300	14	31	2	95	100	9,055
1959	5,127.4	3,810	15	28	2	95	100	9,177
1960	4,872.8	4,020	17	33	2	108	100	9,153
1961	3,516.4	3,640	18	30	2	121	100	7,427
1962	4,568.0	2,070	19	26	2	125	132	6,952
1963	6,036.4	0	19	25	2	125	168	6,375
1964	5,253.4	0	22	20	2	129	157	5,583
1965	7,044.8	180	22	19	2	71	155	7,494
1966	3,048.5	460	12	16	2	49	143	3,731
1967	2,924.7	620	11	16	2	11	141	3,726
1968	4,655.2	1,110	7	14	2	12	85	5,885
1969	3,898.1	690	7	8	2	15	88	4,708
1970	1,487.8	310	6	6	2	16	155	1,983

TABLE F.3.I.2-4 (Continued)

Year	1 Uranium FMPC-2082 Totals	2 Uranium Gulping Emissions	3 Other Uranium Process Emissions	4 Uranium Emissions Building Exhausts	5 Uranium Estimated Laboratory Emissions	6 Uranium Fugitive Emissions Waste Pits	7 Uranium Emissions Non-Routine Events	8 Total Uranium Emissions*
1971	772.0	280	5	2	2	16	15	1,092
1972	614.4	950	4	3	2	15	13	1,601
1973	496.0	1,210	5	3	2	15	8	1,739
1974	234.8	2,430	4	6	2	14	6	2,697
1975	318.0	2,780	4	7	2	18	9	3,138
1976	169.1	3,330	5	7	2	20	6	3,539
1977	191.9	750	5	2	2	20	7	978
1978	222.0	0	4	2	2	22	9	261
1979	154.7	0	4	1	2	31	7	200
1980	266.5	0	4	2	2	34	8	317
1981	587.2	30	5	2	2	42	9	677
1982	279.8	50	6	2	2	41	14	395
1983	181.2	130	6	4	2	40	13	376
1984	377.5	570	6	5	2	40	13	1,014
Total	135,473.6	38,179	319	379	68	1,371	2,780**	
					Total Uranium			179,058 kg

NOTE: Numbers may not add due to round-off.
*The 1985, 1986 and 1987 emissions as reported in the Environmental Monitoring Annual Reports have been added into the column total.
**Includes 272 kg U from estimated emissions not distributed over production years.

F.3.I.3.0 GEOCHEMICAL PROCESSES INFLUENCING THE URANIUM DISTRIBUTION

F.3.I.3.1 RAINWATER/SOIL CHEMISTRY

Rainwater falling on soil media will react with minerals/solids and organic material to form porewater. The geochemistry of porewater is controlled by the pH of the rainwater, activity of carbon dioxide (CO_2) in the water/soil system, and the solubility of various minerals or leaching of solids in the soil. A mineralogical summary of FEMP soils is provided in Table F.3.I.3-1. At the FEMP site, the moderately low pH of the rainwater (about 5) is raised by dissolution reactions with carbonate mineral fragments (dolomite and calcite) present in the soil. Rainwater dissolution reactions are most likely to occur in the upper few feet of the glacial overburden, and these reactions affect the leaching of uranium from near-surface sources. The pH of the water/soil system will be buffered in the range of 7 to 8 by carbonate mineral (e.g., $CaCO_3$) dissolution, CO_2 dissolution, and carbonic acid (H_2CO_3) dissociation. Important reactions in this system are:

(1) $CaCO_3 + H_2O <-> Ca^{+2} + HCO_3^- + OH^-$

(2) $CO_2 + H_2O <-> H_2CO_3$

(3) $H_2CO_3 <-> H^+ + HCO_3^-$

The dissolution of $CaCO_3$ in water (Reaction 1) contacting air containing about 0.03 percent CO_2 results in an equilibrium pH of about 8. Lower pH values are generally observed in FEMP soil because the activity of CO_2 (i.e., partial pressure of CO_2) in the soil is greater than in the air, due to decomposition of organic debris and respiration of microorganisms. The higher CO_2 activity in soil drives Reaction 2 to the right to produce more H_2CO_3, which dissociates immediately (Reaction 3) to release H^+ and lower the pH. The large reservoir of carbonate minerals (30 to 50 percent of the soil) and biogenic sources of CO_2 allow the water/soil system to be buffered between 7 and 8 by the interplay of the above three reactions.

Silicate minerals present in the soil (e.g., quartz, feldspar, and clay minerals) have less influence on the chemistry of the porewater due to their low solubilities (relative to carbonate minerals) at near neutral pH values. These minerals provide silica, potassium, sodium, aluminum, and various trace metals to the porewater via dissolution and ion-exchange reactions. The weathered surface area of these minerals plays an important part in the adsorption of ions from the porewater.

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F.3.I.3.2 LEACHING OF URANIUM SOLIDS

Uranium solids present in near-surface sources will be leached by rainwater to form a portion of the dissolved constituents (i.e., solute) delivered to the porewater. Leaching refers to removing constituents from the solid by desorption, ion exchange, and dissolution reactions. In this sense, dissolution of a solid is a subset process of leaching. The degree to which individual uranium solids will dissolve is a function of bond type (e.g., ionic, covalent, etc.) in the mineral structure, which is reflected by the composition of the solid. The extent of dissolution is expressed mathematically by the solubility product. For example, consider the solubility of UO_2 and UF_4 in distilled water of pH 7 at 25°C with an oxygen partial pressure of 1×10^{-39} atmospheres (corresponding to an Eh of 0.24 volts at pH 7). The reactions are:

(4) $UO_2 + \frac{1}{2}O_2 + 2H^+ <-> UO_2^{+2} + H_2O$

(5) $UF_4 + \frac{1}{2}O_2 + H_2O <-> UO_2^{+2} + 2H^+ + 4F^-$

Using the equilibrium constants reported in the EQ3/6 thermodynamic data base (Version 7.2; Wolery 1992; Wolery and Daveler 1992) for the above reactions, UO_2 will dissolve to yield 0.3 milligrams of uranium per kilogram of water (mg U/kg water) and dissolution of UF_4 yields 28,000 mg U/kg water. Therefore, the solubility of UF_4 under these conditions (i.e., pH = 7, Eh = 0.24 volts, and UO_2^{+2} is the only uranium species formed) is almost 6 orders of magnitude greater than UO_2. It is important to highlight that the calculation above assumes UO_2^{+2} is the only uranium species formed. In natural groundwater systems, a variety of common ions (e.g., CO_3^{-2}) are available to complex UO_2^{+2}, resulting in increased dissolution of uranium solids. Most of these complexing ions are provided by dissolution reactions between rainwater and soil minerals. This important point is discussed in more detail below.

The example above illustrates that UO_2 will remain in the environment much longer than UF_4 if the particle size and emitted quantities (i.e., moles) are similar for each uranium form. As the dissolution rate of a solid is a function of the particle surface area, leaching of very fine UO_2 particles can yield uranium concentrations that are similar to those derived from leaching of coarser UF_4 particles – if the leaching time period is less than that required to establish solubility equilibrium. From the example above, note that if the water is allowed to equilibrate with the solids the uranium yield would be 6 orders of magnitude greater for the UF_4 relative to UO_2, regardless of particle size.

Another point to emphasize from the preceding discussion is that release of uranium to the glacial overburden is tied to the solubility of the uranium solid in the source. Particles of UF_4 will release more dissolved uranium to the glacial overburden than UO_2 particles during any given storm event, given that the quantity (i.e., moles) and particle size of each form are similar. Additionally, UF_4 is not expected to persist in the environment for long periods of time due to its high solubility. This implies that little, if any, of the UF_4 released from operations/accidents remains in the FEMP soil today.

The use of solubility calculations can be extended to all uranium forms believed to have been released from FEMP sources (Section F.3.I.2.0) to develop a leaching hierarchy for uranium minerals. A relative ranking of mineral solubility in rainwater was obtained by computing the saturation indicies for most FEMP uranium minerals of interest. The saturation index (SI) is equal to the log of the ion activity product (iap) minus the log of the solubility product (sp), or SI = log(iap/sp). An SI value of zero (iap = sp) indicates the mineral is saturated in the solution (i.e., the mineral is at its solubility limit). When SI values are compared among the uranium minerals, minerals with the lowest SI values are most soluble and those with the highest values are least soluble. SI calculations were carried out with the EQ3/6 geochemical computer code (Version 7.2; Wolery 1992; Wolery and Daveler 1992) and results are summarized in Table F.3.I.3-2; results are listed in qualitative categories of most leachable (i.e., most soluble), moderately leachable, and least leachable.

TABLE F.3.I.3-2

LEACHABILITY OF URANIUM SOLIDS IN RAINWATER AT 25°C

Most Leachable (SI[a])	Moderately Leachable (SI)	Least Leachable (SI)
$UO_2(NO_3)_2 \cdot 6H_2O$ (−95.6))	UF_4 (−33.2)	U_3O_8 (−8.88)
UF_6 (−89.9)	$Na_2U_2O_7$ (−20.1)	UO_2 (−8.42)
$(NH_4)_2U_2O_7$[b]		UO_3 (−7.10)
$NH_4UO_2PO_4$[b]		

[a] Saturation Index (SI) calculated with the EQ3/6 geochemical code using pH = 5, Eh = 0.4 Volts, and U = 0.001 mg/L. Lowest SI values correspond to most soluble, or leachable, uranium forms.

[b] Mineral is not in EQ3/6 thermodynamic database; therefore, SI is unavailable. Ammonium salts are generally very soluble, and this assumption is used to support the placement of these minerals in the most leachable category.

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Important dissolution reactions for uranium minerals in past and present near-surface sources (Table F.3.I.3-2) are given below:

(6) $UO_2(NO_3)_2 \cdot 6H_2O + H_2O <-> UO_2^{+2} + 2NO_3^- + 7H_2O$

(7) $UF_6 + 2H_2O <-> UO_2^{+2} + 4H^+ + 6F^-$

(8) $(NH_4)_2U_2O_7 + 3H_2O <-> 2NH_4^+ + 2UO_2^{+2} + 6OH^-$

(9) $NH_4UO_2PO_4 + 3H_2O <-> NH_4^+ + UO_2^{+2} + PO_4^{-3}$

(10) $UF_4 + ½O_2 + H_2O <-> UO_2^{+2} + 2H^+ + 4F^-$

(11) $Na_2U_2O_7 + 3H_2O <-> 2Na^+ + 2UO_2^{+2} + 6OH^-$

(12) $U_3O_8 + ½O_2 + 6H^+ <-> 3UO_2^{+2} + 3H_2O$

(13) $UO_2 + ½O_2 + 2H^+ <-> UO_2^{+2} + H_2O$

(14) $UO_3 + 2H^+ <-> UO_2^{+2} + H_2O$

As Reactions 6 through 11 involve uranium salts of moderate to high solubility (Table F.3.I.3-2), rainwater contacting these solids would result in rapid dissolution and subsequent mobilization of uranium. Because of their soluble nature, the uranium salts in Reactions 6 through 11 are not expected to be present in near-surface sources today due to the high annual rainfall (greater than 40 inches) and the cessation of production activities at the FEMP in 1989.

Under the wet and oxidizing surface soil conditions present at the FEMP, uranium will be leached from near-surface sources and released initially as the uranyl ion (UO_2^{+2}). UO_2^{+2} readily forms aqueous complexes with carbonate (CO_3^{-2}), phosphate (PO_4^{-3}), and hydroxide (OH^-) ions present in porewater and groundwater. The rainwater/soil reactions discussed above produce porewater and groundwater compositions that reflect equilibrium with carbonate minerals, resulting in waters composed primarily of the ions Ca^{+2}, HCO_3^-, Mg^{+2}, and CO_3^{-2}. The CO_3^{-2} ion has a strong affinity for UO_2^{+2} and readily forms aqueous uranium complexes as follows:

(15) $UO_2^{+2} + 2CO_3^- <-> UO_2(CO_3)_2^{-2}$

(16) $UO_2^{+2} + 3CO_3^- <-> UO_2(CO_3)_3^{-4}$

Other uranium species that are predicted (based on EQ3/6 geochemical modeling) to exist in FEMP perched groundwater at much lower concentrations are indicated below:

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(17) $2UO_2^{+2} + CO_3^{-2} + 3OH^- <-> (UO_2)CO_3(OH)_3^-$

(18) $UO_2^{+2} + 2OH^- <-> UO_2(OH)_2^\circ$

(19) $UO_2^{+2} + PO_4^{-3} <-> UO_2PO_4^-$

(20) $UO_2^{+2} + CO_3^{-2} <-> UO_2CO_3^\circ$

The formation of uranium complexes in FEMP porewater and perched groundwater enhances the dissolution of uranium minerals by decreasing the activity (i.e., concentration) of UO_2^{+2} in the water. As the UO_2^{+2} activity is lowered in Reactions 15 through 20 by the formation of the indicated complexes, the affinity to drive Reactions 6 through 14 to the right is increased, resulting in dissolution of additional uranium solids. The principle illustrated here is that formation of aqueous uranium complexes increases the uranium concentration in solution.

Another important observation is that the predicted uranium speciation in perched groundwater (Reactions 15 through 20) is dominated by negatively charged complexes, which have greater mobility in most water/soil systems. Most water/soil systems are dominated by particles that have a net negative charge on their surface, creating favorable conditions for the adsorption of positively charged ions (e.g., Cd^{+2}, Ra^{+2}, etc.). The adsorption of negatively charged species is controlled largely by the presence of iron, manganese, and aluminum oxyhydroxide coatings on weathered mineral grains.

F.3.I.3.3 ADSORPTION AND ION-EXCHANGE REACTIONS

As the speciation of uranium into carbonate complexes enhances the solubility of uranium solids, it is unlikely that precipitation of uranium solids from perched groundwater (HCO_3^- = 470 mg/L) will occur at observed uranium concentrations below about 100 mg/L (discussed below). Therefore, the most important processes affecting the migration of uranium in glacial overburden media are adsorption and ion-exchange reactions with the surfaces of soil particles. Examples of these reactions for $UO_2(CO_3)_2^{-2}$ are given below:

(21) $site^{+2} + UO_2(CO_3)_2^{-2} <-> site\text{-}UO_2(CO_3)_2$

(22) $site\text{-}CO_3 + UO_2(CO_3)_2^{-2} <-> site\text{-}UO_2(CO_3)_2 + CO_3^{-2}$

Adsorption (Reaction 21) refers to two distinct processes: physical adsorption and chemisorption (Lasaga 1981). Physical adsorption results from the intermolecular or van der Waal's forces acting between the particle surface and ion. This is the initial step in removing the ion from solution.

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Chemisorption involves the formation of chemical or ionic bonds between the surface atoms and the adsorbed species. Although physical adsorption occurs rapidly, chemisorption is slow and requires that the physically adsorbed specie "age" on the site to allow time for the bonding reaction to take place. Once chemisorption has occurred, it is very difficult to desorb the specie from the solid. Therefore, adsorption/desorption reactions become irreversible with time (i.e., only a fraction of what is initially adsorbed to the solid can be removed or extracted by desorption), which is in contrast to the fully reversible assumption invoked in fate and transport models by the use of the solid/liquid partition coefficient (i.e., K_d). The use of adsorption and desorption values in fate and transport modeling, via the K_d approach, is discussed in Section F.3.I.5.0.

Ion exchange (Reaction 22) is physical adsorption that is accompanied by desorption of a different specie. The exchangeability of an adsorbed ion depends on how it is attached to the soil particle; i.e., physical adsorption versus chemisorption. Species physically adsorbed to the soil particle surface are readily exchanged, while chemisorbed particles are more commonly exchanged only when they are on the corners or edges of particle fragments. In this paper, the term adsorption is used in a generic sense to include all processes in the continuum of physical adsorption, chemisorption, and ion exchange.

Adsorption of negatively charged uranyl carbonate species can take place on mineral surfaces that have a pH zero point of charge (pH_{zpc}) above the water/soil system pH. The pH_{zpc} is the pH at which the net charge on a mineral's surface is zero. When the pH of the water/soil system is below the mineral's pH_{zpc}, there is a net positive charge on its surface and the mineral has an affinity for negatively charged species. At the FEMP, the pH of perched groundwaters is generally near 7.5. Therefore, minerals with a pH_{zpc} above 7.5 will contain potential adsorption sites for negatively charged uranyl carbonate species. Minerals present in the glacial overburden that fit this description are summarized in Table F.3.I.3-3, along with the pH_{zpc} reported by Stumm and Morgan (1981) for oxide and hydroxide minerals and values calculated by the EQ3/6 geochemical code for calcite and dolomite.

TABLE F.3.I.3-3

GLACIAL OVERBURDEN MINERALS WITH pH_{zpc} GREATER THAN 7.5[a]

Mineral	pH_{zpc}
Calcide $CaCO_3$	8.4[b] (7.6[c])
Dolomite $MgCa(CO3)_2$	8.3[b] (7.5[c])
Aluminum oxide $\alpha-Al_2O_3$	9.1
Aluminum oxyhydroxide $\gamma-AlOOH$	8.2
Iron oxyhydroxide $\alpha-FeOOH$	7.8
Amorphous iron hydroxide $Fe(OH)_3$	8.5

[a]Oxide and hydroxide minerals compiled from Stumm and Morgan (1981).
[b]pH_{zpc} calculated with EQ3/6 geochemical code for $P_{CO2} = 10^{-3.5}$.
[c]pH_{zpc} calculated with EQ3/6 geochemical code for $P_{CO2} = 10^{-2.5}$.

The most important oxide and hydroxide surfaces are found on minerals containing aluminum and iron (Table F.3.I.3-3). Weathering of feldspar and amphibole minerals (Table F.3.I.3-1) to clay minerals can produce the oxide and hydroxide phases noted in Table F.3.I.3-3. Additionally, clay minerals (illite, corrensite, chlorite, and iron oxyhdroxide minerals in Table F.3.I.3-1) can provide the aluminum and iron oxyhydroxide surfaces to catalyze the adsorption reactions.

For the carbonate minerals present in the glacial overburden (Table F.3.I.3-1), the pH_{zpc} is dependent on the partial pressure of CO_2 (Table F.3.I.3-3). Rainwater equilibrated with air ($P_{CO2} = 10^{-3.5}$) has a lower CO_2 partial pressure than soil containing organic material and microorganisms. Measurements of the composition of gas samples from soil generally show CO_2 partial pressures from 10^{-3} to 10^{-1} (Freeze and Cherry 1979). The higher CO_2 partial pressure in soil atmosphere drives Reaction 2 to the right to produce more H_2CO_3. Dissociation of the additional H_2CO_3 leads to higher concentrations of HCO_3^- and H^+, which lowers a carbonate minerals pH_{zpc} (Stumm and Morgan 1981). In Table F.3.I.3-3, the pH_{zpc} for calcite drops from 8.4 to 7.6 as P_{CO2} is raised from $10^{-3.5}$ to $10^{-2.5}$. This implies that carbonate minerals in the fractured, weathered glacial overburden should be more efficient at adsorption of uranyl carbonate species because P_{CO2} will be kept near $10^{-3.5}$ by communication with the air reservoir. Specific adsorption values used to model uranium migration in the glacial overburden are discussed in Section F.3.I.5.0.

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F.3.I.3.4 URANIUM MINERAL SOLUBILITY IN PERCHED GROUNDWATER

The concentration of uranium in perched groundwater will be controlled by the dissolution rates of uranium solids in the soil, the adsorption of uranium onto glacial overburden solids, and/or the solubility of uranium minerals in perched groundwater. Observed uranium concentrations in perched groundwater at the FEMP range from 0.0001 to 136 mg/L (based on the statistical reduction of preliminary data). Using the average groundwater constituent concentrations and a uranium concentration of 136 mg/L, mineral SIs were calculated to evaluate the saturation state of uranium phases in perched groundwater (Table F.3.I.3-4).

Five uranium phases are predicted to be saturated (Table F.3.I.3-4) in perched groundwater when pH = 7.4, UO_2^{+2} = 154 mg/L (i.e., U = 136 mg/L), SiO_2° = 4.5 mg/L, and Eh = 200 mV. The most saturated (i.e., least soluble or leachable) phases are the uranyl silicate phases soddyite and haweeite. However, the kinetics of nucleation and precipitation of silicate minerals is considered to be on the order of 10^{+5} to 10^{+6} years at ambient temperatures (Lasaga 1981). Therefore, it is doubtful that uranyl silicate phases have precipitated from groundwater in the 43-year history of the FEMP. Table F.3.I.3-4 suggests that triuranyl diphosphate, saleeite, and calcium uranate are the phases controlling uranium concentrations in perched groundwater. Given the uncertainty in the SI calculations (about ± 0.4 SI units), schoepite is close to saturation and may also play a role in controlling uranium concentrations. As the SIs in Table F.3.I.3-4 are dependent on solution pH, Eh, and composition, large deviations from the average groundwater composition can change the order and magnitude of the listed SIs.

It is important to emphasize that mineral solubility is only one of several geochemical processes that may control uranium concentrations in perched groundwater. Table F.3.I.3-4 indicates that uranium concentrations in groundwater have to be on the order of 100 mg/L (at pH = 7.4, Eh = 0.2 V, Ca^{+2} = 304 mg/L, and PO_4^{-3} = 4.4 mg/L) before $(UO_2)_3(PO_4)_2 \cdot 4H_2O$, $Mg(UO_2)_2(PO_4)_2$, or $CaUO_4$ will precipitate. Therefore, if the soluble uranium phases in the source have been removed by leaching, future uranium concentrations in groundwater may never reach saturation with respect to $(UO_2)_3(PO_4)_2 \cdot 4H_2O$ or other uranium solids. Under this future scenario, the uranium concentration in perched groundwater will be controlled by dissolution rates in the source and adsorption reactions in the soil. This scenario is hypothesized to be the most probable case for present sources of uranium oxide particles derived from air emissions, while mineral solubility may control some uranium

concentrations observed in present groundwater contaminated by past spills of uranyl nitrate and other uranium solutions.

F.3.I.3.5 SUMMARY

Uranium will be mobilized in source areas by rainwater leaching and aqueous complexation of the uranyl ion with carbonate ion. Leaching in the source takes place by dissolution of uranium solids and desorption of uranium from soil particles. As the mobilized uranium migrates away from the source, the plume encounters lower portions of the glacial overburden where adsorption of uranium and/or precipitation of uranium may occur. Precipitation of uranium will be controlled primarily by the concentration of carbonate ion, with waters having higher aqueous carbonate concentrations suppressing uranium precipitation by formation of uranyl carbonate complexes.

Finally, it is important to highlight the contrast between the heterogeneous uranium forms in the source area and the homogeneous uranium forms in the water/glacial overburden system. The heterogeneity of uranium forms in the different source areas results in a wide range of release concentrations to porewater and groundwater (Table F.3.I.3-2 and Reactions 6 through 14). However, once the uranium has been released to the porewater and groundwater, the uranium is homogenized throughout the FEMP area as uranyl carbonate species (Reactions 15 and 16). This conceptual picture is important to recall throughout the discussion presented in Sections F.3.I.4.0 and F.3.I.5.0.

TABLE F.3.1.3-1

MINERALOGICAL SUMMARY OF FEMP GLACIAL OVERBURDEN SOIL

Phase/Ideal Formula	Modal Percent[a]
Calcite $CaCO_3$	25.75 ± 11.62
Dolomite $MgCa(CO_3)_2$	20.77 ± 10.53
Quartz SiO_2	18.03 ± 8.58
Feldspar $KAlSiO_3$	14.76 ± 6.49
Illite $KAl_5Si_7O_{20}(OH)_4$	9.15 ± 17.37
Corrensite $NaCaMg_8Fe_5Al_5Si_{14}O_{40}(OH)_{20}$	4.27 ± 8.30
Organic debris (humus)	3.49 ± 3.68
Chlorite $Mg_7Fe_4Al_2Si_7O_{20}(OH)_{16}$	1.13 ± 1.50
Amphibole $KCa_2Mg_2Fe_2Al_2Si_6O_{20}(OH)_4$	0.95 ± 0.72
Iron oxyhydroxide minerals	0.83 ± 0.72
$Fe(OH)_3$, $FeOOH$, Fe_2O_3	

[a]Average and standard deviation of 20 soil samples analyzed by McCrone Associates, Inc. (1992). Modal percent is based on the mineral area exposed on a thin section prepared for microscopic examination.

TABLE F.3.1.3-4

SATURATION INDICIES FOR URANIUM MINERALS IN PERCHED GROUNDWATER[a]

Mineral Formula (name)	SI[b]
Saturated Phases	
$(UO_2)_2SiO_4 \cdot 2H_2O$ (soddyite)	4.569
$Ca(UO_2)_2(Si_2O_5)_3 \cdot 5H_2O$ (haweeite)	3.634
$(UO_2)_3(PO_4)_2 \cdot 4H_2O$	0.642
$Mg(UO_2)_2(PO_4)_2$ (saleeite)	0.165
$CaUO_4$	0.035
Undersaturated Phases	
$UO_3 \cdot 2H_2O$ (schoepite)	-0.601
β-$UO_2(OH)_2$	-0.751
α-$UO_3 \cdot 0.9H_2O$	-0.820
$Mg(H_3O)_2(UO_2)_2(SiO_4) \cdot 4H_2O$ (sklodowskite)	-0.926
UO_2CO_3 (rutherfordine)	-1.133
U_3O_8	-1.357
U_4O_9	-1.559
$UO_2HPO_4 \cdot 4H_2O$	-2.217
β-U_3O_7	-2.612
UO_2HPO_4	-2.653
UO_2 (uraninite)	-3.059
γ-UO_3	-3.659
$USiO_4$ (coffinite)	-3.774
$Ca(UO_2)_2(SiO_3)_2(OH)$ (uranophane)	-4.209

TABLE F.3.I.3-4 (Continued)

Mineral Formula (name)	SI[b]
$UO_2FOH \cdot 2H_2O$	-4.243
β-UO_3	-4.283
α-UO_3	-4.630
$UO_2FOH \cdot H_2O$	-4.675
UPO_5	-4.965
UO_2FOH	-5.176
$CaU(PO_4)_2 \cdot 2H_2O$ (ningyoite)	-5.343
$H_2(UO_2)_2(PO_4)_2$ (H-autunite)	-5.502
$Na_2U_2O_7$	-5.786
UO_2 (amorphous)	-7.527

[a]Using preliminary average groundwater concentrations from working drafts, except SiO_2° = 4.55 mg/L. The slight differences in constituent concentrations derived from the most recent statistical reduction of data (contained in this report) will slightly change the SI numbers in this table, but the ranking of the minerals will be unchanged.
[b]Saturation Index (SI) calculated with EQ3/6 geochemical code (Version 7.2) for pH = 7.4, Eh = 0.2 volts, and UO_2^{+2} = 154 mg/L.

F.3.I.4.0 DISTRIBUTION OF URANIUM IN THE GLACIAL OVERBURDEN

F.3.I.4.1 INTRODUCTION

Past releases of uranium from the FEMP occurred in two ways: spills from the handling of uranium solutions in Plants 2/3, 6, and 8 (estimated to be 1,300 kg of uranium; RAC 1994); and air emissions from the pilot plant and Plants 1, 2/3, 4, 5, and 8 (estimated to be 179,000 kg of uranium; Table F.3.I.2-2). Accidental spills resulted in concentrated, mobile point sources in the form of uranyl nitrate, ammonium uranyl, and other uranium solutions, while air emissions led to site-wide deposition of uranium fluoride and oxide solids. The leachability, and hence mobility, of uranium solids processed at the FEMP is summarized and discussed in Table F.3.I.3-2 and Section F.3.I.3.0.

Discussed in this section is the past, present, and future uranium distribution in the glacial overburden based on the uranium solids given in Table F.3.I.3-2 and the aqueous uranium forms discussed in Section F.3.I.2.0. The temporal distribution will be discussed with respect to releases in the production area (i.e., aqueous spills and air emissions) and those areas outside of the production area, Operable Units 1, 2, and 4 (i.e., air emissions only).

F.3.I.4.2 INITIAL URANIUM DISTRIBUTION AT TIME OF RELEASE

Figure F.3.I.4-1a is a schematic cross-section of FEMP glacial overburden showing a conceptual view of the initial uranium distribution in the production area. Although the release events occurred over a 30-year period (1955 to 1985), the conceptual view in Figure F.3.I.4-1a depicts all releases as occurring simultaneously at some time in the past. In the illustrated scenario on Figure F.3.I.4-1a, aqueous acid spills released mobile forms of uranium that immediately began to percolate into and react with the glacial overburden. If uranium concentrations in the aqueous spills exceeded mineral solubilities after reactions with glacial overburden, precipitation of $(UO_2)_3(PO_4)_2 \cdot 4H_2O$, $CaUO_4$, $Mg(UO_2)_2(PO_4)_2$, $UO_3 \cdot 2H_2O$, and/or other uranium solids may have occurred (see Table F.3.I.3-4 in Section F.3.I.3.0). The initial distribution of solids released by air emissions is restricted to the top 18 inches of the soil.

Figure F.3.I.4-2a illustrates the initial conditions for uranium release in areas outside of the production area. In these areas, aqueous forms of uranium are absent during the initial deposition, as

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uranium is deposited as particles derived from air emissions. The more soluble form of these uranium particles (e.g., UF_6) is rapidly dissolved upon the first storm event.

F.3.I.4.3 URANIUM DISTRIBUTION AT THE PRESENT TIME

The present-day scenario under the production area is conceptualized in Figure F.3.I.4-1b, which shows uranium distributed throughout most of the glacial overburden. Soluble uranium forms have been removed by leaching, leaving the less soluble U_3O_8, UO_2, and UO_3. The primary uranium phases may be mixed with alteration products like $UO_3 \cdot 2H_2O$ and precipitates of $CaUO_4$ and $(UO_2)_3(PO_4)_2 \cdot 4H_2O$ throughout the upper portion of the brown glacial overburden. The uranium plume generated from the dissolution of soluble $UO_2(NO_3)_2 \cdot 6H_2O$, UF_6, UF_4, and $Na_2U_2O_7$ particles commingles with the plume derived from spills of aqueous uranium solutions. Principal aqueous species in the migrating plumes are predicted to be $UO_2(CO_3)_2^{-2}$ and $UO_2(CO_3)_3^{-4}$, with minor formation of $(UO_2)_2CO_3(OH)_3^-$, $UO_2(OH)_2^\circ$, and $UO_2PO_4^-$. Adsorption of uranium on soil particles may be accompanied by precipitation of $(UO_2)_3(PO_4)_2 \cdot 4H_2O$, $CaUO_4$, $Mg(UO_2)_2(PO_4)_2$, and/or $UO_3 \cdot 2H_2O$. Site-specific data supporting this conceptual scenario are presented after discussing the uranium distribution in areas outside of the production area.

Figure F.3.I.4-2b summarizes the present conceptual model for uranium distribution in areas impacted solely by uranium particles derived from past atmospheric releases. The uranium plume generated from the dissolution of soluble UF_6, UF_4, and $Na_2U_2O_7$ particles has reached the lower section of the glacial overburden in some areas. Principal aqueous species in the migrating plume are predicted to be $UO_2(CO_3)_2^{-2}$ and $UO_2(CO_3)_3^{-4}$, with minor formation of $(UO_2)_2CO_3(OH)_3^-$, $UO_2(OH)_2^\circ$, and $UO_2PO_4^-$. Adsorption of uranium on soil particles may be accompanied by precipitation of $(UO_2)_3(PO_4)_2 \cdot 4H_2O$, $CaUO_4$, $Mg(UO_2)_2(PO_4)_2$, and/or $UO_3 \cdot 2H_2O$, if a large mass of soluble uranium particles was present initially. Site-specific data supporting this conceptual scenario are presented below.

Across most of the FEMP site, the released uranium is concentrated in the upper 1.5 feet of the glacial overburden and may reach uranium concentrations of greater than 1000 mg/kg of soil (Plates D-10 through D-19; see Plates in DOE, 1994). The uranium forms in the upper 15 feet of weathered and fractured soil are expected to be dominated by the less soluble oxides U_3O_8, UO_2, and UO_3, possibly mixed with precipitates of $CaUO_4$ and $(UO_2)_3(PO_4)_2 \cdot 4H_2O$. $CaUO_4$ and $(UO_2)_3(PO_4)_2 \cdot 4H_2O$ are predicted to be present based on EQ3/6 modeling results using solution

analyses obtained from a 70-day leach of surface soil contaminated with uranium oxide particles (Lee et al. 1993). Much of the uranium in the upper 15 feet of the glacial overburden may have been distributed by mechanical processes after deposition. For example, air emission particles that have been reworked into the upper portion of the glacial overburden by construction activities are transported into fractures by percolating rainwater. However, neutralization of acidic uranyl nitrate spills by carbonate minerals may have produced local areas of intense uranium precipitation in the upper few feet of soil. The persistence of these areas through time is dependent on the solubility of the precipitated solid and the volume of percolating water that contacts the precipitate.

Analytical data collected on subsurface soil samples indicate that uranium is distributed throughout the glacial overburden to a depth of 20 feet in the general area surrounding the pilot plant, Plant 2/3, and Plants 6 and 9 (Plates D-10 through D-19). Uranium concentrations in the 15- to 20-foot interval of unfractured gray glacial till reach values greater than 100 mg/kg. The presence of uranium in this interval implies geochemical, rather than mechanical processes are responsible for the distribution. Aqueous spills, rainwater dissolution of $UO_2(NO_3)_2 \cdot 6H_2O$, UF_6, UF_4, and $Na_2U_2O_7$ particles, and reactions with carbonate minerals in the glacial overburden mobilize the uranium primarily as the aqueous species $UO_2(CO_3)_2^{-2}$, $UO_2(CO_3)_3^{-4}$, and to a lesser extent as $(UO_2)_2CO_3(OH)_3^-$, $UO_2(OH)_2^\circ$, and $UO_2PO_4^-$. Percolating rainwater transports the species into the subsurface were adsorption and possibly precipitation occur to redistribute the uranium in the subsurface soil. Solids predicted to precipitate in the subsurface include $(UO_2)_3(PO_4)_2 \cdot 4H_2O$, $CaUO_4$, $Mg(UO_2)_2(PO_4)_2$, and/or $UO_3 \cdot 2H_2O$.

As noted in Section F.3.I.3.0, uranium concentrations range from 0.0001 to 136 mg/L in groundwater perched within the glacial overburden. Groundwater or porewater containing high uranium concentrations will partition some of the uranium into and onto the soils by precipitation and adsorption processes. A uranium concentration of 136 mg/L is in close agreement with the predicted solubility limits for $(UO_2)_3(PO_4)_2 \cdot 4H_2O$, $Mg(UO_2)_2(PO_4)_2$, and $CaUO_4$ in perched groundwater having high bicarbonate activity (Table F.3.I.3-4), implying $(UO_2)_3(PO_4)_2 \cdot 4H_2O$, $Mg(UO_2)_2(PO_4)_2$, and/or $CaUO_4$ have precipitated in some of the perched water zones. Scanning electron microscope work conducted on FEMP soil by Oak Ridge National Laboratory (ORNL) noted the association of calcium and phosphate with uranium particles (Lee and Marsh 1992), supporting the presence of $CaUO_4$, $(UO_2)_3(PO_4)_2 \cdot 4H_2O$ or other calcium/phosphate uranium phases in the soil.

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Lysimeters placed near the base of the unweathered glacial overburden recovered fluid samples with uranium concentrations that varied from 0.002 to 0.052 mg/L. This information indicates uranium mobilized on the surface of the glacial overburden is capable of infiltrating to the base of the glacial overburden in less than 40 years. Major ions in the porewater have concentrations similar to perched groundwater, but pH, silica, and phosphate measurements are unavailable. Using major ion analyses of the porewater from Boring 11133, a uranium concentration of 0.052 mg/L, and silica and phosphate analyses from perched groundwater, mineral saturation in the pore fluid was evaluated at a pH of 7.2 (based on the pH for calcite saturation in the porewater). Results of the EQ3/6 run indicate all uranium minerals are undersaturated in the porewater. This implies that the uranium distribution in soil at the base of the unweathered glacial (i.e., in excess of background) is controlled by adsorption.

F.3.I.4.4 URANIUM DISTRIBUTION AT SOME FUTURE TIME

Most of the present source of U_3O_8, UO_2, and $UO_3 \cdot 2H_2O$, and possibly $CaUO_4$ and $(UO_2)_3(PO_4)_2 \cdot 4H_2O$, in the upper 1.5 feet of glacial overburden will be remediated through soil washing and/or removed for solidification. Therefore, the future distribution of uranium in the glacial overburden will be controlled by desorption of physically adsorbed uranium and dissolution of $(UO_2)_3(PO_4)_2 \cdot 4H_2O$, $Mg(UO_2)_2(PO_4)_2$, $CaUO_4$, $UO_3 \cdot 2H_2O$, and/or other uranium particles in the subsurface. This scenario is depicted in Figures F.3.I.4-1c and F.3.I.4-2c. Semiquantification of this future uranium distribution is addressed in the remaining discussion of this section.

Based on a hypothetical Operable Unit 5 FS clean-up level of 150 mg U/kg soil, future uranium concentrations in subsurface soil will be less than or equal to 150 mg/kg. If the uranium is assumed to be physically adsorbed, then bounds can be placed on the future concentration of uranium in glacial overburden porewater and groundwater by using the calculated adsorption/desorption values for the 15- to 20-foot depth of glacial overburden (Wells 1348, 1354, 1360, 1266, 1317, 1341, 1225, 1230, and 1250 in Table F.3.II.3-3 of Attachment F.3.II). The lowest and highest adsorption/desorption values for the indicated well locations are 12 and 2433 L/kg, yielding respective uranium concentrations of 12.5 and 0.064 mg/L in groundwater equilibrated with a soil containing 150 mg U/kg soil (i.e., 150 mg/kg ÷ 12 L/kg and 150 mg/kg ÷ 2344 L/kg).

As noted in Section F.3.I.3.0, desorption of adsorbed uranium will depend on the extent of chemisorption, with the expectation that with time desorption values will be higher than adsorption

values as uranium is retained or incorporated into the solid by chemisorption (which is evident in the 75 to 2433 L/kg range of values reported in Table F.3.II.3-3. Therefore, a uranium concentration of 12.5 mg/L can be considered the maximum future groundwater concentration (i.e., a conservative estimate) derived from a kilogram of soil containing 150 mg of adsorbed uranium.

For particulate uranium that remains in FEMP soil after remediation efforts are completed, useful information can be extracted from the ORNL leaching study (Lee et al. 1993) to estimate the fraction of uranium leached and released during a three day storm event. A conclusion from the leaching of A-14 and B-16 soil is that 0.1 to 4.5 percent, respectively, of the available uranium may be leached from this soil in three days of leaching (i.e., a large storm event). If FEMP soil of density 1.8 kg/L contains 150 mg of particulate uranium per kg of soil (Operable Unit 5 hypothetical clean-up level) and the porosity is 30 percent, 1 liter of water will contact 3.3 liters of soil – or 891 mg of uranium (i.e., 1.8 kg/L * 3.3 L * 150 mg U/kg). Using the 0.1 and 4.5 percent extractable uranium values from the ORNL study, the calculated uranium solution concentration after three days of leaching is 0.89 and 40 mg/L, respectively. Assuming the uranium forms are similar to the particles present in the ORNL study, these calculated solution concentrations indicate that uranium pore water concentrations derived from the leaching of uranium particulates (as indicated by lysimeter data) can exceed the solubility limit of $(UO_2)_3(PO_4)_2 \cdot 4H_2O$, $Mg(UO_2)_2(PO_4)_2$, and/or $CaUO_4$ if bicarbonate concentrations in the porewater remain below 300 mg/L. The effect of bicarbonate concentrations on uranium solubility is addressed in the summary presented below.

F.3.I.4.5 SUMMARY OF URANIUM DISTRIBUTION

Dissolution of uranium particles (derived from past releases) and precipitates (derived from leaching of uranium source materials) will occur as undersaturated water percolates through the glacial overburden. The rate of dissolution will be highly variable and depend on the surface area and composition of the solid, the pH and composition of the water, and the resident time of the water (i.e., the infiltration rate). As water percolates from the surface to greater depths, total dissolved solids increase and the concentration of individual ions can have a significant effect on uranium concentrations (e.g., HCO_3^-). For example, distilled water contacted with FEMP soil in the ORNL study simulate the conditions in the surface and near surface soil, perched groundwater analyses represent complete equilibration of the water/soil system, and lysimeter data have solute concentrations between these two end members that serve as an analog of percolating porewater. A significant factor influencing the uranium concentration in the water/soil system is the increase in

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HCO_3^- concentration as water moves from the near surface (121 mg/L, ORNL study), to subsurface (310 mg/L, lysimeter data), to the perched groundwater (470 mg/L). The geochemical conditions in each of these three zones is discussed with respect to the future distribution of uranium in the glacial overburden.

The ORNL study provides analytical data that can be used to estimate the uranium concentrations that may be attainable if rainwater interacts with surface and near-surface soil containing $(UO_2)_3(PO_4)_2 \cdot 4H_2O$ or $CaUO_4$. Based on the ORNL analytical results after 70 days of leaching, EQ3/6 solubility calculations indicate both solutions are supersaturated with the uranium silicate phases haweeite and soddyite and saturated with quartz, while one solution is saturated with calcite, dolomite, and $CaUO_4$ (pH = 7.7, Ca^{+2} = 40.7 mg/L, UO_2^{+2} = 9.5 mg/L, HCO_3^- = 121 mg/L, PO_4^{-2} = 0.12 mg/L) and the other solution is saturated with $(UO_2)_3(PO_4)_2 \cdot 4H_2O$ (pH = 7.1, Ca^{+2} = 31.8 mg/L, UO_2^{+2} = 0.84 mg/L, HCO_3^- = 90 mg/L, PO_4^{-3} = 4.2 mg/L). The predicted supersaturated state for haweeite and soddyite is in agreement with current understanding on the long time periods required to nucleate and precipitate silicate minerals, as discussed in Section F.3.I.3.0. Saturation of $CaUO_4$ in the B-16 solution indicates that uranium concentrations may reach about 9 mg/L when $CaUO_4$ is present in the glacial overburden and the PO_4^{-3} concentration is kept below 1 mg/L. In contrast, $(UO_2)_3(PO_4)_2 \cdot 4H_2O$ will be stabilized if the PO_4^{-3} concentration increases to about 4 mg/L, resulting in a lower uranium concentration of about 1 mg/L. Therefore, the presence of PO_4^{-3} in moderate concentration will stabilize the more insoluble phase and prolong the time needed to flush uranium from the soil.

As water percolates into the subsurface, HCO_3^- concentrations increase as the CO_2 partial pressure in the soil atmosphere rises (Reactions 2 and 3). As the HCO_3^- concentration increases, the CO_3^{-2} concentration also increases and additional uranium can be complexed by Reactions 15 and 16. Therefore, the solubility of uranium solids is enhanced by the formation of uranyl carbonate species and waters containing higher HCO_3^- concentrations that have the ability to dissolve and flush more uranium out of the soil. Solubility calculations performed with the lysimeter data indicate that uranium concentrations in the water/soil system rise to 42, 17, and 12 mg/L when the lysimeter porewater is saturated with $CaUO_4$, $Mg(UO_2)_2(PO_4)_2$, and $(UO_2)_3(PO_4)_2 \cdot 4H_2O$, respectively. A possible drawback of porewater being saturated with one of the indicated uranium phases is that higher uranium concentrations in the water may result in less desorption of uranium. Therefore, if

uranium precipitates persist in the subsurface soil, their dissolution will increase the time needed to desorb uranium from underlying soil.

Groundwater present in perched bodies within the glacial overburden has the highest observed concentrations of HCO_3^- in the water/glacial overburden system, and therefore the highest observed uranium concentrations. As noted in previous discussions, the uranium concentration in perched groundwater will be close to 100 mg/L when the water is near saturation with $CaUO_4$, $Mg(UO_2)_2(PO_4)_2$, or $(UO_2)_3(PO_4)_2 \cdot 4H_2O$. In line with the same arguments presented for the lysimeter data, the increased HCO_3^- concentrations allow a greater portion of the precipitated uranium to be solubilized and carried out of the system. However, the presence of these precipitates in the perched groundwater system will result in less desorption of uranium along the flow path, with the possibility of additional uranium being partitioned onto the soil.

In summary, the future distribution of uranium forms will be similar to the present day distribution with the exception of the removed uranium oxide particles from the surface source. Remediation activities will result in uranium concentrations in the glacial that are less than or equal to 150 mg/kg. Uranium concentrations in groundwater will be lowered as a result of soil remediation and source removal, and will continually decrease with time as fresh water percolates through the soil and removes uranium by dissolution and desorption. Dissolution of uranium solids will be enhanced as the fresh water increases its HCO_3^- concentration, but the extent of desorption will be suppressed if the dissolution of uranium solids takes place in advance of encountered adsorbed uranium.

F.3.I.5.0 GEOCHEMICAL PARAMETERS FOR FATE AND TRANSPORT MODELING

F.3.I.5.1 DEFINITION OF GEOCHEMICAL PARAMETERS

Available site-specific data on uranium concentrations in soil and aqueous media are used to define the following geochemical parameters used in the Operable Unit 5 fate and transport model.

- K_l – FEMP term defined as the leaching coefficient in units of L/kg. This coefficient is determined using a batch test that contacts waste or contaminated soil with a distilled water solution adjusted to a pH of 5.6 with sulfuric acid. The batch test is run for 15 to 20 days by tumbling the solid and solution in a reaction vessel, and the final solution is analyzed for uranium. A leaching coefficient is calculated by dividing the uranium concentration on the solid (only uranium in excess of background) by the uranium concentration in solution (i.e., mg/kg ÷ mg/L = L/kg).

- K_l^{calc} – FEMP term defined as the calculated leaching coefficient in units of L/kg. This coefficient represents the in situ leaching coefficient as determined by dividing the uranium concentration for the contaminated soil (only uranium in excess of background) by the uranium concentration in perched groundwater contacting the soil (i.e., mg/kg ÷ mg/L = L/kg). The calculated leaching coefficient applies to soils in the upper 15 feet of glacial overburden, where weathering and fractures allow particulate uranium to be transported to depth.

- K_d – the adsorption/desorption value or partition coefficient in units of L/kg. The partition coefficient is determined by batch tests that contact soil with spiked uranium solutions (adsorption) and distilled water (desorption). A partition coefficient is calculated by dividing the uranium concentration on the solid (only uranium in excess of background) by the uranium concentration in solution (i.e., mg/kg ÷ mg/L = L/kg). In general, only an adsorption or desorption value is determined from the batch test and the assumption is made that the reaction is reversible (i.e., adsorption = desorption = K_d). These tests are conducted with uncontaminated soil (adsorption) or contaminated soil that are known to contain only adsorbed uranium (desorption).

- K_d^{calc} – the calculated adsorption/desorption value or calculated partition coefficient in units of L/kg. The calculated partition coefficient represents the in situ partition coefficient as determined by dividing the adsorbed uranium concentration for the contaminated soil (only uranium in excess of background) by the uranium concentration in perched groundwater contacting the soil (i.e., mg/kg ÷ mg/L = L/kg). The calculated partition coefficient applies to soil in unweathered gray till at depths of 15 to 20 feet below the surface, where weathering and fractures are absent and uranium is transported only as a dissolved specie.

- K_e – the extractable uranium present in contaminated soil in units of percent total uranium. This parameter represents the extractable portion of uranium that can be removed from contaminated soil by washing techniques proposed for the Operable Unit 5

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FS. Preliminary batch tests indicate 30 to 90 percent of the total uranium present can be extracted using soil washing reagents.

The distinction between the parameters K_l and K_d is based on the type of uranium solid that is present in the soil. For K_l, uranium may be present as particulate and adsorbed uranium, and the leaching coefficient measures uranium mobilization due to dissolution and desorption. The K_d is a measurement of adsorption/desorption equilibrium between soil and water, and solid uranium in excess of background is present only as adsorbed uranium.

In the Operable Unit 5 fate and transport model describing uranium migration in the glacial overburden, K_l or K_l^{calc} is used to define the initial aqueous loading of uranium based on the extractable portion of uranium (i.e., K_e) in the soil. For example, a kilogram of soil contains 150 mg of uranium of which 50 percent can be extracted by soil washing techniques, and K_l is determined to be 20 L/kg. Using these values, the first pore volume of rain water to move through this soil is estimated to have a uranium concentration of 3.75 mg/L (i.e., (150 mg/kg * 0.5) ÷ 20 L/kg). Each successive pore volume of water will have a lower uranium concentration as the extractable percent of uranium becomes depleted. A calculated depletion curve is used to determine the uranium loading as a function of time. Once uranium is loaded into the aqueous medium and transport begins through the glacial overburden, K_d or K_d^{calc} is used to calculate the uranium retardation factor for the glacial overburden. Further details on the use of these parameters are developed below.

F.3.I.5.2 SITE-SPECIFIC GEOCHEMICAL PARAMETERS

Available information that can be used to assign geochemical parameters for fate and transport modeling include site-specific batch tests with waste materials and contaminated and uncontaminated soil, existing uranium analytical data on glacial overburden and perched groundwater, and pertinent literature studies conducted with similar soil. The current range of site-specific geochemical parameters is given in Table F.3.I.5-1.

For contaminated soil defined as waste materials (Table F.3.I.5-1), the K_l values range from 12 to 1708 L/kg and K_l^{calc} from 0.6 to 3558 L/kg. This wide range in leaching coefficients reflects both the variation in solubility of the uranium solids present in the soil (see Table F.3.I.3-2) and the amount of time adsorbed uranium has been present on the soil particles. Soil (containing soluble uranium forms (e.g., UF_6) and physically adsorbed uranium (as opposed to chemisorbed uranium) readily release the uranium to solution, resulting in low leaching coefficients. Conversely, less soluble uranium particles

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(e.g., UO_2) and chemisorbed uranium are slowly released to solution, resulting in high leaching coefficients.

For the Operable Unit 5 fate and transport model, the leaching coefficients that reflect the present release of uranium from contaminated soil range from 12 to 311 L/kg (Table F.3.I.5-1). This range is in good agreement with the mean values reported for K_l^{calc} in the production area, with 14 L/kg representing the soluble uranium forms and 301 L/kg the less soluble uranium solids. Therefore, uranium loadings in the fate and transport model will be derived using leaching coefficients near 12 L/kg when aqueous spills and/or soluble uranium forms are known or suspected to be present (i.e., in the Plant 2/3, Plant 6, and Plant 9 areas) and by using values near 311 L/kg when less soluble forms of uranium are present. This latter condition presently holds for most of the site soil where residual uranium oxide particles are the dominant source of uranium.

After uranium is leached from the source it is free to migrate through the glacial overburden; the fate and transport model uses K_d or K_d^{calc} to describe the retardation of uranium by the glacial overburden. Glacial overburden K_d values derived from adsorption batch tests range from 11 to 40 L/kg, with a combined mean of 25 L/kg for the four reported values (Table F.3.I.5-1). The K_d^{calc} values are grossly different for production area soil associated with aqueous spills (12 to 32 L/kg) as compared to the soil known to be contaminated solely by release of uranium from surface particles (75 to 2433 L/kg). Discreet ranges of K_d^{calc} for these two areas are interpreted to reflect the difference in surface reaction kinetics associated with adsorption and desorption, as discussed in Section F.3.I.3.0 and conceptualized below.

Leaching of uranium results in a migrating plume away from the source. The front of this plume reaches an underlying soil horizon and the uranium concentration in the plume continues to increase at this horizon as the plume passes through. As long as the surface source is present, the uranium concentration in the plume will increase toward its maximum concentration and adsorption of uranium will be the dominant process at this soil horizon if the maximum concentration (i.e., the peak) of uranium remains below the solubility limit of uranium solids. To illustrate, assume partition-coefficient equilibrium (a tenet of the fate and transport model) between the aqueous and solid phases is given by:

$$\text{adsorbed uranium (mg/kg)} \div \text{aqueous uranium (mg/L)} = 24 \text{ L/kg}$$

where 24 L/kg is the average K_d value for the Operable Unit 2 and Brookhaven National Laboratory (BNL) adsorption studies (Table F.3.I.5-1). As the aqueous uranium concentration increases, uranium must be adsorbed onto the solid to satisfy the partition-coefficient equilibrium. Therefore, desorption is not favored as long as the aqueous uranium concentration is increasing toward the peak concentration.

Removal of the uranium source will result in dilution of the uranium plume by fresh infiltrating rainwater, which will lower aqueous uranium concentrations and initiate desorption to satisfy the partition-coefficient equilibrium. However, as noted in Section F.3.I.3.0, desorption values are greater than adsorption values when enough time is available (i.e., months to years) for chemisorption to occur because chemisorption imparts a hysteresis to the adsorption/desorption process that prevents desorption of the entire mass of adsorbed uranium. Using the partition-coefficient expression above and the principle of chemisorption, adsorbed uranium will not completely desorb in response to a decreasing aqueous uranium concentration and the partition coefficient must increase to account for the hysteresis phenomenon. Therefore, if the migrating plume takes years to pass a given horizon of the soil (a common observation), ample time has passed for chemisorption to occur and calculated desorption values will exceed adsorption values.

These adsorption and desorption concepts can be applied to glacial overburden in the production area. Glacial overburden soil contaminated by aqueous spills is experiencing active adsorption (12 to 32 L/kg, Table F.3.I.5-1), due to the presence of a soluble uranium source that is leaching to produce increasing uranium concentrations in the plume. Soil contaminated by the release of uranium from air emissions are experiencing desorption (75 to 2,433 L/kg, Table F.3.I.5-1), because past releases of soluble particles (e.g., UF_6) have been dissolved by rainwater and the peak concentration from the dissolution of these particles has passed through the overburden. The less soluble uranium oxides remaining on the surface do not leach as readily as uranium fluoride particles, resulting in a decrease in the aqueous uranium concentration in the plume and initiation of the desorption process.

Historical information on uranium releases (Section F.3.I.2.0) supports the conceptual model of adsorption in areas of aqueous spills/leaks versus desorption in areas that received only uranium particles from air emissions. Aqueous spills and leaks occurred on a continuous basis from production activities associated with Plants 2/3, 6, and 9, and these activities have placed a large source of soluble uranium in local areas of the glacial overburden. Air emissions of uranium fluoride

and oxide particles cover the entire production area, with uranium oxides comprising about 75 percent of the released mass (Section F.3.I.2.0). As rainwater rapidly dissolved the soluble uranium fluoride particles, the resulting plume reached its maximum uranium concentration quickly and this peak has passed through the glacial overburden in most areas (i.e., desorption is now occurring in these areas). Around Plants 2/3, 6, and 9, the large source of soluble uranium has not been depleted, and the uranium concentration in the migrating plume continues to increase (i.e., adsorption is occurring in these areas). Therefore, adsorption values best describe uranium retardation in areas having soluble uranium sources.

Independent evidence for active adsorption in the Plant 2/3, Plant 6, and Plant 9 areas can be found in the adsorption values obtained from the Operable Unit 2 and BNL studies (Table F.3.I.5-1). The average K_d value derived from these adsorption studies is identical to the K_d^{calc} average reported for production area soil contaminated by aqueous spills (i.e., 24 L/kg). Given the Operable Unit 2 and BNL batch-test results and in situ measurements from the production area, a K_d value of 24 L/kg is recommended for the fate and transport model to describe the adsorption of uranium onto glacial overburden, if the migrating plume hasn't reached its peak concentration. When soluble forms of uranium have been depleted from the source and the plume peak has passed through the glacial overburden, larger K_d values are warranted to describe the desorption. The best estimate of K_d for the fate and transport model when desorption is occurring is the K_d^{calc} geometric mean of 270 L/kg (Table F.3.I.5-1). A sensitivity analysis conducted with the fate and transport model has bounded the uranium migration using values of 15 and 222 L/kg. The slight difference in these and the recommended values will produce no significant change in the existing sensitivity analysis.

Numerous uranium adsorption values have been reported in the literature, and a summary by Sheppard et al. (1984) lists several studies conducted under a variety of conditions that cover a range of uranium adsorption values from 0.13 to 790,000 L/kg. The studies summarized in Sheppard et al. (1984) that are most pertinent to the FEMP glacial overburden and Great Miami Aquifer are those of Rancon (1973) and Yamamoto et al. (1973).

Rancon (1973) studied the adsorption of uranium on carbonate soil and reported uranium adsorption values of 16 and 33 L/kg, respectively. These values are in good agreement with the Operable Unit 2 and BNL adsorption studies (Table F.3.I.5-1), and indicate that the adsorption behavior of uranium in carbonate soils is remarkably consistent.

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Yamamoto et al. (1973) investigated uranium adsorption onto sandy soil from carbonate solutions and reported uranium adsorption values of 0.13 to 0.25 L/kg. These low values reflect the coarse particle size (i.e., reduced surface area) and composition (i.e., lack of carbonate minerals, aluminum and iron oxyhydroxide surfaces, and clay minerals) of the sandy soil and the complexation of uranium by carbonate ion (Reactions 15 and 16 in Section F.3.I.3.0). Results from this study are close to the lowest value reported for the saturated sand and gravel aquifer in the south plume area (Table F.3.I.5-1), and may be appropriate for examining adsorption in the Great Miami Aquifer.

F.3.I.5.3 SUMMARY

Experimental data derived from batch tests, site-specific uranium concentrations in soil and groundwater, and literature studies are used to define and justify the assignment of geochemical parameters to the ODAST fate and transport model of the glacial overburden. Leaching of uranium from near-surface Operable Unit 5 soil sources has been investigated with batch tests and analytical measurements on site-specific soil and groundwater samples to define the 12 to 311 L/kg range for K_l and K_l^{calc} values. The K_l and K_l^{calc} values are used to develop uranium loading curves as a function of time, and these curves are used as input data to the fate and transport model. The large range in K_l and K_l^{calc} values reflects the heterogeneity of uranium forms in the contaminated soil.

Adsorption batch tests, uranium analyses of site-specific soil and groundwater samples, and literature studies indicate that the adsorption of uranium onto glacial overburden soil is best defined using a K_d value of 24 L/kg. The uniform range of adsorption values for several independent studies reflects the homogeneous distribution of uranyl carbonate species in the groundwater/glacial overburden environment. Desorption of uranium will occur when the plume peak has passed through the overburden or when the uranium source is removed from the glacial overburden, and a K_d value as high as 270 L/kg may be used to model the desorption of uranium. A large range in the observed desorption values (75 to 2433 L/kg) reflects chemisorption of uranium by the soil particle surface; with chemisorption favored by increasing residence time. Modeling a desorption scenario will apply to source areas depleted of their soluble uranium or areas where the source is excavated and removed.

TABLE F.3.I.5-1

RANGE OF SITE-SPECIFIC GEOCHEMICAL PARAMETERS

Media	Parameter (L/kg)	Range
Waste Materials		
Plant 2/3, Plant 6, and Plant 9 contaminated soils	K_t^{calc}	0.6 - 8.35[a] (14[b])
Remaining production area contaminated soil	K_t^{calc}	75 - 3,558[a] (301[b])
OU2 waste	K_t	37 - 177[c]
OU2 contaminated soil	K_t	200 - 280[c]
OU4 contaminated soil	K_t	12 - 15[c]
OU5 contaminated soil	K_t	12 - 311[d]
Contaminated soil studies by Oak Ridge National Laboratory	K_t	64 - 1708[e]
Glacial Overbandon		
OU2 soils	Adsorption K_d	11 - 40[c]
BNL study	Adsorption K_d	23 - 25[f]
Production area subsurface soils contaminated by aqueous spills	Adsorption K_d^{calc}	12 - 32[g] (24[h])
Production area subsurface soils contaminated by air emissions	Desorption K_d^{calc}	75 - 2,433[g] (270[h])
Unsaturated Sand and Gravel		
OU2 South Field Area	K_d	10 - 12[c]
Saturated Sand and Gravel		
OU1 waste pit area	K_d^{calc}	2 - 68[i] (14[b])
OU2 South Field area	K_d	6 - 9[c]
South Plume area	K_d^{calc}	0.8 - 4.4[i] (2.7[h])
Calibration of SWIFT model	K_d^{calc}	1.8

[a]Production area soil contaminated by uranium releases, as indicated in Table F.3.II.3-3.
[b]Geometric mean for indicated range.
[c]DOE (1993c). K_t determined from 17-day batch test with deionized water at initial pH of 5.6. Adsorption K_d determined from 17-day batch test with spiked solution.
[d]Unpublished preliminary results from OU5 soil washing studies. K_t determined from 17-day batch test with deionized water at initial pH of 5.6.
[e]Lee et al. (1993). K_t determined from 21-day batch test with deionized water.
[f]IT (1993). K_d determined from 60-day batch test spiked with perched groundwater.
[g]Production area subsurface soil between 15 and 20 feet below the surface contaminated by uranium releases, as indicated by Wells 1348, 1354, 1360, 1266, 1317, 1341, 1225, 1230, and 1250 in Table F.3.II.
[h]Arithmetic mean for indicated range.
[i]DOE (1993d). Appendix A, Issue 3 and 5 Report.

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TABLE F.3.I.5-1

RANGE OF SITE-SPECIFIC GEOCHEMICAL PARAMETERS

Media	Parameter (L/kg)	Range
Waste Materials		
Plant 2/3, Plant 6, and Plant 9 contaminated soil	K_l^{calc}	0.6 - 8.35[a] (14[b])
Remaining production area contaminated soil	K_l^{calc}	75 - 3,558[a] (301[b])
OU2 waste	K_l	37 - 177[c]
OU2 contaminated soil	K_l	200 - 280[c]
OU4 contaminated soil	K_l	12 - 15[c]
OU5 contaminated soil	K_l	12 - 311[d]
Contaminated soil studied by Oak Ridge National Laboratory	K_l	64 - 1708[e]
Glacial Overburden		
OU2 soil	Adsorption K_d	11 - 40[c]
BNL study	Adsorption K_d	23 - 25[f]
Production area subsurface soil contaminated by aqueous spills	Adsorption K_d^{calc}	12 - 32[g] (24[h])
Production area subsurface soil contaminated by air emissions	Desorption K_d^{calc}	75 - 2,433[g] (270[h])
Unsaturated Sand and Gravel		
OU2 South Field	K_d	10 - 12[c]
Saturated Sand and Gravel		
OU1 waste pit area	K_d^{calc}	2 - 68[i] (14[b])
OU2 South Field	K_d	6 - 9[c]
South Plume area	K_d^{calc}	0.8 - 4.4[i] (2.7[h])
Calibration of SWIFT model	K_d^{calc}	1.8

[a]Production area soil contaminated by uranium releases, as indicated in Table F.3.II.3-3.
[b]Geometric mean for indicated range.
[c]DOE (1993c). K_l determined from 17-day batch test with deionized water at initial pH of 5.6. Adsorption K_d determined from 17-day batch test with spiked solution.
[d]Unpublished preliminary results from OU5 soil washing studies. K_l determined from 17-day batch test with deionized water at initial pH of 5.6.
[e]Lee et al. (1993). K_l determined from 21-day batch test with deionized water.
[f]IT (1993). K_d determined from 60-day batch test with spiked perched groundwater.
[g]Production area subsurface soil between 15 and 20 feet below the surface contaminated by uranium releases, as indicated by Wells 1348, 1354, 1360, 1266, 1317, 1341, 1225, 1230, and 1250 in Table F.3.II.
[h]Arithmetic mean for indicated range.
[i]DOE (1993d). Appendix A, Issue 3 and 5 Report.

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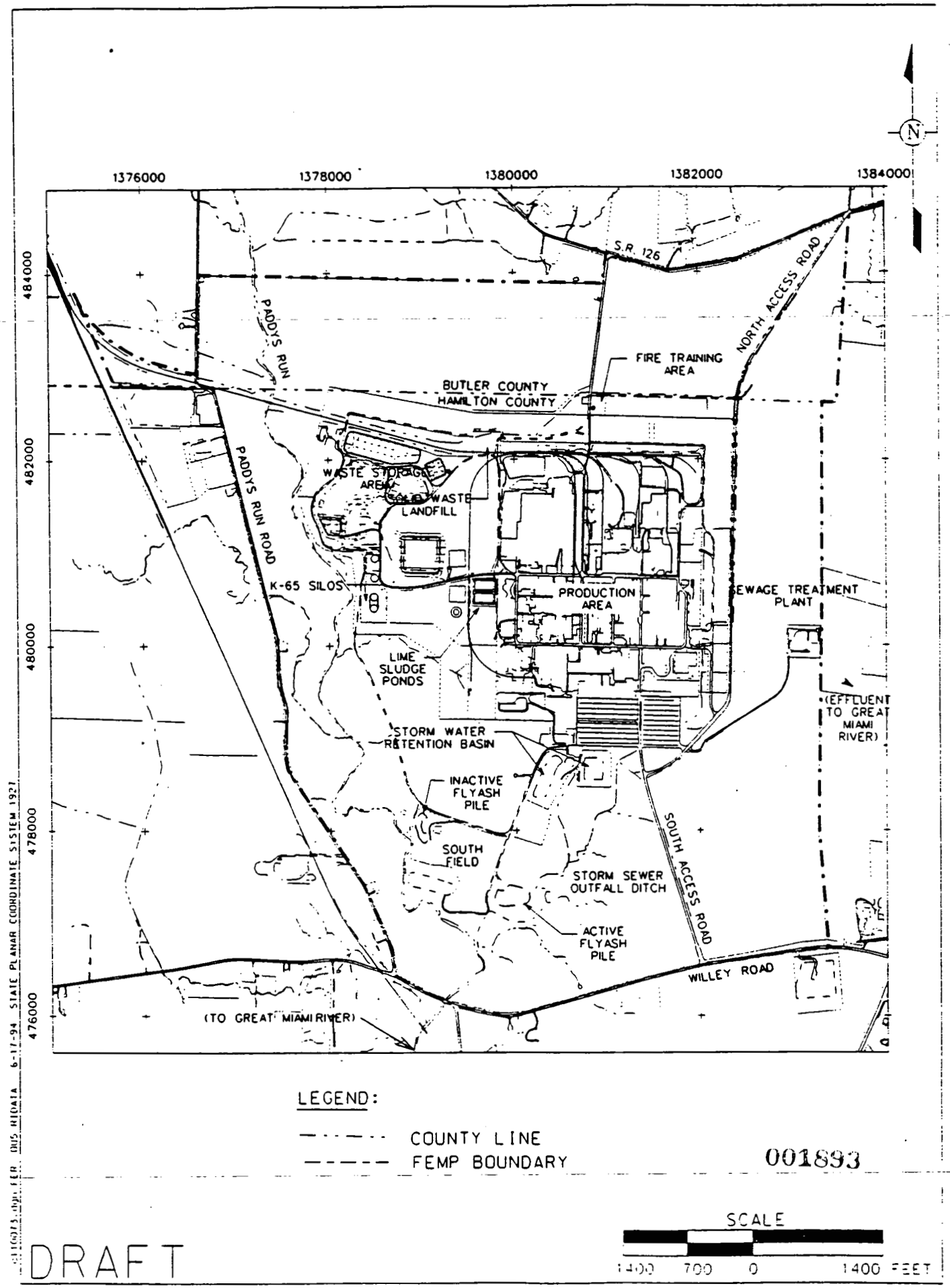

FIGURE F.3.1.2-1. MAJOR FEATURES OF THE FEMP

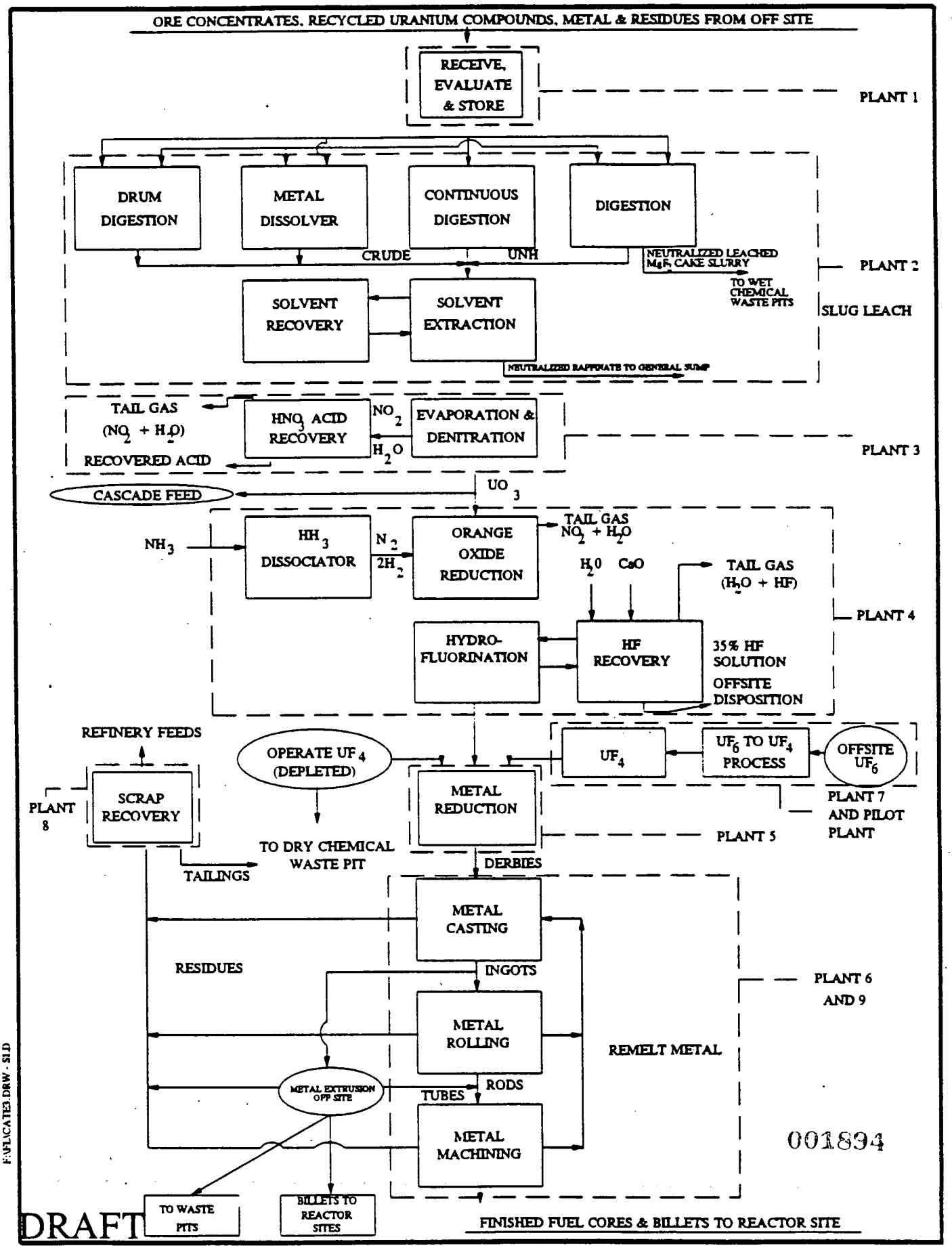

FIGURE F.3.1.2-2. SCHEMATIC DIAGRAM OF THE FEMP PROCESS

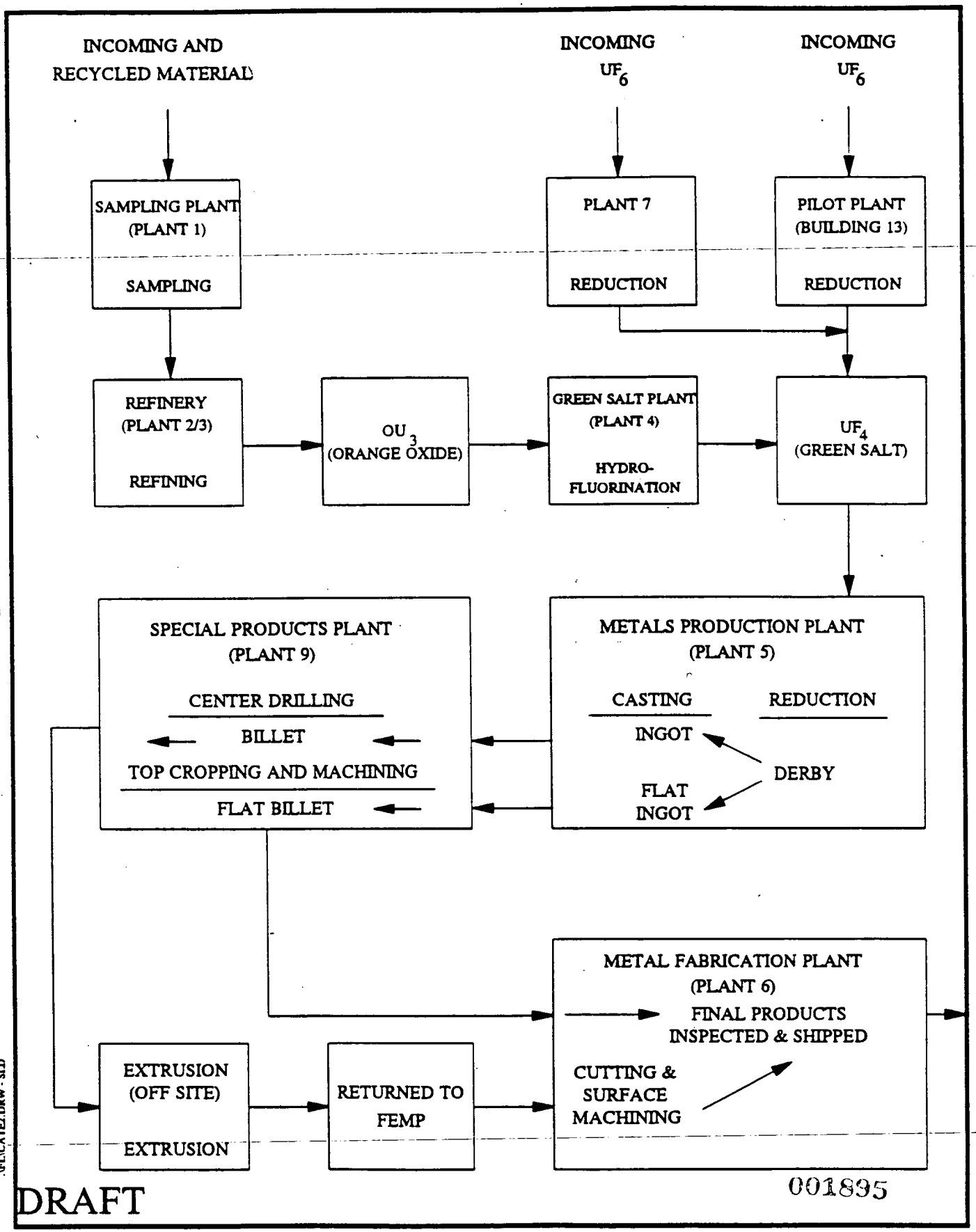

FIGURE F.3.I.2-3. URANIUM METAL PROCESS DIAGRAM

C:\AHSIZE.DWG 6/17/94 MRM

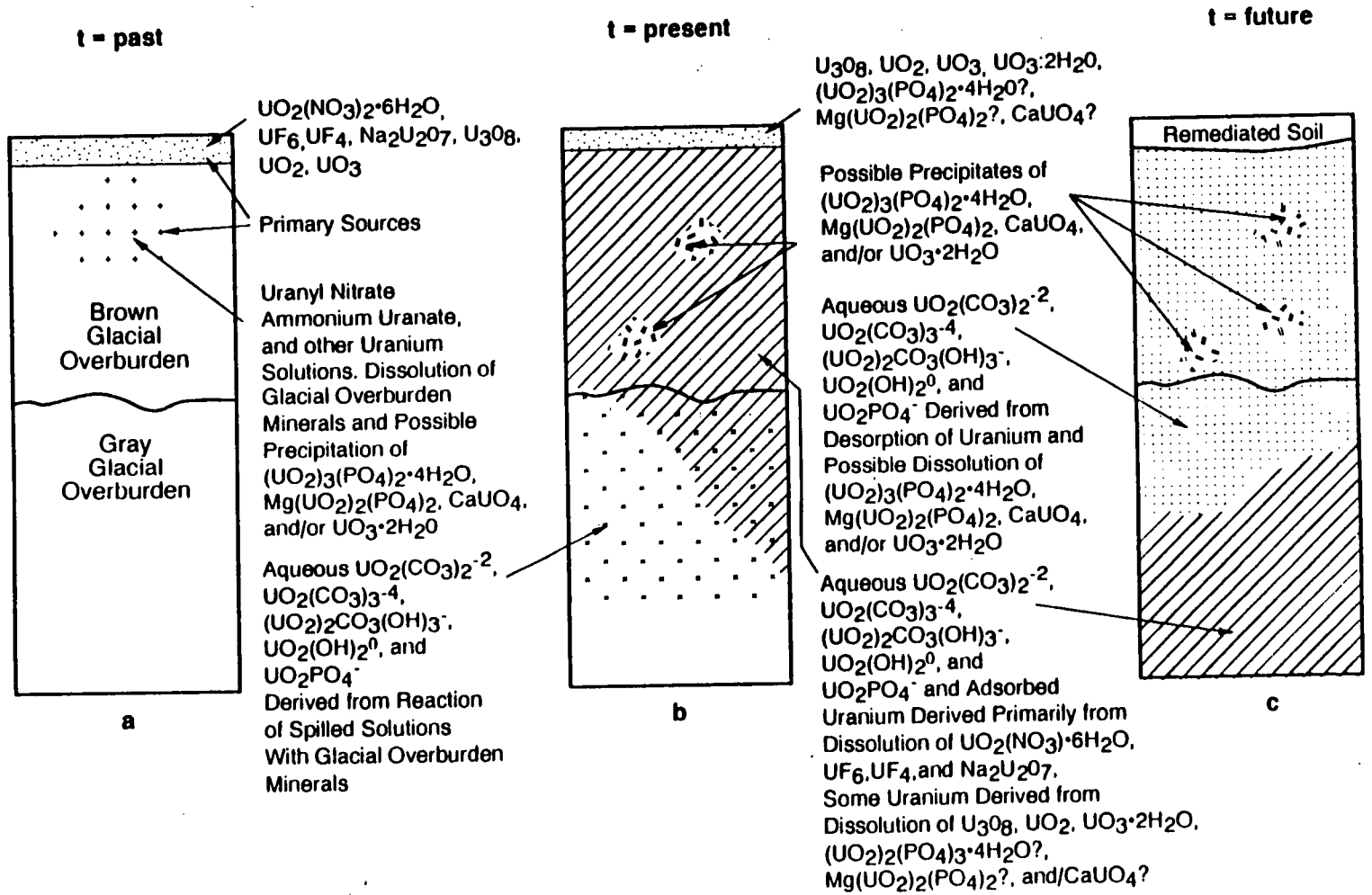

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FIGURE F.3.1.4-1. URANIUM DISTRIBUTION RESULTING FROM AQUEOUS AND PARTICULATE SOURCES

C:\AHSI/I DWG 6/17/94 MRM

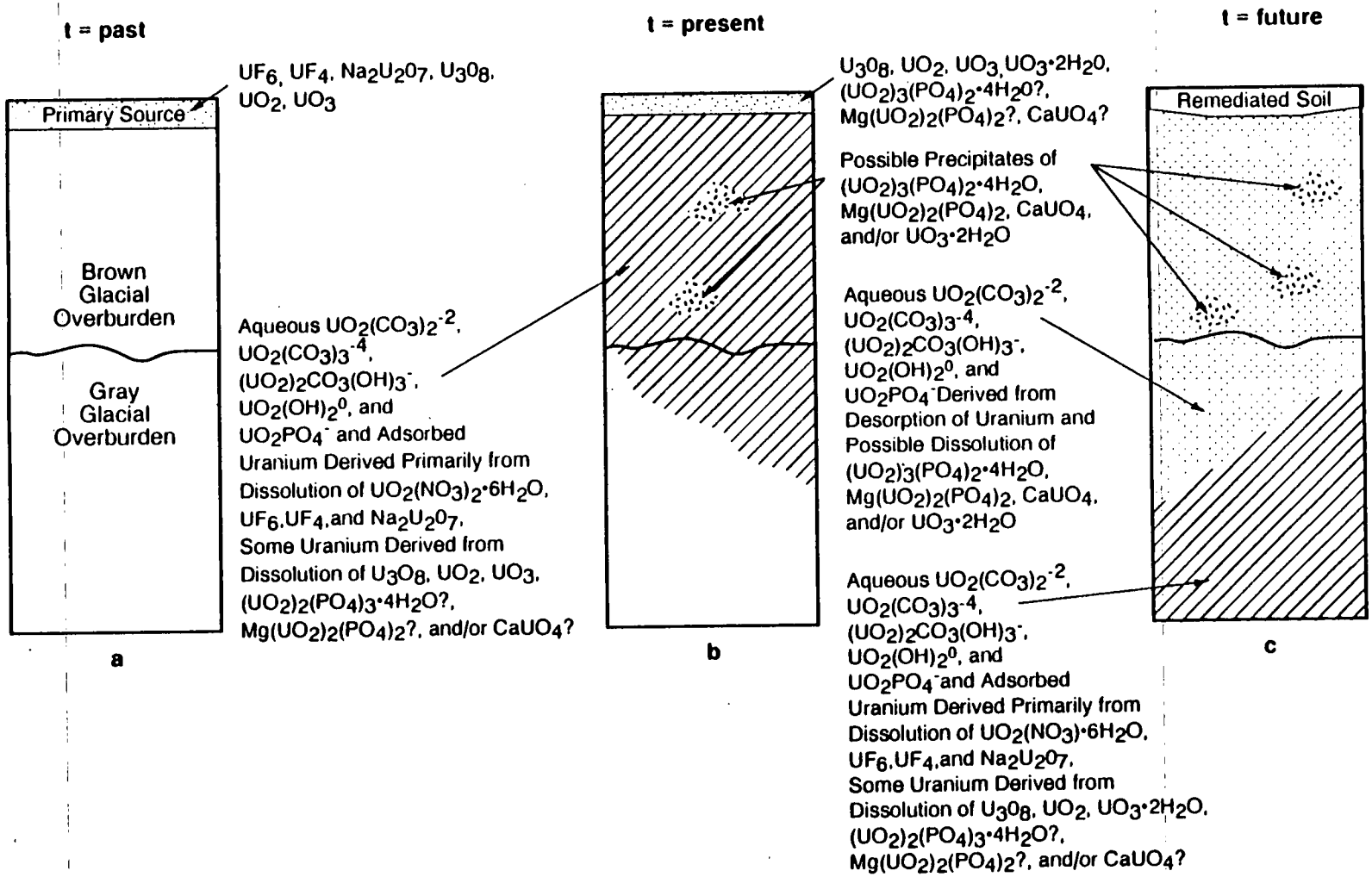

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FIGURE F.3.1.4-2. URANIUM DISTRIBUTION RESULTING FROM PARTICULATE SOURCES

APPENDIX D.5

DEVELOPMENT OF MODIFIED SOIL PRGS PROTECTIVE OF SEDIMENTS AND SURFACE WATER

D.5.0 DEVELOPMENT OF MODIFIED SOIL PRGS PROTECTIVE OF SEDIMENTS AND SURFACE WATER

The following section summarizes the calculation of PRGs for use in the FS. PRGs and PRLs are presented in Section 2.0, utilized in Section 3.0 to calculate volumes, and utilized in Section 5.0 to define long-term residual risks. PRGs were calculated for COCs that were defined in the Baseline Risk Assessment. These COCs are listed in Table 2-1. PRGs are separated into four categories: risk based, land-use modified, cross-media modified, and source control modified.

D.5.1 Risked Based Soil PRG Development

Risked based soil PRGs were calculated in the Baseline Risk Assessment for the on-property resident farmer, the expanded trespasser, and the off-property resident farmer. The risk based soil PRGs were calculated by proportioning the risk due to a COC from all pertinent pathways to the COC's soil concentration and equating that value to the ratio of an acceptable ILCR (1×10^{-6}) to the PRG.

$$PRG_i = \frac{(ILCR)(C_{si})}{\Sigma risk_i} \qquad (D.5\text{-}1)$$

where:

PRG_i = Preliminary remediation goal for constituent "i" in surface soils

ILCR = Target risk level 10^{-4} to 10^{-6} for carcinogens

Σ $risk_i$ = Sum of risk from all direct and indirect exposure pathways from Great Miami River water

C_{si} = Concentration of COC "i" in surface soils

The soil PRG for a COC is calculated for those subunits where the COC applies by using the risk and soil concentrations from the Baseline Risk Assessment. Since the relationship between risk and exposure point concentration is linear, the resulting PRG will remain the same when concentrations and risks vary for the individual Operable Unit 2 subunits. Only a small variation occurs in the PRGs between the Operable Unit 2 subunits due to rounding and changes in the exposure pathways.

Because the PRGs are similar, the South Field PRGs were chosen to represent the Operable Unit 2 risk based PRGs. The South Field was chosen because it had the most COCs, and it's PRGs were conservative when compared to other subunits (i.e. South Field PRGs were lower than other

subunits). For those COCs that were not in the South Field (e.g. carbazole in the Solid Waste Landfill) the most conservative PRG from the other subunits was used. Table D.5-1 contains the risk values and soil concentrations used to develop the risk based soil PRGs for Operable Unit 2 COCs.

An example calculation for the risk based soil PRG is provided below:

$$PRG = \frac{9.31\ pCi/g}{3.8E-5\ ILCR} \times 10^{-6}\ ILCR$$

$$PRG = 2.5E-1\ pCi/g$$

The values shown in the above equation are for the South Field (see Table D.5-1). The soil concentration is the concentration term for uranium-238 in surface soils in the South Field, and the risk is the ILCR for uranium-238 exposure to the on-property resident farmer. The resulting PRG is the risk based soil PRG for uranium-238 in the South Field.

D.5.2 Land-use Modified Soil PRG Development

Land-use modified soil PRGs are calculated using equation D.5-1, the same as risk based PRGs; however, the ILCR is for the expanded trespasser or off-property resident farmer, rather than the on-property resident farmer. Table D.5-2 contains the data from the RI Report that was used to calculate expanded trespasser PRGs. The risk to soil is due to ingestion, inhalation, dermal contact, and external radiation. Table D.5-3 contains the data from the RI Report that was used to calculate off-property resident farmer PRGs for federal ownership.

D.5.3 Cross Media Modified PRG Development

This section provides the details of development of the modified soil PRGs protective of sediments, surface water, and air (radon). Modified soil PRGs were based on the following:

- For chemical toxicants, a HI $\geq$ 0.2
- For chemical and radiation carcinogens, an ILCR $\geq$ 1.0 x 10^{-6}
- Dose limits, ARARs, and TBC requirements

TABLE D.5-1

ON-PROPERTY RESIDENT FARMER SOUTH FIELD PATHWAY RISKS (ILCR or HI) AND RISK BASED PRGs

COCs	Soil Concentration (mg/kg or pCi/g)	Risk Due to Ingestion, Inhalation, Dermal Contact, and Direct Radiation from Soil	Risk Due to Ingestion From Vegetables and Fruits	Risk Due to Ingestion From Milk and Beef	Total Risk	PRG 1×10^{-6} ILCR or 0.2 HI
Cesium - 137	0.509	4.2E-5	5.4E-7	5.5E-6	4.8E-5	1.1E-2
Neptunium - 237	0.21	4.3E-6	6.1E-7	3.6E-8	4.95E-6	4.3E-2
Plutonium - 238	0.12	3.0E-7	1.6E-9	2.2E-11	3.02E-7	4.0E-1
Radium - 226	30.80	7.8E-3	4.7E-5	1.1E-4	7.96E-3	3.9E-3
Radium - 228	3.88	4.7E-4	7.5E-7	1.8E-6	4.73E-4	8.2E-3
Thorium - 228	4.41	1.0E-3	2.7E-8	6.2E-9	1E-3	4.3E-3
Thorium - 230	13.80	1.8E-5	2.1E-8	4.7E-9	1.8E-5	7.7E-1
Thorium - 232	3.99	1.4E-3	7.8E-8	1.8E-8	1.4E-3	2.8E-3
Uranium - 234	8.66	9.9E-6	7.2E-7	6.1E-7	1.1E-5	7.7E-1
Uranium - 235/236	0.89	9.8E-6	7.3E-8	6.3E-8	9.9E-6	9.0E-2
Uranium - 238	9.31	3.5E-5	1.3E-6	1.2E-6	3.8E-5	2.5E-1
Arsenic	7.27	3.5E-5	5.5E-5	7.3E-5	1.6E-4	4.5E-2
Beryllium	0.94	2.0E-5	4.4E-6	4.2E-6	2.9E-5	3.3E-2
Benzo(a)anthracene	5.5	2.0E-5	6.0E-5	1.6E-4	2.4E-4	2.3E-2
Benzo(a)pyrene	9.4	3.4E-4	5.7E-4	5.4E-3	6.3E-3	1.5E-3
Benzo(b)fluoranthene	6.2	2.2E-5	3.7E-5	3.7E-4	4.3E-4	1.4E-2
Benzo(k)fluoranthene	7.3	2.6E-6	1.7E-6	1.5E-4	1.5E-4	4.7E-2
Dibenzo(a,h)anthracene	1.9	6.9E-5	4.3E-5	4.0E-3	4.1E-3	4.6E-4
Indeno(1,2,3-cd)pyrene	6	2.2E-5	1.9E-5	7.8E-4	8.2E-4	7.3E-3
Aroclor - 1254	0.09	6.0E-6	6.3E-6	4.9E-5	6.1E-5	1.5E-3
Aroclor - 1260	0.05	3.5E-6	8.3E-7	2.1E-4	2.1E-4	2.3E-4
Dieldrin	0.01	1.2E-6	2.5E-4	1.5E-7	2.5E-4	4E-5
Uranium Total[a]	214.32	------	9.3E-4	1.7E-4	1.1E-3	37000
Strontium - 90	1.6	2.6E-7	1.9E-5	8.3E-5	1.02E-4	1.6E-2

TABLE D.5-1
(continued)

COCs	Soil Concentration (mg/kg or pCi/g)	Risk Due to Ingestion, Inhalation, Dermal Contact, and Direct Radiation from Soil	Risk Due to Ingestion From Vegetables and Fruits	Risk Due to Ingestion From Milk and Beef	Total Risk	PRG 1×10^{-6} ILCR or 0.2 HI
Technetium 99	142.00	8.7E-7	3.6E-4	7.8E-3	8.16E-3	1.74E-2
Antimony*	22.6	4.4E-1	2.8	1.7E-1	3.4	1.33
Arsenic*	7.27	6.2E-2	1.0E-1	1.9E-4	1.6E-1	8.97

*These PRGs are HI based.
[a]The data for this PRG is from the Lime Sludge Ponds.

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TABLE D.5-2

EXPANDED TRESPASSER FEDERAL OWNERSHIP MODIFIED SOIL PRGs SOUTH FIELD CONCENTRATIONS AND RISKS

COC	Soil Concentration (mg/kg or pCi/g)	Risk Due to Ingestion, Dermal Contact, and Direct Radiation From Soil	PRG 1×10^{-6} ILCR 0.2 HI
Neptunium - 237	0.21	4.2E-8	4.99
Radium - 226	30.8	8.3E-5	3.69E-1
Radium - 228	3.88	5.0E-5	7.7E-1
Thorium - 228	4.41	1.1E-5	3.99E-1
Thorium - 232	3.99	1.5E-5	2.63E-1
Uranium - 238	9.31	1.7E-7	53.6E+1
Arsenic	7.27	4.3E-7	1.69E+1
Benzo(a)pyrene	9.4	3.3E-6	2.86
Arsenic*	7.27	1.3E-3	1E+3
Uranium Total[a]	214.32	2.1E-1	2E+2

*These PRGs are HI based.
[a]This data is from the Lime Sludge Ponds.

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TABLE D.5-3

OFF-PROPERTY FARMER FEDERAL OWNERSHIP MIDIFIED SOIL PRGs SOUTH FIELD CONCENTRATIONS AND RISKS

COC	Soil Concentration (mg/kg or pCi/g)	Risk Due to Inhalation of Suspended Particles	Risk Due to Ingestion of Home Produce	Risk Due to Ingestion of Beef/Milk	Total Risk or HI	PRG 1×10^{-6} ILCR 0.2 HI
Thorium - 228	4.41	2.9E-8	2.6E-10	2.6E-13	2.9E-8	1.5E+2
Thorium - 230	13.8	3.4E-8	2.0E-10	1.1E-12	3.4E-8	4.0E+2
Thorium - 232	3.99	3.7-E8	7.4E-10	4.2E-12	3.8E-8	1.1E+2
Uranium - 238	9.31	4.1E-8	2.8E-10	2.9E-11	4.1E-8	2.2E+2
Benzo(a)pyrene	9.4	2.7E-9	4.3E-8	1.3E-7	1.8E-7	5.1E+1
Dibenzo(a,h)anthrance	1.9	5.5E-10	8.5E-9	1.4E-7	1.5E-7	1.3E+1
Indeno(1,2,3-cd)pyrene	6	1.7E-10	2.7E-9	2.4E-8	3.03E-8	2E+2
Aroclor - 1260	0.05	-	3.7E-10	4.4E-8	4.4E-8	1.1

*These PRGs are HI based.
[a]This data is from the Lime Sludge Pond.

D.5.3.1 Cross-Media Impact on Groundwater

Cross Media impacts to groundwater occur when soil concentrations leach into a drinking water supply. Cross media impacts to groundwater are calculated by defining the highest acceptable groundwater concentration at the receptor and reverse model to determine the soil concentration that would produce the desired groundwater concentration. Appendix D.1 discusses the process of calculating cross-media impacts to groundwater.

D.5.3.2 Cross-Media Impact on Surface Water

D.5.3.2.1 Great Miami River

Modified soil PRGs were developed to be protective of the Great Miami River surface water for the South Field. Other Operable Unit 2 subunits had no COCs that impacted the Great Miami River surface water. Modified soil PRGs were calculated from the results of the RI modeling and the Baseline Risk Assessment. The relationships between surface soil concentrations, the Great Miami River concentrations, and risk are linear. Therefore, the modified PRGs can be calculated using equation D.5-1. Table D.5-4 presents modified soil PRGs protective of the Great Miami River surface water from the South Field surface soils. These modified soil PRGs were developed assuming no source controls and apply for continued administrative controls as well as private ownership of the FEMP.

D.5.3.2.2 Paddys Run

Surface water concentrations on the subunits determined in the Baseline Risk Assessment (no action alternative) were compared to water quality standards for Paddys Run (see Appendix B). Only the South Field surface water concentrations were high enough to cause the surface water concentrations in Paddys Run to exceed water quality standards for Dieldrin and polynuclear aromatic hydrocarbons (PAHs). Therefore, modified soil PRGs were developed for the South Field so that concentrations in Paddys Run surface water will not exceed ARARs. Other Operable Unit 2 subunits had no COCs with concentrations exceeding ARARs in Paddys Run.

TABLE D.5-4

SOUTH FIELD
CROSS-MEDIA MODIFIED PRGs
PROTECTIVE OF THE GREAT MIAMI RIVER SURFACE WATER
WITHOUT SOURCE CONTROLS

COCs Impacting Great Miami River	Units	Surface Soil Concentration	Baseline Risk	Modified Soil PRGs[a]			Background
				10^{-4} ILCR[b]	10^{-5} ILCR	10^{-6} ILCR	
Radium-226	pCi/g	30.8	1.3E-6	2,400	240	24	1.42
Technetium-99	pCi/g	142	2.0E-6	7,100	710	71	0

[a]Modified soil PRGs were calculated using Equation D.5-1.

[b]ILCR = incremental lifetime cancer risk.

The ARARs are concentration-based requirements; therefore the PRGs are calculated by the following equation:

$$\frac{\text{ARAR Concentration}}{\text{PRG (Soil)}} = \frac{\text{Paddys Run Concentration}}{\text{Surface Soil Concentration}}$$

$$\text{PRG (Soil)} = \frac{\text{ARAR} * \text{Surface Soil Concentration}}{\text{Paddys Run Concentration}}$$

This equation is possible because the relationship between surface soil concentrations and Paddys Run concentrations is linear. For total PAHs, the ratio of the concentration of one PAH to the total PAH concentration is assumed to be the same for the PRG (e.g., benzo(a)pyrene contributes 10 percent of the total PAH concentration in Paddys Run; therefore, it contributes 10 percent of the PRG concentration). Table D.5-5 presents modified soil PRGs for the South Field contaminated material/soil that would not exceed ARAR water quality standards in Paddys Run. These modified soil PRGs were developed assuming no source control and apply for continued federal ownership as well as private ownership of the FEMP.

D.5.3.3 Cross-Media Impact on Sediments

Modified soil PRGs were developed to be protective of sediments. Modified PRGs were required for the Solid Waste Landfill, South Field, and Active Flyash Pile. The Lime Sludge Ponds and Inactive Flyash Pile had no COCs that impacted sediments; therefore, no modified soil PRGs were necessary for these two subunits.

Modified soil PRGs were calculated from the results of the RI modeling and the Baseline Risk Assessment. The relationship between surface soil concentrations and sediment concentration is linear. The relationship between sediment concentration and the risk is also linear. Therefore, the modified PRGs can be calculated from equation D.5-1.

Table D.5-6 presents the modified soil PRGs that were calculated to be protective of sediments. These modified soil PRGs were developed assuming no source controls and apply to continued administrative controls (i.e., expanded trespasser).

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TABLE D.5-5

SOUTH FIELD
CROSS-MEDIA MODIFIED SOIL PRGs AND PRLs
MEETS ARARs IN THE PADDYS RUN WITHOUT SOURCE CONTROL

COCs Impacting Paddys Run	Surface Soil Concentration (mg/kg)	Paddys Run Concentration (mg/L)	Modified Soil PRGs and PRLs (mg/kg)
Dieldrin[a]	9.7E-3	7.73E-4	9.57×10^{-3}
Benzo(a)anthracene[b]	5.5E-3	3.52E-3	4.55×10^{-1}
Benzo(a)pyrene[b]	9.4E-3	2.52E-3	7.77×10^{-1}
Benzo(b)fluoranthene[b]	6.2E-3	4.26E-4	5.13×10^{-1}
Benzo(k)fluoranthene[b]	7.3E-3	2.70E-4	6.03×10^{-1}
Dibenzo(a,h)anthracene[b]	1.9E-3	5.20E-4	1.57×10^{-1}
Indeno(1,2,3-cd)pyrene[b]	6.0E-3	3.37E-5	4.96×10^{-1}
Phenanthrene[b]	2.3E-3	3.75E0	1.90×10^{-1}

[a]ARAR for dieldrin was 7.6E-4 μg/L.
[b]ARAR for total PAHs was 0.31 μg/L.

TABLE D.5-6

CROSS-MEDIA MODIFIED SOIL PRGs AND PRLs PROTECTIVE OF SEDIMENTS WITHOUT SOURCE CONTROLS

COCs Impacting Sediments	Units	Surface Soil Concentration	Baseline Risk	Hazard Index	FEDERAL OWNERSHIP Expanded Trespasser Modified PRGs[a]				Background
					10^{-4} ILCR[b]	10^{-5} ILCR	10^{-6} ILCR	0.2 HI[c]	
Solid Waste Landfill									
Uranium-Total	mg/kg	225	NA[e]	0.26	-[d]	-	-	180	3.7
South Field									
Radium-226	pCi/g	30.8	1.3E-5	NA	240	24	2.4	NA	1.42
Active Flyash Pile									
Radium-226	pCi/g	4.6	2.2E-6	NA	230	23	2.3	NA	1.42
Arsenic	mg/kg	90	1.0E-6	NA	8,600	860	86	NA	8.2

[a]Modified PRGs were developed using Equation D.5-1.

[b]ILCR = incremental lifetime cancer risk.

[c]HI = hazard index.

[d]For total uranium, PRGs/PRLs were developed for a non-carcinogenic HI of 0.2.

[e]NA = not applicable.

D.5.3.4 Radon PRG Development

Radon-222 is a COC for four of the five Operable Unit 2 subunits (Solid Waste Landfill, Active Flyash Pile, Inactive Flyash Pile, and South Field). Radon concentrations in air result from radium-226 concentrations in the soil. Radon concentrations were estimated using the REACOM model algorithms developed for the NRC (NRC 1984) which converts radium-226 concentrations (pCi/g) to radon-222 fluxes (pCi/s-m^2).

Radon-222 is a cross-media impact from radium-226 in soils, therefore the PRG developed to be protective of human health due to exposure to radon is a cross media modified soil PRG for radium-226. The PRG is calculated by proportioning the risk due to radon-222 to the radium-226 soil concentration and equating that value to the ratio of an acceptable ILCR (1 x 10^{-6}) to the PRG.

$$\text{PRG} = \frac{\text{Radium-226 soil concentration(pCi/g)}}{\sum \text{risk, inhalation of radon-222}} \times 1\text{x}10^{-6}\ \text{ILCR}$$

The cross media modified soil PRG for radium-226 is calculated for those subunits where radon-222 is a COC by using the risk and soil concentrations from the Baseline Risk Assessment. Table D.5-7 contains the risk values and soil concentrations used to develop the cross media modified soil PRGs for radium-226.

An example calculation for the cross media modified soil PRG is provided below:

$$\text{PRG} = \frac{31\ \text{pCi/g}}{6.0\text{E-5 ILCR}} \times 10^{-6}\ \text{ILCR}$$

$$\text{PRG} = 5.1\text{E-1 pCi/g}$$

The values shown in the above equation are for the South Field (see Table D.5-7). The soil concentration is the concentration term for surface soils in the South Field, and the risk is the ILCR for the on-property resident farmer. The resulting PRG is the private ownership cross media modified soil PRG for radium-226 in the South Field.

TABLE D.5-7

RADON PRG CALCULATIONS

Subunit	Soil Concentration	Risk Expanded Trespasser	PRG	Off-Property Farmer		On-Property Farmer	
				Risk	PRG	Risk	PRG
Active Flyash Pile	4.6E+00	NA[a]	NA	NA	NA	1.5E-06	3.1E+00
South Field	3.1E+01	1.9E-06	1.6E+01	4.4E-06	7.0E+00	6.0E-05	5.1E-01
Inactive Flyash Pile	2.0E+00	NA	NA	NA	NA	4.2E-06	4.7E-01
Solid Waste Landfill	1.4E+00	NA	NA	NA	NA	1.4E-06	1.0E+00
Lime Sludge Pond	NA	NA	NA	NA	NA	NA	NA

[a]NA means not applicable to that receptor or subunit.

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D.5.4 Source Control Modified Soil PRG Development

Source control modified PRGs are generated by controlling exposure pathways or contaminant migration through engineering source controls. Source controls in this FS are capping and lateral migration. Capping source controls prevent direct-contact exposure pathways and limit source migration to groundwater. Lateral migration source controls limit the source migration laterally, thereby reducing overall source migration. The calculation of source control modified soil PRGs is covered in detail in Appendix D.1.

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