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REVISED DRAFT FINAL

PHASE II RFI/RI REPORT
903 PAD, MOUND, AND
EAST TRENCHES AREA
OPERABLE UNIT NO. 2

REPLACEMENT PAGES

ALL SECTIONS AND APPENDIXES
TEXT AND TABLES

U.S. Department of Energy
Rocky Flats Environmental Technology Site
Golden, Colorado

October 1995

ADMIN RECORD

(4040-1030-0041-510) (R4-CVRS) (10/02/95 7:59PM)

1/395

SPECIFIC COMMENTS CDPHE Comment #	Section	Original Draft Final Page(s)	Replace with Revised Draft Final Page(s)
35	App. H	H11-3	H11-3
	App. H	H11-4	H11-4
36	6.0	Table 6.3-3	Table 6.3-3 — can't find
why is a response necessary?	App. H	H3-4 ← No change found for this comment	H3-4
	App. H	Table H3-4	Table H3-4 missing
38	6.0	Table 6.5-4	~~Table 6.5-4~~
	App. H	Table H5-4	Table H5-4 ~~missing~~
42	App. H	H.ES-5	H.ES-5, H.ES-5a
48	6.0	6-10	6-10
	App. H	H3-3	H3-3
49	App. H	H3-4	H3-4
51	App. H	H3-5	H3-5,H3-5a
53	ES	ES-6	ES-6 — Missing
	6.0	6-15	6-15
	App. H	H4-6	H4-6,H4-6a — Missing
	App. H	H8-5	H8-5,H8-5a
	App. H	H8-7	H8-7,H8-7a
54	6.0	6-16	6-16
	App. H	H4-8	H4-8,H4-8a
56	App. H	H4-11	H4-11,H4-11a — Missing
57	6.0	6-22	6-22 — Missing
	App. H	H4-11	H4-11
	App. H	H5-9	H5-9
60	6.0	6-18	6-18 — ~~missing~~ I don't see why this is referenced.
	App. H	Table H5-3	Table H5-3
64	App. H	H10-14	H10-14
65	6.0	Table 6.5-4	Table 6.5-4 — I don't see why this is referenced.
	6.0	Table 6.5-5	Table 6.5-5
	App. H	Table H5-5	Table H5-5
66	6.0	Table 6.5-4	Table 6.5-4
	6.0	Table 6.5-5	Table 6.5-5
	App. H	Table H5-6	Table H5-6
	App. H	Table H5-7	Table H5-7
	App. H	Table H5-8	Table H5-8
	App. H	Table H5-13	Table H5-13

GENERAL COMMENTS			
CDPHE Comment #	Section	Original Draft Final Page(s)	Replace with Revised Draft Final Page(s)
3	ES	ES-5	~~ES-5~~
	ES	ES-6	~~ES-6~~
	6.0	6-34,6-35	6-34,6-35,6-35a
	6.0	6-47,6-49	6-47,6-49
	App. H	H8-10	H8-10
	App. H	H8-16	H8-16,H8-16a
	App. H	H11-3	H11-3
	App. H	H11-4	H11-4
5	ES7.0	ES-40 through ES-42	ES-40 through ES-43
6	ES7.0	ES-42	ES-42
	ES7.0	ES-43	ES-43
	~~7.0~~	7-7	7-7 Has this been deleted?

SPECIFIC COMMENTS			
CDPHE Comment #	Section	Original Draft Final Page(s)	Replace with Revised Draft Final Page(s)
8	2.3.1	2-37	2-37
9	2.3.1.2	2-38	2-38
	Ref.	R-46	R-46,R-46a
11	3.5	3-9	3-9
	3.5.2	3-32	3-32 not included
	3.5	3-33	3-33
	Ref.	R-35	R-35,R-35a
14	4.4.2.5	4-166	4-166,4-167
17	4.0	Table 4.7-1	Table 4.7-1
18	5.3.2	5-37	5-37, 5-37a
22	6.5.1	6-17	6-17,6-17a
	App. H	H5-1	H5-1,H5-1a
29	6.0	6-44	Missing ~~6-44~~ Missing comment This was suppose to be on Sect. 6.1 p 29
	App. H	H10-8	H10-8
33	6.0	6-47 through 6-50	6-47 through 6-50
	App. H	H10-1	H10-1 NOT There
35	6.0	6-47,6-48,6-49	6-47,6-48,6-49
	App. H	H8-10	H8-10
	App. H	H8-16	H8-16,H8-16a
	App. H	H8-17	H8-17
	App. H	H11-2	H11-2

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67	App. H	Table H5-13	Table H5-13
68	App. H	Attachment H2 Table 10-A	Attachment H2 Table 10-A Missing
69	App. H	Attachment H2 Table 10-F	Attachment H2 Table 10-F Missing
71	App. H	Table H5-13	Table H5-13
72	App. H	Attachment H3 (portion)	Attachment H3 (pages contained)
73	App. H	Attachment H3 (portion)	Attachment H3 (pages contained)
74	App. J App. J	J-25 through J-47 -	J-25 through J-47 Add Appendix J4
75	J7.2.1	J-27	J-27,J-27a,J-27b

GENERAL COMMENTS				
EPA Comment #	EPA Section	Section	Original Draft Final Page(s)	Replace with Revised Draft Final Page(s)
1		ES7.0	ES-40 through ES-42	ES-40 through ES-43
2		ES7.0	ES-40 through ES-42	ES-40 through ES-43
1	7.0	7.0	7-1 through 7-7	7-1 through 7-7
2	7.0	7.0	7-1 through 7-7	7-1 through 7-7
1	App. H	App. H	H3-1	H3-1
2	6.0	6.0	6-37,6-42	6-37,6-42 – Missing
	6.0	6.0	Tables 6.8-1 through 6.9-3	Tables 6.8-1 through 6.9-3
	App. H	App. H	Table ES-1 thru Table H11-1	Table ES-1 thru Table H11-1 – why all these?
	App. H	App. H	Attachment H3 (portion)	Attachment H3 (pages contained)
	App. H	App. H	Attachment H4 (portion)	Attachment H4 (pages contained)
	App. H	App. H	H8-6	H8-6
	App. H	App. H	H8-9	H8-9 – what was changed?
	App. H	App. H	H8-12	H8-12
	App. H	App. H	H8-15	H8-15
	App. H	App. H	H9-8 through H9-15	H9-8 through H9-15
2	App. J	App. J	J-21	J-21
	App. J	App. J	-	Add Tables 6.3-1A through 6.3-1D
3	App. J	App. J	J-34	J-34,J-34a

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1	2.0	2.0	2-39	2-39,2-39a
2	3.0	3.6.3	3-48	3-48
5	4.0	4.1.1.2	4-7	4-7
6	4.0	4.2	4-28	4-28
7	4.0	4.3.2.1	4-76	4-76
1	App. E	App. E	E6-3,E6-4,E6-6	E6-3,E6-4,E6-4a,E6-6,E6-6
2	App. E	App. E	Table E6-3	Table E6-3
5	App. H	6.0	6-22	ok 6-22 – ~~Missing~~
	App. H	App. H	H5-9	H5-9
7	App. H	6	Table 6.5-3	Table 6.5-3 – Missing
	App. H	App. H	Table H5-3	Table H5-3

SPECIFIC COMMENTS EPA Comment #	EPA Section	Section	Original Draft Final Page(s)	Replace with Revised Draft Final Page(s)
8	App. H App. H	App. H 6.0	H10-8 6-44	H10-8 6-44 Missing
9	App. H	App. H	H7-6	H7-6
10	App. H App. H	6.8.2 H8-3	6-31 H8-3	6-31,6-31a H8-3,H8-3a
12	App. H App. H	6.0 App. H	6-45,6-46 H10-14	6-45,6-46 H10-14

Section Page

J7.0 PARCC PARAMETERS J-25

J7.1 PARCC DEFINITION J-25
J7.2 PARCC ASSESSMENT J-26

J7.2.1 Precision J-27
J7.2.2 Accuracy J-31
J7.2.3 Representativeness J-33
J7.2.4 Comparability J-34
J7.2.5 Completeness J-37

J8.0 SUMMARY OF THE DATA ASSESSMENT J-43

Therefore, the HHRA results suggest that OU2 surface soil, and possibly subsurface soil, may not pose a threat to public health

In general, when cancer risk levels that do not exceed 1E-04 are combined with HIs that do not exceed 1, ~~may be used to support a decision that remediation is not warranted for the protection of the conclusion that environmental contamination does not pose a threat to~~ public health. These results suggest that ~~remediation of~~ surface and subsurface soil in OU-2 ~~may~~ do not be ~~necessary for protection of a threat to~~ public health. is pose

This does not make sense

Concentrations of chlorinated solvents in UHSU groundwater in AOC No. 1 would pose an unacceptable risk if directly ingested. However, direct ingestion of groundwater is an incomplete exposure route for all current and possible future receptors in OU-2. ~~largely because of availability of public water.~~ Therefore, chemicals in groundwater do not pose a risk to human health under current and possible future land use scenarios.

ES7.0 CONCLUSIONS AND RECOMMENDATIONS

Section 7 presents a summary of the previous six sections and presents recommendations for limited additional work in OU-2. Because Sections 1 through 6 have been summarized in the previous portions of this Executive Summary, only the recommendations portion of Section 7 is summarized here.

The results of the HHRA support the conclusions that environmental contamination within OU-2 does not pose a threat to public health under the evaluated exposure scenarios~~, and that remediation of environmental media to address public health risk issues is not warranted.~~ However, evaluation of the nature and extent of contamination in OU-2 indicates that certain IHSSs contain materials that are likely to act as continuing sources of contamination to soil and groundwater for the foreseeable future. For example, NAPL was observed and sampled during the SVE Pilot Test project conducted in Trench T-3 in the Northeast Trenches Source Area. Analysis of the NAPL samples indicated the presence of VOCs and SVOCs at very high concentrations (up to several million ppb for VOCs and several hundred thousand ppb for SVOCs), petroleum compounds (several hundred thousand ppm for gasoline and diesel), and radionuclides at high activities (up to 3,240 pCi/g for U-238).

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~~To limit the ongoing effects to the environment from contamination in OU-2, it may be appropriate to remove or immobilize materials in IHSSs that are acting as continuing sources of contamination. For example, it may be appropriate to remove waste materials (including~~

Area. Analysis of the NAPL samples indicated the presence of VOCs and SVOCs at very high concentrations (up to several million ppb for VOCs and several hundred thousand ppb for SVOCs), petroleum compounds (several hundred thousand ppm for gasoline and diesel), and radionuclides at high activities (up to 3,240 pCi/g for U-238).

~~To limit the ongoing effects to the environment from contamination in OU-2, it may be appropriate to remove or immobilize materials in IHSSs that are acting as continuing sources of contamination. For example, it may be appropriate to remove waste materials (including NAPL) buried in shallow trenches within OU-2 so that those materials will not continue to leach or migrate downward to affect subsurface soil and groundwater. Such removal would require an adequate understanding of the location and dimensions of high concentration areas within the IHSSs.~~

This sentence should be deleted, it does not stand alone without support.

~~However, (a)Available data for OU-2 are insufficient for characterizing high concentration areas at the level of detail necessary to calculate reliable estimates of the volumes of material providing continuing sources of contamination. Therefore, additional focused investigations are recommended for selected IHSSs where continuing environmental contamination sources have been identified. Based on available chemical data for the nature and extent of contamination in OU-2, the following IHSSs should undergo focused additional investigation:~~

- ~~903 Pad (IHSS 112)~~
- ~~Trench T-1 (IHSS 108)~~
- ~~Trench T-2 (IHSS 109)~~
- ~~Trench T-3 (IHSS 110)~~
- ~~Trench T-4 (IHSS 111.1)~~
- ~~Mound Site (IHSS 113)~~

~~The objectives of the additional focused investigations should be to gather data to identify the locations and dimensions (volumes) of high concentration areas in these IHSSs so that potential remediation alternatives can be reliably assessed. Data to be collected should include the following:~~

- ~~Approximate dimensions of trenches and source area boundaries~~

- ~~Locations and dimensions of high concentration areas~~

- ~~Chemical concentration/activity concentrations concentration data for contaminants in high concentration areas~~

- ~~Types of high concentration materials present in IHSSs and source areas (e.g., NAPLs, soils, drums)~~

- ~~Geotechnical properties of subsurface materials in source areas~~

~~The additional focused investigations should be based on well defined DQOs and incorporate DOE's Streamlined Approach for Environmental Restoration (SAFER) observational approach to ensure that only the data necessary for decision making are collected.~~

With respect to surface soil contamination, the results of the HHRA indicate that RME cancer risks (2E-04) to a future onsite industrial/office worker in OU-2 (the maximum exposed individual under current and possible future land use scenarios at RFETS) are near but slightly exceed EPA's target cancer risk range (1E-04 to 1E-06). Although the RME provides a conservative overestimation of the actual risk to a future onsite industrial/office worker in the 30-acre maximum exposure site, it may be appropriate to consider a further reduction in the RME cancer risk so that it is within EPA's target cancer risk range. ~~In particular, such further risk reduction should consider the localized areas of relatively high Pu activities in surface soil in the 30 acre maximum exposure site. If a further risk reduction is considered, the site specific conditions associated with RFETS surface soil Pu contamination should be factored in when determining the feasibility and reasonability of Pu remediation activities in surface soil.~~

~~During the more than twenty years that Pu and Am have been in surface soil at RFETS, the contamination has experienced weathering and some redistribution so that much of it lies near but somewhat beneath the immediate surface of the soil. The vertical extent of the distribution is typically not great (i.e., within a few inches) but is variable with location. Because Pu and Am emit primarily non penetrating alpha radiation with very little and generally low energy penetrating X and gamma radiation, it is very difficult to accurately identify even high activities of weathered contamination that are not directly on the surface.~~

~~This limits the available detection technologies suitable for identifying Pu high activity concentrations areas and complicates design of an effective remediation approach. Therefore, if localized remediation is to be undertaken to reduce the RME cancer risk, an evaluation of the feasibility of remediating Pu high activity concentrations areas should begin by assessing the capabilities and limitations of available detection technologies, including field instrumentation and soil sampling and analysis approaches. Additionally, the uncertainties associated with characterizing the locations and extent of the high activity concentrations areas and the volume of soil potentially requiring remediation should factor into the feasibility assessment.~~

- Schedule 40 PVC was installed for the isolation casings in all pilot boreholes and source boreholes, rather than Schedule 80 PVC, as specified in TM8. These boreholes and isolation casings were grouted and abandoned following drilling, as specified in TM8.

2.3 AIR QUALITY AND METEOROLOGICAL INVESTIGATION

This section provides a general discussion of the air quality programs and meteorological data collected at RFETS. Air quality and meteorological data pertinent to the description of site conditions at OU-2 will be addressed in detail.

2.3.1 Air Quality

Air quality monitoring programs have been conducted at RFETS since the early 1950s. The plant currently incorporates air quality programs that protect the plant employees, the general public, and the environment through appropriate engineering, administrative controls, and subsequent monitoring and assessment of the impact to the air from both radiological and nonradiological sources. As part of this effort, an annual RFETS site environmental report is published that includes all air monitoring data and associated impact analyses. The latest issue of this annual report is dated 1991 and includes the period from January through December 1991 (EG&G 1992d). The program currently includes monitoring for radionuclides and nonradioactive ambient air monitoring, which ~~includes consisted of~~ total suspended particulates and respirable particulates less than or equal to 10 micrometers (PM_{10}).

2.3.1.1 Radionuclide Ambient Monitoring

Currently monitored air quality data include data collected as part of the Radiological Ambient Air Monitoring Program (RAAMP). The RAAMP ambient air samplers monitor airborne dispersion of radioactive materials from RFETS into the surrounding environment. Samplers are designated in three categories by their proximity to the main industrial area. Twenty-three onsite samplers are located within RFETS, concentrated near the main industrial area. Fourteen perimeter samplers border RFETS along major highways on the north (Highway 128), east (Indiana Street), south (Highway 72), and west (Highway 93). Sampler locations are shown on Figure 2.3-1. Ambient samplers operate continuously at a volumetric

flow rate of approximately 25 cubic feet per minute (cfm) using a RFETS designed sampler that incorporates a brushless induction blower assembly. The samplers collect particulate matter on a fiberglass filter medium. Manufacturer's test specifications rate this filter media to be 99.97 percent efficient for relevant particle sizes under conditions typically encountered in routine ambient air sampling. Sampler flow rates are checked weekly, and filters are collected biweekly. Filters taken from the sampling network are analyzed for Pu and Am. Onsite and perimeter sites within OU-2 for 1991 are given in Table 2.3-1 and locations are shown on Figure 2.3-1.

2.3.1.2 Nonradionuclide Ambient Monitoring

Nonradioactive ambient air monitoring was conducted in 1991 for total suspended particulate (TSP) and respirable particulates less than or equal to PM_{10}. Ambient particulates are regulated by EPA and CDH under the Clean Air Act Amendments of ~~1977~~1990 (US Congress ~~1977~~1990), as defined by the National Ambient Air Quality Standards (NAAQS) and Colorado Air Quality Control Commission Ambient Air Standards. The NAAQS was originally based on total suspended particulate (TSP), a measure of total particulate recovery and not based on particulate size. The present EPA standard is based on PM_{10}. However, the CDH TSP standard also remains in effect.

Ambient air monitoring at RFETS provides baseline information on particulate levels. TSP and PM_{10} samplers are located near the east entrance to RFETS, unobscured by structures, and generally downwind from plant buildings. The reference method hi-volume TSP sampler and Wedding PM_{10} sampler are operated on the EPA sampling schedule of 1 day for every 6 days.

2.3.2 Meteorology

Meteorological data collected for this report are based on the primary meteorological station at RFETS, the 61-meter tower located in the west buffer zone. The tower is instrumented at 10, 25, and 60 meters to measure horizontal wind speed, vertical wind speed, wind direction and temperature. Dew point measurements are made at the 10 meter level. Solar radiation measurements are taken by a radiometer mounted on an unobstructed platform at 1.5 meters above ground level. Ground level precipitation and pressure are also measured. The climate

U.S. Soil Conservation Service (SCS). 1975. "Soil Taxonomy: A Basic System of Soil Classification for Making and Interpreting Soil Surveys." *USDA-SCS Agric. Handb. 436.* U.S. Government Printing Office. Washington, D.C.

U.S. Soil Conservation Service (SCS). 1973. "A Method for Estimating Volume and Rate of Runoff in Small Watersheds." Technical Paper No. 149, USDA-SCS, Washington, D.C.

~~United States Congress. 1977. Clean Air Amendments of 1977. 42 U.S.C. 1857-18571 as amended by Public Law 95-95, August 7.~~

United States Congress. 1990. Clean Air Amendments of 1990. Title I, CAA Section 109, 40 CFR Parts 50).

Urban Drainage and Flood Control District, Denver, Colorado. 1989. CUHPE-PC, A Personal Computer Digital Model for Storm Hyetograph and Hydrograph Prediction.

van Genuchten, M. Th. and P. Wierenga. 1976. "Mass Transfer Studies in Sorbing Porous Media." 1. Analytical Solutions. *Soil Sci. Soc. Am. J.* 40:473-480.

van Genuchten, M. Th., D.H. Tang, and R. Guenellon. 1984. "Some Exact Solutions for Solute Transport through Soils Containing Large Cylindrical Macropores." *Water Resour. Res.* 20:335-346.

Van Horn, R. 1976. Geology of the Golden Quadrangle, Colorado. U.S. Geological Survey Prof. Paper 872.

Van Horn, R. 1972. Surficial Bedrock Geologic Map of the Golden Quadrangle, Jefferson County, Colorado; U.S. Geologic Survey Misc. Geol. Field Inv. Map I-761-A.

Vanoni, V.A. 1977. Sedimentation Engineering. Headquarters of The Society. New York.

Viessman, V. Jr., G.L. Lewis and J.W. Knapp. 1989. *Introduction to Hydrology. Harper* & Row Publishers, New York.

Villholth, K. and K.H. Jensen. 1993. "Experimental and Numerical Investigations of Macropore Flow and Transport." Proceedings of the 1993 Ground Water Modeling Conference, June 9-12, 1993. Colorado School of Mines Campus, Golden, Colorado. International Ground Water Modeling Center. p. 6-31.

data are taken from data collected in 1991 as summarized in the annual environmental report (EG&G 1992d). The meteorological data included in this report represent 98 percent data recovery. The data set used in the air dispersion modeling analysis ~~is from the more complete data set (greater than 99 percent data recovery) collected in 1992. Mixing height data were calculated from twice daily radio sounds from Stapleton International Airport during 1992.~~ ~~was collected in 1989 through 1993 (see Appendix G). Generic mixing height data for the Denver area, obtained from *Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution throughout the Contiguous United States* (EPA 1992a), were used in the modeling. Eight mixing heights were used, one for morning and one for afternoon for winter, spring, summer, and autumn. The heights ranged from 163 meters to 3358 meters.~~

2.4 SURFACE WATER AND SEDIMENT INVESTIGATION

This section provides a brief discussion of the surface water investigation, which is part of the site-wide Surface Water Data Collection Program. Only seep and sediment locations pertinent to OU-2 will be discussed in more detail.

2.4.1 Sample Locations, Collection, and Frequency

Under the Environmental Restoration Program, the RFETS Surface Water Data Collection Program is conducted at a network of fixed sites, involving surface water, seep, sediment and detention pond sample collection. Routine surface water and sediment sites are sampled quarterly, with the exception of several "seasonal" sites that are sampled on a monthly basis from March to June. Sampling locations are divided into nine program areas:

1. Rock Creek
2. Landfill
3. Protected Area
4. 881 Hillside
5. Woman Creek
6. South Interceptor Ditch
7. North Walnut Creek
8. South Walnut Creek
9. Mound Area

Seeps represent the only source (excluding stormwater runoff) of surface flow originating in OU-2. The seeps are sampled under the site-wide surface monitoring program, but due to seasonal variations, that often result in very low to non-existent flow rates, it is frequently

seasonal variations, that often result in very low to non-existent flow rates, it is frequently impossible to obtain samples from the seeps. Surface water sampling stations that include seep locations are designated as SW. Sediment sampling locations are designated as SED.

U.S. Environmental Protection Agency (EPA). 1992e. *Guidance for Data Useability in Risk Assessment (Part B).* 9285.7-09B. May.

U.S. Environmental Protection Agency (EPA). 1992f. Health Effects Summary Tables, Fourth Quarter 1992. OERR 9200 6-300 (90-4). Washington, D.C.

U.S. Environmental Protection Agency (EPA). 1992g. Guidance on Risk Characterization for Risk Managers and Risk Assessors. F. Henry Habicht II, Deputy Administrator. February.

U.S. Environmental Protection Agency (EPA). 1992h. *New Interim Region IV Guidance Recommending 1% Absorption Factors for All Organics.*

U.S. Environmental Protection Agency (EPA). 1992i. *Dermal Absorption Factors for Multiple Chemicals.* Union Carbide Corporation, Marietta, Ohio.

U.S. Environmental Protection Agency (EPA). 1992j. *New Interim Region IV Guidance Recommending 0.1% Absorption for Inorganics.* 1992. 11 February.

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U.S. Environmental Protection Agency (EPA). 1992l. *User's Guide for the Fugitive Dust Model (FDM).* Revised. September.

U.S. Environmental Protection Agency (EPA). 1992m. User's Guide for the Industrial Source Complex (1SC2) Dispersion Models. Volume 1 - User Instructions. Office of Air Quality Planning and Standards. EPA-450/4-92-008a. March.

U.S. Environmental Protection Agency (EPA). 1992n. *Mixing Heights, Wind Seeds, and Potential for Urban Air Pollution throughout the Contiguous United States* (AP-101) G.C. Holzworth Research Triangle Park, NC: EPA, Office of Air Programs, 1972.

U.S. Environmental Protection Agency (EPA). 1991a. *National Functional Guidelines for Organic Data Review*. Multi-Media Concentration, and Low-Concentration Water. USCPA Contract Laboratory Program.

Most of the soil series are classified within the Argiustoll great group (Table 3.4-1). Argiustolls are generally characterized as well-drained soils with molic (dark) epipedons, argillic "B" horizons, and calcic "C" horizons. They exist in aridic and ustic (limited moisture) regimes, which are adequate for plant growth during the growing season. The two predominant subgroups are Torretic and Aridic. Torretic Argiustolls have a higher shrink-swell potential than Aridic Argiustolls (Department of Agriculture 1980).

3.5 GEOLOGY

This section, which presents descriptions, interpretations, and discussions of the geology of the OU-2 area, is divided into two subsections: Surficial Geology and Bedrock Geology. Geologic information and interpretations presented in these sections are based on data gathered during historical, Phase I, Phase II (alluvial and bedrock), and other ongoing investigations. The regional geologic setting surrounding the RFETS site is discussed in each section to assist in understanding the local geology. For more detailed discussions on the regional geology of the Front Range and High Plains surrounding the FRETS site, the reader is referred to the *Geologic Characterization Report* (DOE 1991d). (It should be noted that the March 1995 *Geologic Characterization Report* for RFETS [DOE 1995d] has recently become available.)

Geologic interpretations in this section use both subsurface and surface data control. Subsurface stratigraphic control was obtained from lithologic logs of core and/or cuttings collected during the drilling of boreholes and monitoring wells, lithologic mapping along trench walls, and borehole geophysical logs. Pre-1991 core and/or cuttings were logged according to a visual geologic protocol (DOE 1991d, Appendix G). Post-1991 core and/or cuttings were logged systematically and uniformly according to ER SOP GT.1 (EG&G 1992a). Table 3.5-1 lists the investigations that have placed boreholes, monitoring wells, and trenches in the OU-2 area and the number of each category. Lithologic logs from 182 monitoring wells, 111 boreholes, and 3 trenches were used in this study. Appendix A4 contains the lithologic logs for these monitoring wells and boreholes. Specific stratigraphic information obtained from these lithologic logs and used in construction of subsurface maps is summarized in Appendix A3. The locations of all historical and other investigation boreholes and monitoring wells used in this study are shown on Plates 1.3-1 and 1.3-2, respectively. The locations of OU-2 Phase II boreholes and monitoring wells installed during the alluvial program are shown on Figures 2.1-1 and 2.1-2, respectively. The locations of

workplans (DOE 1991a; 1991b) used this No. 1 through No.5 designation for the sandstones beneath the OU-2 area as well. [It should be noted that the March 1995 *Geologic Characterization Report* for RFETS [DOE 1995d] has recently become available.]

In 1992, a palynologic study of bedrock core samples from the RFETS site (many from the OU-2 area) was undertaken (DOE 1993e). The study analyzed spores, pollen, dinoflagellates and acritarchs (marine plankton), collected from the bedrock materials for determinations of age and environments of deposition. According to Dodge (EG&G 1993c), this study has tentatively age-dated the geologic units directly beneath the Arapahoe Formation No. 1 Sandstone as lower to middle Maastichtien in age (i.e., part of the Laramie Formation). Analysis of samples collected from the No. 1 Sandstone, adjacent, and overlying claystone units did not yield definitive age dates for these units. Based on this palynological study, the base of the Arapahoe Formation has tentatively been moved upward from the base of the No. 5 Sandstone to the base of the No. 1 Sandstone. Further discussion on bedrock geology in this OU-2 Phase II report will use this current (1992) age and formation designation for bedrock units.

Phase I and Phase II subsurface investigations have shown that the No. 1 Sandstone is a distinct bedrock unit separate in geologic characteristics from the underlying Laramie Formation sandstones. These geologic characteristics will be discussed further in the following sections. The No. 1 Sandstone designation used by DOE (1991d) is therefore continued in this report. Limited subsurface information is available though, to evaluate the geometries and lateral continuity of the stratigraphically lower Laramie Formation sandstones. These sandstones were referred to as No. 2 - No. 5 in earlier studies, which implies that the sandstones are correlatable units traceable across the RFETS site. Unlike the No. 1 Sandstone, these sandstones appear to be discontinuous in nature, thus correlations from borehole to borehole are tenuous even within the limited area of OU-2. In this Phase II report, Laramie Formation sandstone/siltstone correlations between boreholes are based solely on like stratigraphic positioning relative to elevation although lateral continuity between boreholes is uncertain. Due to this uncertainty in lateral continuity, the Nos. 2 through 5 designation for Laramie Formation sandstones is discontinued in this report. Rather, the units are referred to as Laramie Formation sandstone/siltstone intervals.

U.S. Department of Energy (DOE). 1993d. *Geologic Characterization Report for the Rocky Flats Environmental Technology Site*. March.

U.S. Department of Energy (DOE). 1994a. *Technical Memorandum No. 5, Exposure Assessment: 903 Pad, Mound, and East Trenches Areas, Operable Unit No. 2.* Rocky Flats Environmental Technology Site, Golden, Colorado. Draft Final. December.

U.S. Department of Energy (DOE). 1994b. *Technical Memorandum No. 9, Chemicals of Concern: 903 Pad, Mound, and East Trenches Areas, Operable Unit No. 2.* Rocky Flats Environmental Technology Site, Golden, Colorado. Draft Final. August.

U.S. Department of Energy (DOE). 1994c. *Technical Memorandum No. 10, Toxicity Assessment: 903 Pad, Mound, and East Trenches Areas, Operable Unit No. 2.* Rocky Flats Environmental Technology Site, Golden, Colorado. Draft Final. September.

U.S. Department of Energy (DOE). 1994d. DOE Response to Comments from CDPHE and EPA on Technical Memorandum No. 9, Chemicals of Concern (Draft Final), August 1994 for Operable Unit No. 2, 903 Pad, Mound, and East Trenches Areas. October.

U.S. Department of Energy (DOE). 1994e. Interim Policy for Preble's Meadow Jumping Mouse. Rocky Flats Field Office. October 4.

U.S. Department of Energy (DOE). 1994f. Letter Report. Colorado Department of Public Health and the Environment Conservative Screen to Define Areas of Concern at Operable Unit 3. Rocky Flats. DOE Review Draft. August 31.

U.S. Department of Energy (DOE). 1994g. *Programmatic Risk-Based Preliminary Remediation Goals.* Final. July.

U.S. Department of Energy (DOE). 1994h. *U.S. Department of Energy Radiological Control Manual.* DOE/EH-0256T. Revision 1. April.

U.S. Department of Energy (DOE). 1994i. DOE Response to Comments from CDPHE and EPA on Technical Memorandum No. 4, Chemicals of Concern (Draft Final), August 1994 for Operable Unit No. 6, Walnut Creek Priority Drainage. November 8.

briefly in Section 3.6.2.2.3 and in more detail in Section ~~3.6.3~~3.6.2.3. The hydrogeology of the hillside deposits (colluvium, terrace deposits, and disturbed ground) is discussed in Section 3.6.2.2.4. The UHSU system interactions are discussed in Section 3.6.2.2.5.

Evidence presented in the following sections suggests that the saturated alluvial/colluvial and No. 1 Sandstone components of the UHSU exhibit a high degree of hydraulic communication in much of OU-2. However, groundwater flow and hydraulic gradients in the respective units are quite different. Thus, separate potentiometric surface maps for the alluvial/colluvial and No. 1 Sandstone components of the UHSU were prepared and are discussed in the following sections.

3.6.2.2.1 Rocky Flats Alluvium. Groundwater flow within the Rocky Flats Alluvium is strongly influenced by the top of bedrock features and the geometry and lithology of geologic units discussed in Section 3.5. Saturated alluvial conditions within the Rocky Flats Alluvium occur predominantly within lows and scours in the top of the Arapahoe and/or Laramie Formation bedrock materials. The largest of the scours, the medial paleoscour (Section 3.5.1.1.1) contains and transmits most of the alluvial groundwater in OU-2. This paleoscour appears to originate in the vicinity of the 903 Pad and trends predominantly from southwest to northeast (Figures 3.5-5 and 3.5-6 and Plate 3.5-1). Paleoridges, capped by claystone, to the north and south of the medial paleoscour and a claystone high west of the paleoscour apparently bound the lateral extent of saturated alluvium across much of OU-2 west of the East Spray Fields. It is believed that alluvial groundwater inflow to OU-2 from the west is restricted by the claystone high just west of the 903 Pad. Well 1087 (located west of the 903 Pad) and Well 37691 (southwest of the 903 Pad) are generally either dry or the saturated thickness in the unconsolidated materials at these wells is small (less than 2 feet). Thus, it appears that inflow of water in the alluvium from the west, if it occurs at all, is not substantial.

The north and south paleoridges restrict groundwater outflow from the alluvium to the north and south, particularly during the drier seasons when groundwater levels are at their lowest. As described in Section 3.5, the medial paleoscour is believed to be truncated at the South Walnut Creek hillside. Alluvial groundwater flowing within the scour discharges at the head of a well-developed surface drainage gully on the hillside, probably as a result of truncation of the paleoscour at this location (Plate 3.6-1).

Only results from subsurface soil samples collected in OU-2 above the high water table levels (based on May 1992 water levels) were included in the background comparison in order to avoid including chemicals transported by groundwater. Potential groundwater contaminants are discussed in Sections 4.4 and 4.5.

4.1.1.3 Groundwater Data

Groundwater data used to characterize OU-2 were obtained from samples collected from RFETS monitoring wells during specific OU-2 investigation programs and on a quarterly basis under the site-wide RFETS Groundwater Monitoring Program. The lithologic material from which the samples were collected was reviewed and a determination made of the hydrostratigraphic unit sampled. The UHSU includes the Rocky Flats Alluvium, colluvium, valley fill alluvium, the Arapahoe Formation No. 1 Sandstone, weathered claystone of the Arapahoe and/or Laramie Formations, and subcropping Laramie Formation sandstones in communication with saturated UHSU materials. The LHSU consists of all unweathered units stratigraphically lower than those mentioned above.

- Groundwater data obtained from UHSU wells installed and sampled during the OU-2 alluvial investigation program were added to the quarterly site-wide RFETS Groundwater Monitoring Program sampling results from the second quarter of 1991 through the fourth quarter of 1992 for those wells and previously installed UHSU wells were used in the OU-2 characterization. In general, UHSU groundwater samples were analyzed for VOCs, SVOCs, pesticides/PCBs, metals (filtered and unfiltered), radionuclides (filtered and unfiltered), and other non-metal inorganics. The sampling methodology used during the OU-2 alluvial investigation is described in Section 2.1.3, and the analytical protocol are documented in the *General Radiochemistry and Routine Analytical Services Protocol* (GRRASP) (EG&G 1994a). The work plan associated with the RFETS Groundwater Monitoring Program is *Groundwater Protection and Monitoring Program Plan* (GPMPP) (EG&G 1991 through 1994).

- Groundwater data obtained from the RFETS Groundwater Monitoring Program LHSU wells sampled quarterly from the second quarter of 1991 through the

SVOCs, pesticides/PCBs, metals (filtered and unfiltered), other non-metal inorganics, and radionuclides (filtered and unfiltered). The data used in the OU-2 characterization were collected from the first quarter of 1991 through the third quarter of 1992.

Seep sediment samples were obtained at selected seep surface water locations; these include sediment locations SED031 and SED038, co-located with SW064 water locations SW064 and SW057/SW051, respectively. In general, the seep sediment samples were analyzed for VOCs, SVOCs, pesticides/PCBs, metals, other non-metal inorganics, and radionuclides. The data evaluated were collected from the first quarter of 1991 through the third quarter of 1992 under the RFETS Surface Water Monitoring Program. Sampling SOPs used to collect seep surface water and seep sediment samples are described in Section 2.4, and the analytical protocol are documented in GRRASP (EG&G 1994a).

For the evaluation of potential contamination of seep surface water and seep sediment (Section 4.6), all the organic compounds detected were used. However, of the inorganic compounds (metals and radionuclides), only those chemicals that were identified as PCOCs in UHSU groundwater and surface soil were used. This approach focused the evaluation on those inorganic chemicals that were truly potential contaminants because the source of contamination to seep surface water and seep sediment is contaminated UHSU groundwater and contaminated surface soils transported by overland flow.

4.1.1.5 Air Data

Air samples are collected from RFETS monitoring stations on a bi-weekly basis under a plant-wide air monitoring program. Data used in the OU-2 evaluation consists of measured Pu activity concentrations in air from nine RAAMP samplers sampled in 1993 (Section 4.7). Data from analyses of these samples have been used as a comparison to modeled activity concentrations for the air contaminant migration pathway. Pu activity concentrations in the surface soil data set were used as potential sources for air modeling. All available surface soil data were used (regardless of the sampling method) in this evaluation. No background comparison was performed for the air data.

purposes of identification and notification of state standards, the term "promulgated" means that the standards are of general applicability and are legally enforceable.

In addition to ARARs, other non-promulgated advisories, criteria, or guidance documents that are to-be-considered (TBC) to supplement an ARAR provision for a particular release may be identified. TBCs are not legally binding and do not have the status of potential ARARs. However, TBCs can be used, when suitable, to determine the level of cleanup required to protect human health and the environment. In accordance with the National Contingency Plan (40 CFR 300), ARARs for OU-2 will be evaluated in the feasibility study process.

4.2 SURFACE SOIL CHEMICAL RESULTS

This section presents chemicals in OU-2 surface soil that were identified as PCOCs by the process described in Section 4.1.4. PCOCs have been plotted to assess the spatial distribution of potential contamination.

The various sampling programs and methodologies used to collect surface soil samples are described in Section 2.5, Surface Soil Investigation. Surface soil sample locations are shown on Figure 2.5-1 and Plate 2.5-1. Section 4.1.1.1, Surface Soil Data, describes the data used for the characterization of OU-2.

The PCOCs identified in OU-2 surface soil include SVOCs, pesticides/PCBs, metals, and radionuclides. Polynuclear aromatic hydrocarbon (PAH) compounds are widely distributed across the site. The PAHs detected are believed to be from anthropogenic sources. Pu-239/240 and Am-241 are also widely distributed in surface soil at OU-2 due to wind dispersion from historic releases during cleanup activities at the 903 Drum Storage Site (IHSS 112). Because the elevated activity concentrations of Pu-239/240 and Am-241 in the surface soil at OU-2 are related to cleanup activities at the 903 Pad Drum Storage Site, and the PAH compounds are widely distributed with no apparent relationship to source areas, the nature and extent of surface soil contamination is discussed on an OU-wide basis, rather than a source area basis. Source area boundaries have been included on the figures only for reference (Section ~~4.1.5.3~~ 4.1.5 contains a discussion of the source areas.)

The other SVOC detected was n-nitrosodiphenylamine (51J µg/kg) collected from a depth of 0.9 to 3.75 feet in borehole BH2887.

Pesticides/PCBs

No pesticides or PCBs were detected in the subsurface soil samples collected at IHSS 140.

Metals

Four PCOC metals (As, Ba, Cd, and Pb) were detected at concentrations above the BSLs in IHSS 140, as presented in Table 4.3-4. As (a subsurface soil COC), Cd (also a subsurface soil COC), and Pb detections above the BSLs are shown on Figure 4.3-7, and the Ba results above the BSL are displayed on Figure 4.3-8. Cd was detected at concentrations above the BSL of 1.7 mg/kg in 7 of 24 samples analyzed. Detections above the BSL occurred in samples collected for 1987 vintage boreholes only. The elevated concentrations of Cd were generally constant with depth but vary slightly between boreholes; Cd concentrations ranged from 1.8 mg/kg to 5.4 mg/kg. Post-1987 borehole samples collected near locations previously sampled during the 1987 sampling program did not confirm the presence of Cd concentrations above the BSL. As, Ba, and Pb were detected only once, at concentrations slightly above their BSLs.

Radionuclides

Twelve radionuclides were detected at activity concentrations above BSLs in the Reactive Metal Destruction Site (IHSS 140), as shown in Table 4.3-4. The actinides (Pu-239/240, Am-241, U-233/234, U-235, and U-238) detected at activity concentrations above the BSLs are shown on Figure 4.3-9. The non-actinides (Cs-137, gross alpha, gross beta, Ra-226, Ra-228, Sr-89/90, and ^{3}H) detected at activity concentrations above the BSL are shown on Figure 4.3-10.

Pu-239/240 (a subsurface soil COC) was detected above the BSL of 0.018 pCi/g in 8 of 25 samples. The sample with the maximum Pu-239/240 activity concentration was collected from borehole BH2687 (83 pCi/g) at a depth of 0.3 to 2.5 feet. Borehole BH2687 is located on the southwest corner of IHSS 140. All except one sample of Pu exhibiting elevated

from borehole BH4987. Bis(2-ethylhexyl)phthalate was detected in samples collected from borehole 07991 at depths greater than 14 feet. Di-n-butyl phthalate was detected in 5 of 11 samples analyzed. The di-n-butyl phthalate detections were in samples collected from boreholes 07991 and BH4987. Pyrene was detected in one sample at a concentration of 570 µg/kg collected from borehole 07991 at a depth of 2 to 8 feet.

Pesticides/PCBs

The PCB Aroclor-1254 was detected in 1 of 11 samples analyzed. The PCB detection (250 µg/kg) was observed in a sample collected at a depth of 2 to 8 feet from borehole 07991 (Table 4.3-7 and Figure 4.3-27).

Metals

Table 4.3-7 illustrates the four PCOC metals (As, Cd, Ca, and Pb) that were detected at concentrations above the BSLs from subsurface soil samples collected from Trench T-9. As (a subsurface soil COC), Cd (a subsurface soil COC), and Pb concentrations above the BSL are displayed on Figure 4.3-28. Ca concentrations above the BSL are shown on Figure 4.3-29. As, Cd, and Pb were all infrequently detected at concentrations only slightly above the BSLs. Ca was detected above the BSL in 3 of 18 samples analyzed with a maximum concentration of 131,000 mg/kg. Elevated Ca concentrations are probably related to a naturally occurring caliche layer within the Rocky Flats Alluvium.

Radionuclides

Seven PCOC radionuclides exceeded the BSL in subsurface soil samples collected from Trench T-9, as shown in Table 4.3-7. Actinide (Pu-239/240, Am-241, U-233/234, U-235, and U-238 [all subsurface soil COCs]) activity concentrations above the BSLs are shown on Figure 4.3-30. Am-241, U-233/234, and U-235~~, and U-238~~ were all infrequently detected at activity concentrations only slightly above the BSLs. U-238 and Pu-239/240 ~~was~~ were infrequently detected, but ~~an~~ elevated activity concentrations of 2.95 pCi/g and 0.122 pCi/g, repsectively, were ~~was~~ detected at a depth of 2 to 8 feet from borehole 07991.

SVOCs

Bis(2-ethylhexyl)phthalate was detected once (estimated at 3 µg/L) at Well 41691, in the extreme northeastern corner of the East of IHSSs Source Area (Table 4.4-7 and Plate 4.4-5). No other SVOCs were detected in this source area.

Pesticides/PCBs

No pesticides/PCBs were detected in UHSU groundwater in this source area (Table 4.4-7 and Plate 4.4-6).

Filtered Metals

Twelve metals were observed at concentrations above BSLs in filtered samples collected from wells in the East of IHSS Source Area (Table 4.4-7). The distribution of the metals detected above BSLs is shown on Plates 4.4-7 through 4.4-9. Two of the metals, Sb and Li, were detected at maximum concentrations that were the highest observed for these two metals within all of OU-2 UHSU groundwater.

The maximum concentration of Sb (87.5 µg/L, BSL=43 µg/L) was detected in a sample from Well 0286, located along the eastern facility boundary. Sb was not detected above BSLs in two other samples collected from Well 0286.

The three highest concentrations of Li observed in all of OU-2 UHSU groundwater, including the maximum detected concentration of 253 µg/L (BSL=145 µg/L), were detected in samples from Well 06491, located adjacent to the eastern facility boundary. ~~The BSLs for these metals are 4.4, 12, and 29, and 50 µg/L, respectively.~~

Cd, Cr, Ni, and Zn were all detected at their highest concentrations (6.3, 22.2, 108, and 65 µg/L, respectively) for this source area in samples from Well 0386, located between Wells 0286 and 06491 along the eastern facility boundary. The BSLs for these metals are ~~26,631 µg/L, 208 µg/L, and 1,486 µg/L, respectively.~~ 4.4 µg/L, 12 µg/L, 29 µg/L, and 50 µg/L, respectively.

Mg, Mn, and Sr were all observed at their highest concentrations (97,200, 1,200, and 2,310 μg/L, respectively) in this source area in samples from Well 41591, which is paired with Well 0286 along the eastern facility boundary. The BSLs for these metals are 26,611 μg/L, 208 μg/L, and 1,486 μg/L, respectively.

Unfiltered Metals

Twenty-three metals were detected at concentrations above BSLs in unfiltered samples collected in the East of IHSSs Source Area (Table 4.4-7). The distribution of the metals is shown on Plates 4.4-10 through 4.4-14.

Sixteen of the metals (Al, Sb, Ba, Be, Cd, Co, Cu, Fe, Pb, Mn, Hg, K, Si, Ag, V, and Zn) were observed at their highest concentrations for this source area in samples from Well 41691, located in the extreme northeast corner of the area.

Maximum concentrations for this source area for the other metals occurred at the following wells: 41591 (As, mg, and Sr), 06491 (Li and Na), and 0286 (Cr and Ni).

Filtered Radionuclides

Filtered radionuclides detected at activity concentrations above BSLs in UHSU groundwater are Am-241, gross beta, Ra-226, and Sr-89/90 (Table 4.4-7 and Plates 4.4-15 and 4.4-16). Because insufficient background data were available to calculate a BSL for Pu-239/240 in filtered samples, detections of this radionuclide are also shown on the table and plates.

Each of these radionuclide PCOCs (excluding Sr-89/90) was observed at its maximum activity concentration in samples from Well 41691, located in the extreme northeast corner of the source area. Sr-89/90 was observed at its maximum activity concentration in a sample from Well 0386. The detected activity concentrations of the PCOC radionuclides in this source area were low relative to other OU-2 source areas.

Unfiltered Radionuclides

Am-241 and Pu-239/240, both OU-wide UHSU COCs, were detected at activity concentrations above BSLs for unfiltered groundwater samples in this source area

TABLE 4.7-1
SUMMARY OF RAAMP PLUTONIUM ACTIVITY CONCENTRATIONS - 1993

Station	Number of Samples	C (minimum) (µg/*m*l)	C (maximum) (µg/*m*l)	C (mean) (µg/*m*l)	Standard Deviation C(standard)	Percent of DCG C(mean)
PLUTONIUM ACTIVITY CONCENTRATIONS ONSITE IN OU-2						
S6	10	0.016E-15	0.241E-15	0.078E-15	0.0794E-15	0.391E-15
S7	12	0.019E-15	0.4697E-15	0.163E-15	0.1E-15	0.813E-15
S8	12	0.03E-15	0.849E-15	0.353E-15	0.250E-15	0.117E-15
S9	12	0.032E-15	0.381E-15	0.1712E-1	0.115E-15	0.857E-15
S19	11	0.007E-15	0.092E-15	0.024E-15	0.024E-15	0.120E-15
Overall	57	0.021E-15	0.4061E-15	0.158E-15	0.120E-15	0.790E-15
PLUTONIUM ACTIVITY CONCENTRATIONS PERIMETER SITES ON OU-2						
S36	11	0	0.004E-15	0.001E-15	0.001E-15	0.006E-15
S37	9	0	0.004E-15	0.0024E-1	0.002E-15	0..010E-15
S38	9	0	0.109E-15	0.014E-15	0.036E-15	0.069E-15
S39	11	0	0.004E-15	0.001E-15	0.001E-15	0..005E-15
Overall	40	.004	0.030E-15	0.005E-15	0.010E-15	0.0023E-15
PLUTONIUM ACTIVITY CONCENTRATIONS ALL RFP ONSITE SAMPLERS (S-1 THRU S-25)						
Overall	237	-0.001E-15	0.8497E-15	0.056E-15	0.119E-15	0.278E-15
PLUTONIUM ACTIVITY CONCENTRATIONS ALL PERIMETER RFP STIES (S-31 THRU S-44)						
Overall	157	-0.001E-15	0.109E-15	0.002E-15	0.010E-15	0.012E-15
PLUTONIUM ACTIVITY CONCENTRATIONS ALL COMMUNITY SITES (S-51 THRUH S-73)						
Overall	118	0.001E-15	0.021E-15	0.001E-15	0.002E-15	0.006E-15

Note:
~~New text in italics~~

contaminate groundwater. Leaching of residual contamination from the vadose zone and downward migration of DNAPL may continue to contaminate groundwater.

Elevated concentrations of VOCs (particularly TCE) have been detected in groundwater in Well 3687, which is screened in the Arapahoe Formation No. 1 Sandstone and located hydraulically downgradient (north) of Trench T-4. It should be noted that no wells were installed immediately north of Trench T-3 in the Arapahoe Formation No. 1 Sandstone as part of the OU-2 investigations. Based on the presence of NAPL and elevated concentrations of VOCs in Trench T-3 soils, elevated concentrations of VOCs are expected in groundwater north of that trench. Wells 11891, 03391, and 03691 are located downgradient of Trench T-3 and are screened in the Arapahoe Formation No. 1 Sandstone. These wells exhibited elevated total VOC concentrations of 1,535 µg/L, and 941 µg/L, respectively, for the second quarter 1992 sampling period. VOCs appear to have migrated in groundwater from the T-3 and T-4 trenches by advection and dispersion processes to form contaminant plumes within the Arapahoe Formation No. 1 Sandstone and, to a lesser extent, within the alluvium. Contaminant plumes in the sandstone migrate toward the north-northeast and appear to discharge at sandstone seeps on the hillside of the South Walnut Creek drainage. Contaminated groundwater in the alluvium flows along the medial paleoscour, northeastward toward the surface drainage gully. The contribution of contamination from the Northeast Trenches Source Area to alluvial groundwater appears to be limited, except under high groundwater conditions, because much of the area (including Trench T-3 and part of T-4) overlies unsaturated alluvium. To date, discharge of contaminants at the surface drainage gully appears to be minimal based on groundwater concentrations in the gully that are at or ~~below~~ the method detection limits.

Additionally, the migration of contaminants eastward of the IHSS source area appears to be minimal based on groundwater concentrations in the eastern portion of OU2 that are at or below the detection limits (Figures 4.4.3 through 4.4-45).

Analytical data indicate that VOCs occur (at low concentrations) in a Laramie sandstone where the sandstone subcrops to the Arapahoe Formation No.1 Sandstone on the South Walnut Creek hillside, north of Trench T-4. In the subcrop area, the Laramie sandstone unit is considered to be part of the UHSU and is in hydraulic communication with the Arapahoe

Formation No. 1 Sandstone. A discussion of contaminant migration in the Laramie Formation is presented in Section 5.3.6.

Volatilization of VOCs to form soil gas potentially occurs beneath the T-3 and T-4 trenches due to the presence of residual contamination and possibly NAPL in vadose zone soils. Volatilization of VOCs from groundwater to form soil gas may also occur in association with groundwater contaminant plumes in the Arapahoe Formation No. 1 Sandstone and Rocky Flats Alluvium. The resulting soil gas may reach the atmosphere, depending on the depth of the residual contamination or water table.

This approach was considered appropriate and adequate because the goal of the modeling was to simulate total annual loading to the creek to compute concentrations at exposure points for the human health risk assessment. Detailed simulation of the loading distribution along the creeks was not necessary because the surface water model used to estimate exposure point concentrations does not require that information.

The major assumptions used in applying the ONED3 model were presented in Section E3.3. The following section discusses the rationale used to develop input parameters for the colluvium fate and transport model.

E6.3 MODEL INPUT PARAMETERS

Flow System

The application of ONED3, which is a one dimensional saturated flow model, requires the assumption that uniform saturated conditions extend in the colluvium from the seeps on the hillsides to the creeks in the drainages. Because the model is one dimensional, it is assumed that the width of the flow system is constant and equal to the width of the seep.

Hydraulic Parameters

The hydraulic input parameters required for the ONED3 simulations are pore velocity (i.e., average linear velocity), longitudinal dispersivity, and travel distance.

Pore velocity, v, is given by:

$$v = \frac{K}{n_e}\left(\frac{dH}{dL}\right) \qquad \text{(E6.1)}$$

The hydraulic conductivity, K, and the effective porosity, n_e, of the colluvium/terrace deposits in OU-2 were assumed to be the same as estimated for the colluvium on the OU-1 881 Hillside at Rocky Flats (Fedors et al. 1992). The geometric mean of the hydraulic conductivity field measurement values for the colluvium in OU-1 is 0.4 ft/d (1×10^{-4} cm/s),

and the effective porosity is estimated to be 0.1. The hydraulic gradient, dH/dL, for the hillside of the Woman Creek drainage was estimated from the May 1992 alluvial/colluvial water table map (Figure 3.6-9) to be 0.15 ft/ft. The hydraulic gradient for the hillside of the South Walnut Creek drainage was estimated from the topographic slope to be 0.17 ft/ft. Based on these parameters, the pore velocities toward South Walnut Creek and Woman Creek were calculated using equation E6.1 to be 0.68 ft/d and 0.6 ft/d, respectively.

The longitudinal dispersivity used for the colluvial models for both hillsides was 20 feet, as was used for the MT3D model.

The average travel distances from the groundwater seeps to South Walnut Creek and Woman Creek are approximately 200 feet and 1,000 feet, respectively. The average travel distance from the Trench T-2 source to Woman Creek is approximately 1,000 feet.

Fate and Transport Parameters

Fate and transport parameters required for ONED3 simulations are retardation factors, degradation half-lives, source half-lives, and initial and boundary conditions. Table E6-1 summarizes the fate and transport parameters used in the colluvial models.

Retardation Factor. Site-specific data for organic carbon fraction, f_{oc}, were not available for the colluvium to estimate the distribution coefficient, K_d, for VOC COCs. Therefore, the average of the calculated retardation values for the MT3D model (Table E5-2) were used in the colluvium simulations for VOC COCs (Table E6-1). For radionuclides, the low end values of the retardation range used in the MT3D simulations were used for the colluvial simulations.

Degradation half-life. As for the MT3D model, degradation was assumed not to occur for the VOC COCs. For the radionuclides, the radioactive half-lives used for the MT3D model were also used for the colluvial models.

MT3D model source half-life. The source term for the colluvial model on the Woman Creek hillside consists of a seep source term (from the results of the MT3D model) and a separate continuous trench source term to account for the Trench T-2 site located directly in the colluvium on the hillside (Figure E2-2). Because the 903 Pad source has a finite lifetime as a source of groundwater contamination, the seep source to the colluvial model was simulated as a decaying source. The maximum value used for this source term was equivalent to the maximum average seep concentration along the seep boundary (Figure E2-2) predicted by the MT3D model, and the source term was

infiltration and from upgradient seeps) moves through the trench, as indicated by the colluvial plumes emanating from Trench T-2 (Figures E3-3 through E3-8). Because the width of the contamination plume emanating from the trench is substantially smaller than the assumed width of the flow system (assumed to equal the width of the seep on the hillside), it was necessary to average the trench source concentrations to reflect the actual mass input from Trench T-2 to the flow system. The maximum concentrations observed emanating from Trench T-2 (e.g. approximately 150,00 µ/gl for TCE) are not appropriate for use as source term concentrations for the one dimensional ONED3 model because use of those values would imply that those concentrations were being input across the entire width of the flow system, thus greatly overestimating the masses being contributed to the system from Trench T-2. ~~Because the flow conditions through the Trench T-2 area are not known, it was assumed for modeling purposes that saturated flow occurs in the colluvium from the seeps to the creek across the entire seep width and that the flow conditions are uniform. Based on these assumptions,~~ Therefore, a length-weighted average source concentration was computed for each contaminant emanating from the trench. These length-weighted average concentrations were computed by estimating the average concentrations for the plume width from the plume maps and adjusting those average concentrations for the width of the entire saturated colluvium flow area.

Table E6-2 summarizes the flow-weighted seep source terms and the length-weighted trench source terms used for the colluvial models.

E6.4 PREDICTIVE SIMULATION SCENARIOS AND RESULTS

The predictive simulation scenario for the colluvial models was based on the predictive simulation for the MT3D model (i.e., high recharge, no decay for VOC COCs, decay for radionuclides).

For Woman Creek, two simulations were performed: one for the seep source and one for the Trench T-2 source located directly within the colluvium. The results from these two simulations were then added to yield the combined effect of both sources.

constituents were retained for consideration in a separate risk evaluation in Section H10.2 of the uncertainty section of the HHRA (CDPHE 1994; EPA 1994b; DOE 1994d):

- Surface soil: PAHs
- Groundwater: As, Sb, Be, and Mn

Evaluation of Infrequently Detected Compounds: Organic compounds and metals that were detected at less than 5 percent frequency in surface soil, subsurface soil, and groundwater are listed in tables accompanying Appendix H (Tables H3-3, H3-9, and H3-14). For these infrequently detected compounds, maximum concentrations were compared to screening levels equivalent to 1,000 times RBC to determine whether there was potential risk to human health on the basis of high concentration and toxicity even though the chemicals were rarely detected and exposure potential was low. RBCs were defined as chemical concentrations associated with an excess lifetime cancer risk of 1E-06 (1 in 1 million) or a hazard index of 1 for noncarcinogenic effects. RBCs for chemicals in surface soil were calculated assuming residential exposure by ingestion of soil and inhalation of airborne particulates. RBCs for chemicals in subsurface soil were calculated assuming construction worker exposure by soil ingestion and inhalation of particulates and VOCs. RBCs for chemicals in groundwater were calculated assuming residential exposure by ingestion of water and inhalation of VOCs during water use.

Infrequently detected chemicals whose maximum concentrations exceeded 1,000 times the RBC were retained as special-case COCs for separate evaluation in the risk assessment. Only vinyl chloride in groundwater was identified as exceeding 1,000 times the RBC. The risk-based evaluation of infrequently detected chemicals is described in detail in Appendix B of the TM 9 for OU-2 (DOE 1994b).

Special-Case COCs: Special-case COCs are (1) compounds that were infrequently detected (< 5 percent, and therefore not potential OU-wide chemicals of concern) but that exceeded 1,000 times the RBC and (2) compounds that are probably not environmental contaminants but were retained for separate consideration because of toxicity. Special-case COCs were vinyl chloride in groundwater, PAHs in surface soil, and four metals in groundwater (As, Sb, Be, and Mn).

No. 1. This receptor is the maximum exposed individual (has the highest exposure to chemicals and radionuclides) of all the current and future nonresidential receptors.

Future Ecological Researchers: A future onsite ecological researcher, assumed to perform specific field research projects involving contact with surface soil, surface water, and sediments, was evaluated in AOC No. 1, AOC No. 2, and the 50-acre maximum exposure area in AOC No. 1.

Future Open Space Use: An onsite open space exposure scenario, developed to estimate risks from recreational use of open space areas at RFETS, was evaluated in AOC No. 1 and AOC No. 2.

Future Construction Worker: Future onsite construction workers, assumed to contact subsurface soil during excavation activities associated with construction of commercial buildings, were evaluated in AOC No. 1 and AOC No. 2.

Hypothetical Onsite Resident: EPA, CDPHE, and DOE have agreed that evaluation of a future onsite residential scenario is not required in the HHRA because future land use at RFETS will not include residential development (DOE 1995b; EPA 1995a; CDPHE 1995). Nevertheless, an onsite residential exposure was evaluated in the HHRA in AOC No. 1, AOC No. 2, and in a 10-acre maximum exposure area in AOC No. 1 as a hypothetical scenario to provide an upperbound estimate of risk that may support risk management decisions for low-hazard areas within OU-2. Because residential development is not a reasonable future land use in OU-2, ~~cleanup levels will not be based on estimates of risk to this hypothetical receptor.~~ actual risks to current and possible future receptors will be lower than those estimated for this scenario.

Current and Future Offsite Residences: The two closest current residences to RFETS, located near its southeast border (Figure 6.4-1), were evaluated for impacts from airborne particulate matter released from surface soil in OU-2. Two hypothetical future residences located at Indiana Street were also assessed: at Woman Creek at the southern boundary of OU-2 and at Walnut Creek at the northern boundary of OU-2 (Figure 6.4-1). These receptors were evaluated for exposure to airborne particulate matter and surface water/sediment.

6.4.4 Exposure Pathways

Potentially complete exposure pathways for each receptor are listed in Table 6.4-2 and shown in the CSM on Figure 6.4-2.

The CSM is a schematic representation of the chemical sources, chemical release mechanisms, environmental transport media, human intake routes, and human receptors for OU-2. A complete exposure pathway requires a chemical source, chemical release mechanism, environmental release medium, exposure point, and human intake route. If one of these elements is lacking, the pathway is incomplete and no human exposures can occur.

Incomplete pathways and pathways that were potentially complete but negligible (i.e., potentially complete pathways that are unlikely to have any bearing on mathematical estimations of total risk to receptors) were not evaluated in the HHRA. The following exposure pathways are incomplete or negligible for all receptors.

- Ingestion of fish in Woman or Walnut Creeks (incomplete).
- Ingestion of livestock (likely negligible, but will be evaluated for possible impacts in the residential scenario of the HHRA for OU3).
- Inhalation of VOCs released to outdoor air through volatilization from soil or groundwater (negligible).
- Dermal uptake of metals and radionuclides from soil and sediment (negligible).
- Exposure to groundwater in the LHSU (incomplete). Additional information on the LHSU is presented in Section 4.5 of the RFI/RI report.

Site-wide negligible and incomplete pathways are discussed further in Appendix H of this report and in the Exposure Assessment TM for OU-2 (DOE 1994a).

6.5 EXPOSURE POINT CONCENTRATIONS

Exposure point concentrations of COCs were calculated for each exposure area and exposure medium (surface soil, subsurface soil, groundwater, air, surface water/suspended sediment, and garden produce) evaluated in the risk assessment. The exposure point concentration of a chemical in a sampled medium (e.g., soil or groundwater) is usually the 95 percent upper confidence limit (95% UCL) on the arithmetic mean. The 95% UCL on the mean is an estimate of the average concentration to which people would be exposed over time in the exposure area. Sometimes the maximum detected concentration is used as the exposure concentration if the data set does not permit a good estimate of the mean. This can occur with small data sets or in data sets with a high frequency of nondetects. If the calculated 95% UCL concentration exceeds the maximum detected concentration, the maximum is used as the exposure concentration (EPA 1989a). For convenience in this report, the 95% UCL or maximum concentration is referred to as the RME concentration. RME concentrations of COCs were used in estimating risk for both the CT and RME exposure scenarios.

6.5.1 Calculating the Concentration Term

Tables 6.5-1 through 6.5-3 summarize the exposure concentrations of COCs in surface soil, subsurface soil, and groundwater for each exposure area evaluated in the HHRA. Attachment H1 to Appendix H shows analytical results used in the calculations. In calculating exposure concentrations from chemical analytical results, one-half the SQL was used to represent the concentration in samples that were "nondetect" for a chemical, provided that the chemical was detected in at least one other sample in the data set (EPA 1989a). An exception to this rule is when the non-detect SQL is unusually high due to sample dilution. The SQL for diluted samples can far exceed the measured concentrations of the chemical in other samples. EPA (1989a) recommends removal of unusually high nondetect SQLs from the data set when they would cause the calculated exposure concentration to exceed the maximum concentration. ~~These~~ Therefore, samples were excluded from the data set if they caused the arithmetic mean concentration to exceed the maximum detected concentration.

The same principle was applied when a compound was detected in very few samples and only at estimated quantities below the CRQL. If using one-half the CRQL for nondetects caused the arithmetic mean concentration to exceed the maximum reported concentration, those nondetect samples were excluded from the data set.

Attachment H1 to Appendix H contains tables showing all analytical results in the data sets and the calculation of 95% UCL concentrations for surface soil, subsurface soil, and groundwater. The 95% UCL concentrations were calculated based on either a normal or lognormal distribution, as appropriate. Probability plots and histograms are also shown for most data sets. In some cases, the calculation of the 95% UCL based on a lognormal distribution gave an unreasonable result (e.g., a value much higher than the maximum observation), even though the data appear to fit a lognormal distribution. These cases were most common for small data sets and for larger data sets that had a range of several orders of magnitude between the minimum and maximum observations. When unreasonable results were obtained, other values (either the maximum concentration or the 95% UCL based on a normal distribution) were used as the exposure concentration for risk assessment. These cases are noted in Tables 6.5-1 through 6.5-3 and are discussed in Attachment H1.

6.5.2 Surface Soil

Table 6.5-1 summarizes the RME concentrations of COCs in onsite surface soil in each exposure area. COCs are aroclor-1254, aroclor-1260, BEHP, Cr, Am-241, and Pu-239/240. Exposure point concentrations were calculated for AOCs No. 1 and No. 2 and for the maximum exposure areas of 10, 30, and 50 acres in AOC No. 1.

Several factors regarding the surface soil exposure point concentrations are noteworthy:

- Aroclors (PCBs), although identified as OU-wide COCs using the selection process described in Section 6.3, were detected in only 2 of 40 surface soil samples, both collected in 1993 at the Mound Area (IHSS 113) (Figure 6.5-1). Therefore, exposure potential—and probable health risk—is minimal. ~~In addition, the total PCB concentration (0.97 mg/kg aroclor-1254 + 0.66 mg/kg aroclor-1260 = 1.6 mg/kg PCB) is well below the cleanup guideline of 25 mg/kg for industrial use commonly applied to PCB spills (EPA 1990d).~~

- Cr was not statistically different from background concentrations (Appendix A, TM 9 DOE 1994b). Nevertheless, it was identified as an OU-wide COC because two sample results (26 mg/kg and 29.5 mg/kg) exceeded the background upper tolerance limit ($UTL_{99/99}$) of 24.8 mg/kg. RME

The indoor air concentrations were estimated using a simple model in which RME concentrations of VOCs in groundwater were multiplied by a constant volatilization factor (VF) to convert a water concentration (mg/L) to an air concentration (mg/m^3) (Andelman 1990). In the derivation, all uses of household water were considered (e.g., showering, laundering, dish washing.) To estimate an RME air concentration, a CT value for VF of 0.065 mg/m^3 air per mg/L water was multiplied by the RME concentration in groundwater to yield the RME indoor air concentration. A CT value was chosen for the volatilization factor since risks are evaluated for a chronic exposure. This CT value would, therefore, best represent a chronic exposure situation.

6.5.9 Surface Water/Sediment

Currently, under the RFETS surface water management plan, both Woman and Walnut Creeks are monitored, and surface water discharges meet applicable federal and state surface water quality requirements. The current water management plan eliminates or minimalizes transport of potential OU-2 contaminants from creeks to offsite receptors. Thus, there was assumed to be ~~no~~ negligible current risk associated with contact with surface water in the creeks offsite. A screening-level model was used to estimate future reasonable maximum 30-year average concentrations of COCs that could result from migration of OU-2 contaminants in UHSU groundwater to surface water and from transport of contaminated surface soil in storm runoff, assuming that the surface water is not monitored, detained in ponds, diverted, or treated. Concentrations estimated at Woman and Walnut Creeks at Indiana Street were used as exposure concentrations for both onsite and offsite receptors. The 30-year period was selected to correspond to the RME duration for residential receptors. The groundwater modeling, used to estimate contaminant loads to the creeks, is described in Appendix E. The surface water model is described in Appendix F.

The surface water model consisted of two major portions: (1) hydrologic simulation of flow originating from the entire watersheds of Woman Creek and Walnut Creek upstream of Indiana Street and (2) fate and transport simulation of contaminant loads from OU-2 groundwater (chlorinated solvents, Am-241, and Pu-239/240) and surface soil (Am-241 and Pu-239/240). Other COCs in surface soil (BEHP, PCBs, and Cr) were not modeled as source loads to the creeks because they were non-detect or below background levels at all but one or two sampling locations and the mass flux of these COCs would be insignificant compared to mass flux of Pu-239/240 and Am-241, which were found at nearly all surface soil sampling locations.

6.8.2 Carcinogenic Risk

Potential carcinogenic effects are characterized in terms of the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen. Excess lifetime cancer risk is estimated from the projected lifetime daily average intake and the cancer SF, which represents an upperbound estimate of the dose-response relationship. Excess lifetime cancer risk is calculated by multiplying the average daily chemical intake by the cancer SF as follows:

$$\text{Cancer Risk} = \text{Chemical Intake (mg/kg-day)} \times \text{SF (mg/kg-day)}^{-1}$$

EPA states that carcinogenic risks estimated using SFs are upper-bound estimates. This means that the actual risk is likely to be less than the predicted risk (EPA 1989a). RME cancer risks could be significantly overestimated because they are generally calculated by multiplying together 95th percentile estimates of cancer potency, 95% UCLs of concentrations, and high-end estimates of several exposure parameters.

The risks resulting from exposure to multiple carcinogens are assumed to be additive. The total cancer risk is estimated by summing the risks estimated for each COC and for each pathway. This is a highly conservative approach that results in an artificially elevated estimate of cancer risk, especially if several carcinogens are present, because 95th percentile estimates are not strictly additive (EPA 1989a).

EPA policy must be considered in order to interpret the significance of the cancer risk estimates. In the National Oil and Hazardous Substances Pollution Contingency Plan (EPA 1990d), EPA states that: "For known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper-bound lifetime cancer risk of between 10^{-4} and 10^{-6}." Additionally, where cumulative carcinogenic risk to an individual based on RME exposure is less than 10^{-4} and the total HI does not exceed 1, action is generally not warranted for protection of public health (EPA 1991d).

EPA recommends that cancer risk be evaluated separately for radionuclides and nonradionuclides (EPA 1989a). In the current assessment, separate estimates for radionuclide and nonradionuclide cancer risk were presented in Attachment H3, Health Risk Calculations. However, to reduce complexity in the following sections, cancer risks from radionuclide and nonradionuclide exposures were added and reported as total cancer risk.

6.8.3 AOC No. 1

AOC No. 1 includes the 903 Pad, Mound, Northeast Trenches, and Southeast Trenches, which contain all of the IHSSs that were investigated in OU-2. Hazard/risks results for current and future receptors evaluated in AOC No. 1 are summarized in Table 6.8-1 and detailed in Attachment H3 in Appendix H.

Noncarcinogenic Hazard Index: The cumulative HIs for noncarcinogenic health effects for current and future onsite nonresidential receptors in AOC No.1 are 4E-02 or less for the average and RME conditions (Table 6.8-1). Because the HIs are less than 1, no adverse noncancer health effects are expected even for sensitive individuals exposed under RME conditions.

The cumulative HIs for the onsite residential exposure in AOC No. 1 are 2E+01 and 1.4E+02 for the average and RME conditions, respectively. Ingestion of groundwater is the only pathway that contributes significantly to the total HI (Table 6.8-1). CCl_4 and PCE contribute most of the total HI (Attachment H3 in Appendix H). Residential development is not a reasonable future land-use scenario in OU-2; ~~therefore, cleanup levels will not be based on estimates of hazard/risk to this hypothetical receptor.~~ therefore, actual risks to current and possible future receptors in OU2 will be lower than those estimated for this scenario.

Carcinogenic Risk: Excess lifetime cancer risk estimates for onsite receptors in AOC No. 1 are summarized in Table 6.8-1 and detailed in Attachment H3 in Appendix H. Excess lifetime cancer risk estimates for all nonresidential receptors in AOC No. 1 were less than or within the EPA target cancer risk range of 1E-06 to 1E-04 (1 in 1 million to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1989a). Exposure to Pu-239/240 in surface soil by the ingestion and inhalation pathways accounted for most of excess lifetime cancer risk for these receptors.

The estimated excess lifetime cancer risk for the hypothetical residential scenario is 4E-04 (4 in 10,000) under the average exposure condition and 8E-03 (8 in 1,000) under the RME condition. These levels exceed the EPA target risk range of 1E-06 to 1E-04 (1 in 1 million to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1989a). Since onsite residential developmental will not occur at RFETS, these risk estimates do not reflect actual risk expected from current and probable future use in AOC No. 1.

(Table 6.8-2). Ingestion of CCl_4, $CHCl_3$ and PCE account for most of the total average and RME HIs (Attachment H3 in Appendix H).

The estimated excess lifetime cancer risk is 1E-03 (1 in 1,000) under the average exposure conditions and 1.5E-02 (1.5 in 100) under RME conditions. These levels exceed the EPA target risk range of 1E-06 to 1E-04 (1 in 1 million to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1989a). Ingestion of groundwater, inhalation of indoor VOCs from domestic use of groundwater, and ingestion of surface soil are the pathways that contribute significantly to overall risk (Table 6.8-2). Chief contributors to risk from groundwater exposure are CCl_4, $CHCl_3$, TCE, PCE, and 1,1-DCE (Attachment H3 in Appendix H).

Future Industrial/Office Worker (30-acres): The exposure pathways evaluated for the future onsite worker were surface soil ingestion and dermal contact, inhalation of PM_{10}, and inhalation of indoor VOCs. The cumulative HIs for this receptor in the 30-acre maximum exposure area are 1E-02 for the average exposure condition and 8E-02 for the RME condition. These values are below 1, indicating that no adverse noncancer health effects are expected for the future onsite industrial/office worker in this exposure area.

The estimated excess lifetime cancer risk is 5E-06 (5 in 1 million) for the average exposure condition and 2E-04 (2 in 10,000) under the RME condition. The RME cancer risk level ~~slightly~~ exceeds the EPA target risk range of 1E-06 to 1E-04 (1 in 1 million to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1989a). Exposure to Pu-239/240 in surface soil by the ingestion and inhalation pathways accounted for most of the estimated excess lifetime cancer risk for this receptor.

Future Onsite Ecological Worker (50-acres): The cumulative HIs for this receptor in the 50-acre maximum exposure area are 8E-03 for the average exposure condition and 4E-02 for the RME condition. These values are well below 1, indicating that no adverse noncancer health effects are expected for the future onsite ecological worker.

The estimated excess lifetime cancer risk is 2E-06 (2 in 1 million) for the average exposure condition and ~~6~~7E-06 (6 in 1 million) for the RME condition. These levels ~~are near the point of departure" of 1E-06 (1 in 1 million) of excess cancer risk for evaluating risk associated with~~ are within the EPA target risk range of 1E-06 to 1E-04 (1 in 1 million to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1989a). ~~and indicate negligible risk for this receptor.~~

6.8.5 AOC No. 2

AOC No. 2 is the East of IHSSs area, located in the buffer zone between the IHSSs and Indiana Street. No IHSSs or other waste disposal areas are present in AOC No. 2. Hazard/risk results for current and future receptors located in AOC No. 2 are summarized in Table 6.8-3 and detailed in Attachment H3 in Appendix H.

Noncarcinogenic Hazard Index: For all current and future onsite receptors, including the hypothetical onsite resident, the cumulative HIs for noncarcinogenic health effects in AOC No. 2 are 2E-02 or less for the average and RME conditions. Because the HIs are well below 1, no adverse noncancer health effects are expected even for sensitive individuals exposed under RME conditions.

Carcinogenic Risk: For current and future nonresidential onsite receptors, the estimated excess lifetime cancer risks in AOC No. 2 are 1E-06 (1 in 1 million) or less (Table 6.8-3). These levels are at or below the EPA "point of departure" of 1E-06 (1 in 1 million) for evaluating risk from exposure to chemicals released from hazardous waste sites (EPA 1989a), and indicate that cancer risks are negligible for each of these receptors. Cancer risk results for each receptor are listed below.

The estimated excess lifetime cancer risk for the hypothetical future onsite receptor in AOC No. 2 is 8E-07 (8 in 10 million) under the average exposure conditions and 1E-05 (1 in 100,000) under RME conditions (Table 6.8-3). These levels are within or below the EPA target risk range of 1E-06 to 1E-04 (1 in 1 million to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1989a).

6.8.6 Offsite Residents

Current and future offsite residential receptors were evaluated for exposure to chemicals transported in air from AOC No. 1 and from AOC No. 2. Future offsite receptors were also evaluated for exposure to surface water/suspended sediment transported from OU-2 sources

Cumulative HIs were less than 1 and cancer risk estimates were below 2E-04 for all nonresidential receptors.

HIs for the hypothetical onsite residential scenario ranged from 2E+01 (CT, AOC No. 1) to 1.6E+02 (RME, 10-acre area) and cancer risk estimates ranged from 4E-04 (CT, AOC No. 1) to 2E-02 (RME, 10-acre area), chiefly due to VOCs in groundwater. These results for the residential scenario indicate that hazard/risks from domestic use of groundwater in AOC No. 1 and the 10-acre maximum exposure area would be expected to exceed levels of concern. However, total HIs associated with other exposure pathways were less than 1, and cancer risk estimates ranged from ~~1.3E-05~~1.5E-05 (CT, 10-acre area) to ~~3E-04~~ 4E-04 (RME, AOC No. 1) for other exposure pathways. Residential use of groundwater will not occur in OU-2 because future land use at RFETS will not include residential development (DOE 1995b; EPA 1995a; CDPHE 1995). Drinking water for current onsite workers is provided by a municipal water supply, and it is expected that drinking water for future receptors will be provided from a public water supply. Because direct ingestion of groundwater is an incomplete pathway for all current and possible future onsite receptors in OU-2, chemicals in groundwater do not pose a risk to human health.

A hypothetical onsite residential receptor was evaluated in AOC No. 2 to provide an upper-bound estimate of risk to support risk management decisions. Hazard/risk estimates for this "worst case scenario" did not exceed generally accepted levels of risk: the RME HI was 6E-03, well below 1, and the RME cancer risk was ~~9E-06~~ 1E-05, well within EPA's target risk range of 1E-06 to 1E-04. Hazard/risk estimates for other receptors evaluated in AOC No. 2 were well below levels of concern.

Total HIs and lifetime cumulative excess cancer risk for offsite receptors were very low (HI of 6E-04 or less, cancer risk of 2E-07 or less), indicating that no adverse noncancer health effects are expected and cancer risk is negligible for these receptors. These results reflect insignificant impacts from airborne particulate matter from OU-2 sources and negligible risk associated with modeled concentrations of OU-2 COCs in surface water/sediment in Walnut and Woman Creeks.

Estimated annual radiation doses were 18 mrem or lower for all nonresidential receptors evaluated in AOC No. 1. These doses are below the DOE limit of 100 mrem/year for protection of public health and 5,000 mrem/year for radiological worker exposure.

Estimated annual radiation doses for hypothetical residents ranged from ~~11~~ 13 mrem/year (CT, AOC No. 1) to ~~66~~ 67 mrem/year (RME, 10-acre). External irradiation from surface soil, ingestion of surface soil, inhalation of airborne particulates, and groundwater ingestion were the primary pathways contributing to the total RME annual radiation dose. These levels are also below DOE limits for protection of the public. Because onsite residential development will not occur in OU-2, the estimates of annual radiation dose to hypothetical onsite residents do not reflect actual doses expected under current and probable future land use at RFETS.

The next highest radiation dose results were associated with future industrial/office worker exposures in the 30-acre maximum exposure area. These were ~~8~~ 10 mrem/year and ~~18~~ 20 mrem/year for the CT and RME scenarios, respectively. Inhalation of Pu contributed to most of the annual dose. These values are below the DOE limit of 100 mrem/year for members of the public.

Radiation dose calculations for AOC No. 2 are summarized in Table 6.9-2. Total annual radiation doses were 2 mrem/year or less for all onsite receptors in AOC No. 2, indicating that exposure to radionuclides in AOC No. 2 is negligible.

Total radiation doses for offsite receptors are very low (~~0.003~~ 0.004 mrem/year or less; Table 6.9-3). These results reflect insignificant impacts from airborne particulate matter from OU-2 sources and from radionuclides transported from OU-2 sources in surface water/sediment in Walnut Creek and Woman Creek.

6.10 UNCERTAINTIES AND LIMITATIONS

Uncertainties and limitations are inherent in the risk assessment process. The level of certainty associated with the conclusions of the risk assessment are conditional, based on the quality of data and model used to identify COCs and estimate chemical concentrations, the assumptions made in estimating exposure conditions, the conservatism of the methods used to develop toxicity values, and the conservatism of methods used to characterize risk. At all

do not have EPA-established toxicity factors and could not be evaluated quantitatively in the risk assessment. Most of the chemicals were detected at low frequency and at low concentrations and are not expected to contribute to risk compared to high frequency, high concentration COCs. Pb and Cu in groundwater and soil and 1,1,1-TCA in subsurface soil and groundwater were detected at high frequency and do not have EPA established toxicity values. Each were evaluated qualitatively and are not expected to contribute to underestimation of risk.

As discussed in Section H7.1, unadjusted oral toxicity values were used to estimate effects from dermal absorption of organic chemicals. Risk from dermal exposure may be underestimated by this approach. Risk from dermal exposure for the office worker in the 30-acre maximum exposure area in AOC No.1 was 4E-06 and risks for other receptors were lower. Because these risk estimates for dermal exposure were within or below EPA's target risk range of 1E-06 to 1E-04 and represented only a small percentage of overall risk, further evaluation of dermal toxicity factors was not warranted.

6.10.5 Evaluation of Risk Associated with Special-Case COCs

Special-case COCs are (1) compounds that are infrequently detected (<5 percent) but that exceeded 1,000 times the RBC or (2) compounds that are probably not environmental contaminants but were retained for separate consideration because of toxicity. The special case COCs include: metals and vinyl chloride in groundwater and PAHs in surface soil.

As a comparison to risk estimates for metals in unfiltered OU-2 groundwater samples and to help support the conclusion that metals in OU-2 groundwater are naturally occurring, hazard/risk levels were also estimated for background levels of As, Sb, Be, and Mn. The results indicate that hazard/cancer risk estimates from hypothetical residential exposure to naturally occurring metals in groundwater exceed generally accepted risk levels. However, cancer risk estimates for these metals were similar to or less than cancer risk estimates for background levels, suggesting that the special-case metals in groundwater are naturally occurring, and are not due to environmental contamination.

Vinyl chloride in groundwater was evaluated for the residential ingestion pathway, even though residential development is not a reasonable future use scenario. The cancer risk

level for hypothetical residential ingestion of groundwater from the most contaminated well exceeds the EPA target risk range of 1E-06 to 1E-04. Vinyl chloride was one of several chlorinated solvents detected in groundwater. The other compounds also resulted in excess cancer risk estimates in the range of 1E-03 to 1E-02, so the incremental risk from vinyl chloride would not significantly affect the total cancer risk estimated for exposure to groundwater.

PAHs in surface soil were evaluated for onsite residential exposure. The carcinogenic risk due to PAHs (3E-06) is within the target risk range of 1E-06 and 1E-04 for the hypothetical resident. Estimated risk under the industrial/office worker scenario would be approximately ~~10~~ 5 times less (6E-07) and would not contribute significantly to overall risk from exposure to surface soils for this receptor.

6.11 SUMMARY AND CONCLUSIONS

6.11.1 Summary

The HHRA for RFETS OU-2 estimated health risks and annual radiation doses for current and future onsite and offsite receptors who could be exposed directly or indirectly to COCs at or released from sources in OU-2. COCs were identified as the chemicals, metals, or radionuclides in soil or groundwater that were likely to contribute at least 1 percent of overall risk. The chief COCs were Am-241 and Pu-239/240 in surface soil, subsurface soil, and groundwater and chlorinated solvents in groundwater.

Exposure scenarios evaluated were a current worker (security patrol), a future industrial/ office worker, a future ecological researcher, a construction worker, future open space use, and offsite residential exposures. In addition, a hypothetical onsite residential scenario was evaluated, even though future residential development will not occur, in order to provide an upperbound estimate of risk to support risk management decisions for low-hazard areas in OU-2.

Exposure media evaluated were surface soil, subsurface soil (construction worker only), outdoor and indoor air, surface water/sediment, and groundwater (residential only).

Risks were estimated for two AOCs in OU-2: AOC No. 1 contains all of the IHSSs within the OU and includes the extent of contiguous groundwater contaminant plumes in OU-2. AOC No. 2 is east of the IHSSs and extends to Indiana Street. In addition, risks were evaluated in three maximum exposure areas: a 10-acre area at the 903 Pad area (hypothetical resident), a 30-acre area including the 903 Pad area (industrial/office worker scenario), and a 50-acre ecological study area including the 903 Pad area.

Annual radiation doses in terms of mrem/year were also estimated for comparison to national radiation standards.

The risk characterization process combines average and reasonable maximum estimates of exposure with upperbound estimates of toxicity to yield conservative (protective) estimates of health risk. Estimates of health risk for average (CT) and RME conditions are provided so that risk management decisions can be based on a range of potential risk for different exposure scenarios.

Results of the risk assessment can be described as follows:

AOC No. 1: HIs and cancer risk estimates were below levels of concern for all current and possible future land use scenarios in AOC No. 1. Hazard/risk estimates for the hypothetical resident exceeded levels of concern. These results are described below:

- The future industrial/office worker is the maximum exposed individual under current and possible future land use scenarios in AOC No. 1. Pathways evaluated were exposure to surface soil, airborne PM_{10}, and indoor VOCs from soil gas. Cumulative HIs were below 1, indicating no threat of adverse noncarcinogenic effects. RME (8E-05) and CT ~~(2E-06)~~ (3E-06) cancer risk estimates for this receptor in AOC No. 1 are within EPA's target cancer risk range of 1E-06 to 1E-04. Ingestion of Pu-239/240 in surface soil was the greatest contributor to overall risk (Attachment H3).

  ~~RME cancer risk estimates are likely to significantly overestimate actual risk for this receptor because (1) the concentration terms for Pu-239/240 in surface soil in AOC No. 1 and the 30-acre maximum exposure area are biased~~

~~by two extreme values in the sample set and (2) the estimates are based on ingesting 50 mg/day contaminated soil and inhaling PM_{10} outdoors 8 hours each day for 25 years, with no landscaping, paving, or indoor work to reduce exposure to surface soil.~~

- Cumulative HIs were below 1 for current workers and for future ecological workers, open space users, and construction workers in AOC No. 1, indicating that no adverse noncarcinogenic health hazards are expected for these nonresidential exposure scenarios. RME cancer risk estimates for these receptors ranged from ~~2E-07~~ 3E-07 to 1E-05. These values are within or below EPA's target cancer risk range of 1E-06 to 1E-04. The contaminants that contributed most to estimated health risk for nonresidential onsite receptors are Pu-239/240 and Am-241 in surface soil.

- Chlorinated solvents in groundwater in AOC No. 1 would pose unacceptable risk if directly ingested (hypothetical onsite residential scenario). However, drinking water for current onsite workers is provided by a municipal water supply, and it is expected that drinking water for future onsite receptors will also be provided from a public water supply. Therefore, ingestion of UHSU groundwater is an incomplete pathway for all current and possible future receptors in OU-2. Additionally, migration of groundwater via surface water to offsite locations is not significant, even using conservative modeling assumptions.

Maximum Exposure Areas: HIs were below levels of concern and cancer risk estimates were at or below levels of concern for future industrial/office workers and ecological researchers in 30- and 50-acre maximum exposure areas, respectively. Hazard/risk estimates for hypothetical onsite residents in a 10-acre maximum exposure area exceeded levels of concern. These results are described below.

- Chlorinated solvents in groundwater in the 10-acre maximum exposure area in AOC No. 1 would pose an unacceptable risk if directly ingested (hypothetical onsite residential scenario). However, groundwater ingestion is an incomplete pathway for all current and possible future receptors in OU-2.

- Cumulative HIs were below 1 for the future industrial/office worker in the 30-acre maximum exposure area, indicating no threat of adverse noncarcinogenic effects. ~~RME (2E-04) and~~ The CT ~~(5E-06)~~ cancer risk estimate for this receptor ~~are at or~~ is within EPA's target cancer risk range of 1E-06 to 1E-04, ~~whereas the RME cancer risk estimate (2E-04) exceeds this range. RME cancer risk estimates for this receptor are likey to significantly overestimate acutal risk because overly conservative assumptions resulted in overestimation of intake values for ingestion and inhalation of soil.~~ Ingestion of Pu-239/240 in surface soil was the greatest contributor to overall risk (Attachment H3). ~~However, the concentration term for Pu-239/40 in surface soil in the 30-acre maximum exposure area was biased by an extreme value in one sample and other samples in the data set had significantly lower concentrations.~~ ~~However, RME cancer risk estimates are likely to significantly overestimate actual risk for this receptor because (1) two extreme values in the Pu-239/240 sample set for surface soil bias concentration terms in this exposure area, and (2) intake factors for ingestion and inhalation of soil are overestimated because of overly conservative exposure assumptions.~~

- Cumulative HIs and cancer risk estimates for the future ecological worker in the 50-acre maximum exposure area were below levels of concern.

AOC No. 2: Cumulative HIs ~~were below 1~~ and cancer risk estimates were below levels of concern for onsite receptors in AOC No. 2 (including the hypothetical onsite resident).

Offsite Receptors: HIs and cancer risk estimates for offsite residential receptors were negligible.

6.11.2 Conclusions

The maximum RME cancer risk estimate was 2E-04 for a future industrial/office worker in the 30-acre maximum exposure area. Cancer risk estimates for all other nonresidential receptors and exposure areas were within or below EPA's target cancer risk range of 1E-06 to 1E-04. The highest cancer risk estimate of 2E-04 ~~only slightly~~ exceeds EPA's target risk

range. HIs were below 1 for all onsite nonresidential receptors. Hazard/risk estimates for offsite residents were negligible.

Estimated annual radiation doses for nonresidential onsite receptors were less than 20 mrem/year, well below the DOE standard of 100 mrem/year for protection of the public. The estimated annual radiation dose for the hypothetical onsite residents, even in the 10-acre maximum exposure area, were below 70 mrem/year.

~~In general, cancer risk levels that do not exceed 1E-04, combined with HIs that do not exceed 1, may be used to support a decision that remediation is not warranted for the protection of public health (EPA 1991d). These results suggest that remediation of surface and subsurface soil in OU-2 may not be necessary for protection of public health.~~

Concentrations of chlorinated solvents in UHSU groundwater in AOC No.1 would pose an unacceptable risk if directly ingested. However, direct ingestion of groundwater is an incomplete exposure route for all current and possible future receptors in OU-2 largely because of availability of public water. Therefore, chemicals in groundwater do not pose a risk to human health under current and possible future land use scenarios.

TABLE 6.3-3
CONCENTRATION/TOXICITY SCREEN
SURFACE SOIL
NONCARCINOGENS

Chemical	Maximum Detected Conc. (mg/kg)	Inhalation RfD	Oral RfD	Risk Factor	Risk Index	% of Total Risk Factor
Chromium (1)	29.5	n/a	1.0E+00	3.0E+01	5.4E-01	53.6
Bis(2-ethylhexyl)phthalate	0.51	n/a	2.0E-02	2.6E+01	4.6E-01	46.4
Total Risk Factor				5.5E+01		

RfDs are in units of mg/kg-day.

n/a - not available.

(1) Evaluated as Cr III based on results of speciation study.

TABLE 6.5-4
MAXIMUM ANNUAL AVERAGE AIR CONCENTRATIONS AND DEPOSITION RATES OF CHEMICALS OF CONCERN

	Aroclor-1254		Aroclor-1260		Bis(2-ethylhexyl)phthalate		Chromium		Americium-241		Plutonium-239/240	
	Air Concentration (mg/m^3)	Deposition Rate (mg/m^2-year)	Air Concentration (mg/m^3)	Deposition Rate (mg/m^2-year)	Air Concentration (mg/m^3)	Deposition Rate (mg/m^2-year)	Air Concentration (mg/m^3)	Deposition Rate (mg/m^2-year)	Air Concentration (pCi/m^3)	Deposition Rate (pCi/m^2-year)	Air Concentration (pCi/m^3)	Deposition Rate (pCi/m^2-year)
AOC No. 1												
Maximum	4.15E-09	6.75E-04	3.25E-09	5.29E-04	3.39E-09	5.51E-04	1.89E-07	3.07E-02	4.09E-04	6.646E+01	1.13E-02	1.841E+03
AOC No. 2												
Maximum	--	--	--	--	1.62E-09	2.64E-04	1.93E-07	3.14E-02	2.13E-05	3.461E+00	1.53E-04	2.482E+01
AOC No. 1 10-Acre Maximum Exposure Area												
Maximum	--	--	--	--	4.92E-09	7.99E-04	1.61E-07	2.61E-02	8.45E-04	1.367E+02	3.90E-03	6.333E+02
AOC No. 1 30-Acre Maximum Exposure Area												
Maximum	7.21E-09	NA	5.22E-09	NA	4.29E-09	NA	1.59E-07	NA	8.11E-04	NA	2.15E-02	NA
AOC No. 1 50-Acre Maximum Exposure Area												
Maximum	6.43E-09	NA	4.73E-09	NA	4.10E-09	NA	1.60E-07	NA	7.28E-04	NA	1.55E-02	NA
Impacts from AOC No. 1												
Current: Southeast												
Maximum	6.57E-13	0	5.15E-13	0	5.36E-13	0	2.99E-11	0	6.49E-08	0	1.79E-06	0
Future: Woman/Indiana												
Maximum	3.88E-13	0	3.04E-13	0	3.17E-13	0	1.77E-11	0	3.85E-08	0	1.06E-06	0
Impacts from AOC No. 2												
Current: Southeast												
Maximum	--	--	--	--	7.26E-13	3.47E-07	8.65E-11	4.13E-05	9.51E-09	4.55E-03	6.76E-08	3.23E-02
Current: Indiana South												
Maximum	--	--	--	--	1.10E-14	0	1.31E-12	0	1.44E-10	0	1.02E-09	0
Future: Walnut/Indiana												
Maximum	--	--	--	--	3.30E-14	0	3.93E-12	0	4.33E-10	0	3.07E-09	0
Future: Woman/Indiana												
Maximum	--	--	--	--	4.07E-13	3.47E-07	4.85E-11	4.13E-05	5.32E-09	4.55E-03	3.79E-08	3.23E-02

Notes:

Air concentrations and deposition rates are based on five annual simulations ***from 1989 through 1993*** detailed in Appendix G of this RFI/RI Report. Maximum annual averages were observed in 1990.

Deposition rates reported as ug/m^2-day in Appendix G were converted to mg/m^2-year using a conversion factor of 0.365 days-mg/year-ug.

Radionuclides reported in ug were converted to pCi using specific activities for Am-241 of 3.435E+06 pCi/ug and for Pu-239/240 of 7.32E+04 pCi/ug. The specific activity for Pu is the sum of the relative activities for Pu-238, Pu-239, and Pu-240 based on isotopic composition of Pu used at Rocky Flats (EG&G Rocky Flats 1993e, Table 6-1).

-- Aroclors were not detected in these areas.

NA - ***Not applicable for exposure assessment because deposition onto home grown produce is an incomplete pathway for the 30- and 50-acre exposure areas.***

0 - No predicted impacts ***(the model reports "0" when modeled PM_{10} concentrations are less than 0.001 ug/m^3)***.

TABLE 6.5-5
SUMMARY OF AIR CONCENTRATIONS OF CHEMICALS OF CONCERN
CONSTRUCTION SCENARIO

Chemical of Concern	AOC No. 1	AOC No. 2
Aroclor-1254 (mg/m^3)	4.15E-09	--
Aroclor-1260 (mg/m^3)	3.25E-09	--
Bis(2-ethylhexyl)phthalate (mg/m^3)	3.39E-09	1.62E-09
Arsenic (mg/m^3)	7.12E-11	1.34E-10
Cadmium (mg/m^3)	1.35E-11	5.54E-09
Chromium (mg/m^3)	1.89E-07	1.93E-07
Mercury (mg/m^3)	1.30E-11	--
Americium-241 (pCi/m^3)	4.12E-04	2.13E-05
Plutonium-239/240 (pCi/m^3)	1.13E-02	1.53E-04
Uranium-233, -234 (pCi/m^3)	9.29E-09	1.36E-08
Uranium-235 (pCi/m^3)	7.92E-10	7.92E-10
Uranium-238 (pCi/m^3)	9.82E-09	1.25E-08

NOTE:
Air concentrations are based on the maximums of five annual simulations from 1989 through 1993, detailed in Appendix G of this RFI report.

-- Not detected in this area.

TABLE 6.5-3
EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF CONCERN IN GROUNDWATER

	AOC No.1		AOC No. 2		AOC No. 1 Maximum Exposure Areas 10-Acre		AOC No. 1 Maximum Exposure Areas 30-Acre
1,1-Dichloroethene (µg/L)							
Number of Wells Sampled	99		--		16		32
Number of Wells where Detected	41		--		12		19
Minimum Well Average[a]	0.1		--		0.1		0.1
Maximum Well Average[a]	351		--		351		351
95%UCL[a]	4	ln	--		68	n,d	
RME Concentration	4		--				
Carbon Tetrachloride (µg/L)							
Number of Wells Sampled	100		--		17		33
Number of Wells where Detected	75		--		17		26
Minimum Well Average	0.1		--		0.1		0.08
Maximum Well Average	16,000		--		16,000		16,000
95%UCL	3,478	ln	--		3,569	n,d	
RME Concentration	3,478		--				
Chloroform (µg/L)							
Number of Wells Sampled	100		11		17		33
Number of Wells where Detected	78		2		16		25
Minimum Well Average	0.1		0.2	sr	0.1		0.1
Maximum Well Average	30,667		0.4	sr	30,667		30,667
95%UCL	104	ln			5,178	n,d	
RME Concentration	104		0.4				
Methylene Chloride (µg/L)							
Number of Wells Sampled	100		11		17		33
Number of Wells where Detected	47		4		6		16
Minimum Well Average	0.20		0.3	sr	0.70		0.40
Maximum Well Average	20,433		3.3	sr	20,433		20,433
95%UCL	13.6	ln			3,346	n,d	
RME Concentration	13.6		3.3				
Tetrachloroethene (µg/L)							
Number of Wells Sampled	100		11		17		33
Number of Wells where Detected	81		4		17		30
Minimum Well Average	0.1		0.1	sr	0.3		0.1
Maximum Well Average	11,033		0.62	sr	11,033		11,033
95%UCL	1,148	ln			2,022	n,d	
RME Concentration	1,148		0.62				
Trichloroethene (µg/L)							
Number of Wells Sampled	100		11		17		33
Number of Wells where Detected	79		3		15		27
Minimum Well Average	0.07		0.2	sr	0.1		0.07
Maximum Well Average	97,000		0.7	sr	97,000		97,000
95%UCL	1,103	ln			16,025	n,d	
RME Concentration	1,103		0.7				

TABLE 6.5-3
EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF CONCERN IN GROUNDWATER

					AOC No. 1 Maximum Exposure Areas		
	AOC No.1		AOC No. 2		10-Acre		30-Acre
Americium-241 (pCi/L)							
Number of Wells Sampled	69		5		14		NE
Number of Wells where Detected	69		5		14		NE
Minimum Well Average	-0.01		0.00		0.01		NE
Maximum Well Average	31.5		0.22		31.5		NE
95%UCL	0.19	ln	42.2	ln	6.7	n,d	NE
RME Concentration	0.19		0.22				NE
Plutonium-239/240 (pCi/L)							
Number of Wells Sampled	70		5		15		NE
Number of Wells where Detected	70		5		15		NE
Minimum Well Average	0.00		0.00		0.01		NE
Maximum Well Average	225		1.13		225		NE
95%UCL	2.4	ln	1.6E+05	ln	43.7	n,d	NE
RME Concentration	2.4		1.13				NE

-- Not detected in this area.
ln - Based on lognormal distribution.
n - Based on normal distribution.
d - See discussion in Attachment H1.
sr - Sample result (not a well average).
NE - Inorganic chemicals in groundwater were not evaluated in the 30-acre exposure area.
(1) Sampling results from each well were averaged (arithmetic mean), and those values were used to determine minimum, maximum, and 95% UCL values.

H10.0
UNCERTAINTIES AND LIMITATIONS

This section discusses the chief uncertainties and limitations of the risk assessment and how they affect the results and conclusions. It also provides an assessment of risk from exposure to special-case COCs and discusses their potential contribution to overall site risk.

Uncertainties and limitations are inherent in the risk assessment process. The level of certainty associated with the conclusions of the risk assessment are conditional upon the quality of data and models used to identify COCs and estimate chemical concentrations, the assumptions made in estimating exposure conditions, the methods used to develop toxicity values, and the methods used to characterize risk. Uncertainties in the risk assessment process could result in an overestimation or underestimation of risk. However, it is standard in risk assessment to adopt conservative approaches when uncertainty about a particular assumption exists, so as not to underestimate potential risk. Therefore, the risk assessment process is skewed toward overestimating rather than underestimating risk.

In the current assessment, there are uncertainties that could result in an overestimation or underestimation of risk. Sources of uncertainty that may contribute to an underestimation of risk include COCs for which risk could not be assessed because their toxicity is unknown and the use of unadjusted oral toxicity factors to estimate risk from dermal exposure (Section H10.1.4). However, in most cases of uncertainty, conservative assumptions were used so as not to underestimate risk. In doing this, it is likely that overall risk was overestimated. At all stages of this risk assessment, however, reasonable conservative assumptions were made so as not to underestimate potential risk. Furthermore, estimates of toxicity and carcinogenicity (RfDs and SFs) are very conservative and may result in an overestimate of risk. Therefore, the conclusions regarding identification of chief contaminants of concern, levels of potential health risk associated with direct and indirect exposures, and offsite migration potential are considered reliable.

The chief sources of uncertainty are discussed in Section H10.1. An evaluation of risk from special-case COCs is presented in Section H10.2.

TABLE 10-A
OPEN-SPACE EXPOSURE PARAMETERS
INCIDENTAL INGESTION

DUST, SURFACE SOIL, OR SEDIMENT

	Typical Exposure (CT)	High-End Exposure (RME)
Ingestion Rate - Child (mg/visit)	15 (1)	100 (1)
Ingestion Rate - Adult (mg/visit)	8 (1)	50 (1)
Matrix Effect in GI Tract (Absorption Factor)	CS	CS
Exposure Frequency (visits/yr)	10 (2)	25 (2)
Exposure Duration - Child (yr)	2	6
Exposure Duration - Adult (yr)	7	24
Body Weight - Child (kg)	15	15
Body Weight - Adult (kg)	70	70
Averaging Time - Child, Non-carcinogen (days)	730	2,190
Averaging Time - Adult, Non-carcinogen (days)	2,555	8,760
Averaging Time - Carcinogen (days)	25,550	25,550

(1) Assumes standard default *residential* rates as specified for open-space recreational users at DOE's Fernald Site and Hanford Site (RME=200 mg/day for children and 100 mg/day for adults) and at Denver's Lowry Landfill Superfund Site (CT=100 mg/day for children and 50 mg/day for adults). Assumes that Exposure Time is 1.5 hours per day (CT); 5.0 hours per day (RME) (see Note 2, Table 10-B) and that total soil ingestion occurs over 10 daylight hours (1.5/10 = 0.15; 5.0/10 = 0.5). Using the default daily ingestion rates, soil ingestion per visit for children is calculated as RME=0.5 x 200=100 mg/visit; CT=0/15 ***0.15*** x 100=51 ***15*** mg/visit. For adults the ingestion rates are RME=5.0 and CT=8. Actual open-space recreational intakes would vary, depending on the activity, possibly with di biking at one extreme and photographing wildlife at the other.

(2) Exposure Frequency based upon Boulder County's Park and Open Space Visitor Interviews of 1985 (est. 7 days/yr, CT; 25 days/yr, RME), DOE's Hanford Site recreational user (7 days/yr, CT), and Department of Interior's (DOI) National Survey of Fishing, Hunting, and Nonconsumptive Wildlife Recreation of 1985 for Colorado (9.4 days/yr for nonconsumptive use, CT; 15.4 days/yr for fishing and hunting, CT).

TABLE H5-4
AIR CONCENTRATIONS AND DEPOSITION RATES OF CHEMICALS OF CONCERN AT ONSITE EXPOSURE AREAS

Year	Aroclor-1254 Air Concentration (mg/m³)	Aroclor-1254 Deposition Rate (mg/m²-year)	Aroclor-1260 Air Concentration (mg/m³)	Aroclor-1260 Deposition Rate (mg/m²-year)	Bis(2-ethylhexyl)phthalate Air Concentration (mg/m³)	Bis(2-ethylhexyl)phthalate Deposition Rate (mg/m²-year)	Chromium Air Concentration (mg/m³)	Chromium Deposition Rate (mg/m²-year)	Americium-241 Air Concentration (pCi/m³)	Americium-241 Deposition Rate (pCi/m²-year)	Plutonium-239/240 Air Concentration (pCi/m³)	Plutonium-239/240 Deposition Rate (pCi/m²-year)
AOC No. 1												
1989	3.67E-11	5.95E-06	2.87E-11	4.67E-06	3.00E-11	4.85E-06	1.67E-09	2.71E-04	3.61E-06	5.87E-01	1.00E-04	1.63E+01
1990	4.15E-09	6.75E-04	3.25E-09	5.29E-04	3.39E-09	5.51E-04	1.89E-07	3.07E-02	4.09E-04	6.65E+01	1.13E-02	1.84E+03
1991	1.95E-10	3.18E-05	1.53E-10	2.49E-05	1.60E-10	2.59E-05	8.90E-09	1.45E-03	1.93E-05	3.12E+00	5.34E-04	8.66E+01
1992	8.64E-11	1.41E-05	6.77E-11	1.10E-05	7.06E-11	1.15E-05	3.94E-09	6.39E-04	8.52E-06	1.38E+00	2.36E-04	3.82E+01
1993	2.34E-10	3.80E-05	1.83E-10	2.98E-05	1.91E-10	3.10E-05	1.07E-08	1.73E-03	2.30E-05	3.75E+00	6.39E-04	1.04E+02
Average	9.40E-10	1.53E-04	7.36E-10	1.20E-04	7.68E-10	1.25E-04	4.28E-08	6.96E-03	9.26E-05	1.506E+01	2.57E-03	4.171E+02
Maximum	4.15E-09	6.75E-04	3.25E-09	5.29E-04	3.39E-09	5.51E-04	1.89E-07	3.07E-02	4.09E-04	6.646E+01	1.13E-02	1.841E+03
AOC No. 2												
1989	–	–	–	–	1.43E-11	2.33E-06	1.71E-09	2.77E-04	1.88E-07	3.06E-02	1.35E-06	2.19E-01
1990	–	–	–	–	1.62E-09	2.64E-04	1.93E-07	3.14E-02	2.13E-05	3.46E+00	1.53E-04	2.48E+01
1991	–	–	–	–	7.64E-11	1.24E-05	9.09E-09	1.48E-03	1.00E-06	1.63E-01	7.19E-06	1.17E+00
1992	–	–	–	–	3.38E-11	5.48E-06	4.02E-09	6.53E-04	4.43E-07	7.20E-02	3.18E-06	5.16E-01
1993	–	–	–	–	9.14E-11	1.49E-05	1.09E-08	1.77E-03	1.20E-06	1.96E-01	8.64E-06	1.40E+00
Average	–	–	–	–	3.67E-10	5.97E-05	4.37E-08	7.11E-03	4.83E-06	7.845E-01	3.47E-05	5.625E+00
Maximum	–	–	–	–	1.62E-09	2.64E-04	1.93E-07	3.14E-02	2.13E-05	3.461E+00	1.53E-04	2.482E+01
AOC No. 1 10-Acre Maximum Exposure Area												
1989	–	–	–	–	4.35E-11	7.08E-06	1.42E-09	2.31E-04	7.45E-06	1.21E+00	3.45E-05	5.58E+00
1990	–	–	–	–	4.92E-09	7.99E-04	1.61E-07	2.61E-02	8.45E-04	1.37E+02	3.90E-03	6.33E+02
1991	–	–	–	–	2.32E-10	3.76E-05	7.57E-09	1.23E-03	3.98E-05	6.45E+00	1.84E-04	2.99E+01
1992	–	–	–	–	1.02E-10	1.66E-05	3.35E-09	5.44E-04	1.76E-05	2.85E+00	8.13E-05	1.32E+01
1993	–	–	–	–	2.77E-10	4.49E-05	9.06E-09	1.47E-03	4.74E-05	7.72E+00	2.20E-04	3.58E+01
Average	–	–	–	–	1.11E-09	1.81E-04	3.65E-08	5.92E-03	1.91E-04	3.098E+01	8.84E-04	1.436E+02
Maximum	–	–	–	–	4.92E-09	7.99E-04	1.61E-07	2.61E-02	8.45E-04	1.367E+02	3.90E-03	6.333E+02
AOC No. 1 30-Acre Maximum Exposure Area												
1989	6.37E-11	NA	4.61E-11	NA	3.79E-11	NA	1.40E-09	NA	7.18E-06	NA	1.90E-04	NA
1990	7.21E-09	NA	5.22E-09	NA	4.29E-09	NA	1.59E-07	NA	8.11E-04	NA	2.15E-02	NA
1991	3.39E-10	NA	2.45E-10	NA	2.02E-10	NA	7.48E-09	NA	3.81E-05	NA	1.01E-03	NA
1992	1.50E-10	NA	1.09E-10	NA	8.93E-11	NA	3.31E-09	NA	1.69E-05	NA	4.47E-04	NA
1993	4.06E-10	NA	2.94E-10	NA	2.42E-10	NA	8.96E-09	NA	4.57E-05	NA	1.22E-03	NA
Average	1.63E-09	NA	1.18E-09	NA	9.72E-10	NA	3.60E-08	NA	1.84E-04	NA	4.88E-03	NA
Maximum	7.21E-09	NA	5.22E-09	NA	4.29E-09	NA	1.59E-07	NA	8.11E-04	NA	2.15E-02	NA

Note: Change from Draft Final to Final shown in italicis/bold.

TABLE H3-4
CONCENTRATION/TOXICITY SCREEN
SURFACE SOIL
NONCARCINOGENS

Chemical	Maximum Detected Conc. (mg/kg)	Inhalation RfD	Oral RfD	Risk Factor	Risk Index	% of Total Risk Factor
Chromium (1)	29.5	n/a	1.0E+00	3.0E+01	5.4E-01	53.6
Bis(2-ethylhexyl)phthalat	0.51	n/a	2.0E-02	2.6E+01	4.6E-01	46.4
Total Risk Factor				5.5E+01		

RfDs are in units of mg/kg-day.

n/a - not available.

(1) Evaluated as Cr III based on results of speciation study.

TABLE E6-3

MAXIMUM 30-YEAR AVERAGE ANNUAL CONTAMINANT LOADING AND AVERAGE CONCENTRTATIONS TO SOUTH WALNUT CREEK AND WOMAN CREEK

(From ONED3 Colluvial Models)

	PCE		TCE		CCL_4		$CHCl_3$		Methylene Chloride		1,1-DCE		Pu-239/240		Am-241	
	Mass (g/yr)	$\bar{C}$ (µg/l)	Mass (g/yr)	$\bar{C}$ (µg/l)	Mass (g/yr)	$\bar{C}$ (µg/l)	Mass (g/yr)	$\bar{C}$ (µg/l)	Mass (g/yr)	$\bar{C}$ (µg/l)	Mass (g/yr)	$\bar{C}$ (µg/l)	Annual Activity (Ci/yr)	Average Activity Concentration (pCi/l)	Annual Activity (Ci/yr)	Average Activity Concentration (pCi/l)
South Walnut Creek	3,900	260	35,000	2,400	2,400	170	550	38	280	21	40	3	--	--*	--	--*
Woman Creek	840	330	7,800	3,100	2,000	800	2,400	950	1,400	570	25	10	3.3E-08	0.013	4.5E-08	0.018

Explanation:

1. Values reported are the maximum values that were simulated during the model simulation period (150 years for PCE, TCE, CCl_4, $CHCl_3$, CH_2Cl_2, and 1,1-DCE; 1,000 years for Pu-239/240 and Am-241.)
2. $\bar{C}$ = Average Annual Concentration

* Below the minimum detection limit (0.003 pCi/l) reported for radionuclides.

- The future industrial/office worker is the maximum exposed individual under current and possible future land use scenarios in AOC No. 1. Pathways evaluated were exposure to surface soil, airborne PM_{10}, and indoor VOCs from soil gas. Cumulative HIs were below 1, indicating no threat of adverse noncarcinogenic effects. RME (8E-05) and CT (2E-06) cancer risk estimates for this receptor in AOC No. 1 are within EPA's target cancer risk range of 1E-06 to 1E-04. Ingestion of Pu-239/240 in surface soil was the greatest contributor to overall risk (Attachment H3).

  ~~RME cancer risk estimates are likely to significantly overestimate actual risk for this receptor because (1) the concentration terms for Pu-239/240 in surface soil in AOC No. 1 and the 30-acre maximum exposure area are biased by two extreme values in the sample set and (2) the estimates are based on ingesting 50 mg/day contaminated soil and inhaling PM_{10} outdoors 8 hours/day for 25 years, with no landscaping, paving, or indoor work to reduce exposure to surface soil.~~

- Cumulative HIs were below 1 for current workers and for future ecological workers, open space users, and construction workers in AOC No. 1 indicating that no adverse noncarcinogenic health hazards are expected for these nonresidential exposure scenarios. RME cancer risk estimates for these receptors ranged from 2E-07 to 1E-05. These values are within or below EPA's target cancer risk range of 1E-06 to 1E-04. The contaminants that contributed most to estimated health risk for nonresidential onsite receptors are Pu-239/240 and Am-241 in surface soil.

- Chlorinated solvents in groundwater in AOC No. 1 would pose unacceptable risk if directly ingested (hypothetical onsite residential scenario). However, drinking water for current onsite workers is provided by a municipal water supply, and it is expected that drinking water for future onsite receptors will also be provided from a public water supply. Therefore, ingestion of UHSU groundwater is an incomplete pathway for all current and possible future receptors in OU-2. Additionally, migration of groundwater via surface water

7.0
CONCLUSIONS AND RECOMMENDATIONS

7.1 SUMMARY

A Phase II RFI/RI of OU-2 was conducted to assess the site physical characteristics; characterize contaminant sources and the nature and extent of potential contamination in surface soil, subsurface soil, groundwater, surface water, sediment, and air; assess fate and transport of environmental contaminants; and estimate potential risks to human health.

Field investigations indicate that the site physical characteristics are complex and interactive. Site meteorologic, geologic, hydrologic, and hydrogeologic processes combine interactively to provide mechanisms and pathways for surface and subsurface contaminants to migrate through the environment. However, site physical characteristics also limit contaminant migration. For example, because almost all UHSU groundwater pathways discharge to surface seeps within OU-2, there is limited potential for migration of VOCs to offsite locations.

The nature and extent of environmental contamination in OU-2 has been thoroughly characterized through the collection, analysis, and assessment of thousands of samples of various environmental media. Environmental samples were analyzed for a comprehensive suite of chemicals potentially associated with waste handling and disposal practices conducted during the operating history of the Rocky Flats Plant. Sample analytical results have undergone rigorous data validation and the OU-2 data assessment process was designed to be conservative to ensure an accurate and comprehensive understanding of potential contamination conditions in OU-2.

The results of the OU-2 data assessment process indicate the presence of PCOCs in surface soil, subsurface soil, UHSU and LHSU groundwater, seep surface water, and seep sediment. PCOCs identified in one or more of these environmental media include VOCs, SVOCs, PCBs/pesticides (infrequently detected), metals and other inorganic constituents, and radionuclides. The list of PCOCs for each medium was then screened using risk-based and other screening methods to identify COCs for the HHRA. COCs were identified as the

chemicals in soil or groundwater that were likely to contribute at least 1 percent of overall risk. COCs were selected on an OU-wide basis. The chief COCs are Pu-239/240 and Am-241 in surface soil, subsurface soil, and groundwater, and chlorinated solvents in groundwater.

The presence of COCs in surface soil, subsurface soil, and UHSU groundwater is the result of releases from several IHSSs where waste materials were disposed of or stored. COCs in each particular medium have the potential to migrate from locally effected areas to larger areas within the effected medium or to other media via various migration mechanisms and pathways. Potential migration pathways include the air, surface water, vadose zone, and groundwater pathways.

Potential migration mechanisms associated with surface soil COCs are limited. Wind dispersion and surface water erosion and dispersion, although significant in the past, are less important today because of vegetative stabilization of the soil surface. Currently, such mechanisms can locally redistribute the contaminants in onsite surface soil and surface water features within OU-2, but the potential for offsite migration is small. Downward migration of surface soil contaminants to subsurface soil and groundwater is also limited because of the relative immobility of these contaminant types in the subsurface environment.

Potential subsurface migration pathways consist of downward migration of subsurface soil contaminants to UHSU groundwater, and then subsequent migrations in the UHSU groundwater. UHSU groundwater migration pathways occur either within the Rocky Flats Alluvium or the Arapahoe Formation No. 1 Sandstone, with migration from contaminant source areas toward discharge points at seeps along the hillsides of the Woman Creek and South Walnut Creek drainages. Chemical data and the results of groundwater and surface water modeling indicate that VOCs (one of two types of LHSU groundwater COCS) are likely discharged with UHSU groundwater at seeps on the hillsides but that those VOCs are either volatilized when they reach the seeps, during transport between the seeps and the creeks, or while in the creeks. Therefore, VOCs do not reach offsite locations at concentrations that could pose a threat to human receptors. Radionuclides (the other groundwater COC type) have extremely low mobility in the subsurface, thus their ability to migrate with groundwater to seeps on the hillsides is also limited.

The potential for contaminant occurrence and migration in the LHSU is limited, and evidence suggests that the LHSU is an incomplete exposure pathway for both onsite and offsite receptors. The LHSU is considered an incomplete migration and exposure pathway because (1) it is not a feasible source for a domestic or commercial water supply for current or future receptors in OU-2; (2) it has very limited hydraulic communication with the UHSU, the only potential contamination source for the LHSU in OU-2; and (3) the potential for contaminants to migrate within the LHSU to offsite locations is negligible.

The HHRA for OU-2 estimated health risks and annual radiation doses for current and future onsite and offsite receptors who could potentially be exposed directly or indirectly to COCs at or released from sources in OU-2. Exposure scenarios that were evaluated involved a current worker (security patrol), a future industrial/office worker, a future ecological researcher, a future open space user, a construction worker, and an offsite resident. In addition, even though future residential development will not occur in OU-2, a hypothetical onsite residential scenario was evaluated to provide an upperbound estimate of risk to support risk management decisions for low-hazard areas in OU-2.

Exposure media evaluated were surface soil, subsurface soil (construction worker only), outdoor and indoor air, seep surface water and sediment, and UHSU groundwater (residential only). Risks were estimated for two AOCs: AOC No. 1 contains all of the IHSSs within OU-2 and includes the extent of contiguous groundwater contaminant plumes in OU-2. AOC No. 2 is east of the IHSSs and extends to Indiana Street. In addition, risks were evaluated in three maximum exposure areas: a 10-acre area at the 903 Pad Area (hypothetical resident), a 30-acre area including the 903 Pad Area (industrial/office worker scenario), and a 50-acre ecological study area including the 903 Pad Area.

The risk characterization process combines average and reasonable maximum estimates of exposure with upperbound estimates of toxicity to yield conservative (protective) estimates of health risk. Estimates of health risk for average (CT) and reasonable maximum exposure (RME) conditions are provided so that risk management decisions can be based on a range of potential risk for different exposure scenarios.

The following are the major conclusions of the HHRA:

- The maximum RME cancer risk estimate was 2E-04 for a future industrial/office worker in the 30-acre maximum exposure site. Cancer risks for all other nonresidential receptors and exposure areas were within or below EPA's target cancer risk range of 1E-06 to 1E-04. The RME cancer risk of 2E-04 (equivalent to 2 in 10,000) only slightly exceeds EPA's target risk range. This RME value is based on numerous conservative assumptions; therefore, there is a high likelihood that actual lifetime cancer risk for this receptor is less than 2 in 10,000. Nevertheless, this estimate of lifetime cancer risk is very small compared to overall risk of developing cancer. The lifetime probability in the U.S. of developing invasive cancer is approximately 1 in 2 in men and approximately 1 in 3 in women. The lifetime probability of death from cancer is 1 in 4 for both sexes (Wingo et al. 1995). HIs for non-cancer effects were below 1 for all onsite nonresidential receptors. Hazard/risk estimates for offsite residents were negligible.

- In general, when cancer risk levels that do not exceed 1E-04, are combined with HIs that do not exceed 1, ~~may be used to support~~ ~~the conclusion that environmental contamination does not pose a threat to~~ ~~a decision that remediation is not warranted for the protection of~~ public health (EPA 1991d). The results of the HHRA suggest that ~~remediation of~~ surface and subsurface soil ~~and groundwater~~ in OU-2 ~~are not necessary for protection of~~ ~~do not pose a threat to~~ public health.

- Concentrations of chlorinated solvents in UHSU groundwater in AOC No. 1 would pose an unacceptable health risk if the UHSU was used as a drinking water supply. ~~However, drinking water for current onsite workers is provided by a municipal water supply, and it is expected that drinking water for future onsite receptors will also be provided from a public water supply. Therefore, ingestion of UHSU groundwater is an incomplete pathway for all current and possible future receptors in OU-2.~~ ~~However, direct ingestion of groundwater is an incomplete exposure pathway for all current and possible future workers in OU-2. Therefore, chemicals in groundwater do not pose~~

a risk to human health under current and possible future land use scenarios.

7.2 RECOMMENDATIONS

The results of the HHRA support the conclusions that environmental contamination within OU-2 does not pose a threat to public health under the evaluated exposure scenarios. ~~, and that remediation of environmental media to address public health risk issues is not warranted.~~ However, evaluation of the nature and extent of contamination in OU-2 indicates that certain IHSSs contain materials that are likely to act as continuing sources of contamination to soil and groundwater for the foreseeable future. For example, NAPL was observed and sampled during the SVE Pilot Test project conducted in Trench T-3 in the Northeast Trenches Source Area (Section 4.3.5). Analysis of the NAPL samples indicated the presence of VOCs and SVOCs at very high concentrations (up to several million ppb for VOCs and several hundred thousand ppb for SVOCs), petroleum compounds (several hundred thousand ppm for gasoline and diesel), and radionuclides at high activities (up to 3,240 pCi/g for U-238).

~~To limit the ongoing effects to the environment from contamination in OU-2, it may be appropriate to remove or immobilize materials in IHSSs that are acting as continuing sources of contamination. For example, it may be appropriate to remove waste materials (including NAPL) buried in shallow trenches within OU-2 so that those materials will not continue to leach or migrate downward to affect subsurface soil and groundwater. Such removal would require an adequate understanding of the location and dimensions of high concentration areas within the IHSSs.~~

However, a~~A~~vailable data for OU-2 are insufficient for characterizing high concentration areas at the level of detail necessary to calculate reliable estimates of the volumes of material providing continuing sources of contamination. ~~Therefore, additional focused investigations are recommended for selected IHSSs where continuing environmental contamination sources have been identified. Based on available chemical data for the nature and extent of contamination in OU-2, the following IHSSs should undergo focused additional investigation:~~

- ~~903 Pad (IHSS 112)~~
- ~~Trench T-1 (IHSS 108)~~
- ~~Trench T-2 (IHSS 109)~~

- ~~Trench T-3 (IHSS 110)~~
- ~~Trench T-4 (IHSS 111.1)~~
- ~~Mound Site (IHSS 113)~~

~~The objectives of the additional focused investigations should be to gather data to identify the locations and dimensions (volumes) of high concentration areas in these IHSSs so that potential remediation alternatives can be reliably assessed. Data to be collected should include the following:~~

- ~~Approximate dimensions of trenches and source area boundaries~~
- ~~Locations and dimensions of high concentration areas~~
- ~~Chemical concentration/activity concentration data for contaminants in high concentration areas~~
- ~~Types of high concentration materials present in IHSSs and source areas (e.g., NAPLs, soils, drums)~~
- ~~Geotechnical properties of subsurface materials in source areas~~

~~The additional focused investigations should be based on well defined DQOs and incorporate DOE's Streamlined Approach for Environmental Restoration (SAFER) observational approach to ensure that only the data necessary for decision making are collected.~~

With respect to surface soil contamination, the results of the HHRA indicate that RME cancer risks (2E-04) to a future onsite industrial/office worker in OU-2 (the maximum exposed individual under current and possible future land use scenarios at RFETS) are near but slightly exceed EPA's target cancer risk range (1E-04 to 1E-06). Although the RME provides a conservative overestimation of the actual risk to a future onsite industrial/office worker in the 30-acre maximum exposure site, it may be appropriate to consider a further reduction in the RME cancer risk so that it is within EPA's target cancer risk range. ~~In particular, such further risk reduction should consider the localized areas of relatively high Pu activities in surface soil in the 30-acre maximum exposure site. If a further risk~~

~~reduction is considered, the site specific conditions associated with RFETS surface soil Pu contamination should be factored in when determining the feasibility and reasonability of Pu remediation activities in surface soil.~~

~~During the more than twenty years that Pu and Am have been in surface soil at RFETS, the contamination has experienced weathering and some redistribution so that much of it lies near but somewhat beneath the immediate surface of the soil. The vertical extent of the distribution is typically not great (i.e., within a few inches) but is variable with location. Because Pu and Am emit primarily non penetrating alpha radiation with very little and generally low energy penetrating X and gamma radiation, it is very difficult to accurately identify even high activities of weathered contamination that are not directly on the surface. This limits the available detection technologies suitable for identifying Pu high activity areas and complicates design of an effective remediation approach. Therefore, if localized remediation is to be undertaken to reduce the RME cancer risk, an evaluation of the feasibility of remediating Pu high activity areas should begin by assessing the capabilities and limitations of available detection technologies, including field instrumentation and soil sampling and analysis approaches. Additionally, the uncertainties associated with characterizing the locations and extent of the high activity areas and the volume of soil potentially requiring remediation should factor into the feasibility assessment.~~

to offsite locations is not significant, even using conservative modeling assumptions.

Maximum Exposure Areas: HIs were below levels of concern and cancer risk estimates were at or below levels of concern for future industrial/office workers and ecological researchers in 30- and 50-acre maximum exposure areas. Hazard/risk estimates for hypothetical onsite residents in a 10-acre maximum exposure area exceeded levels of concern. These results are described below.

- Chlorinated solvents in groundwater in the 10-acre maximum exposure area in AOC No.1 would pose an unacceptable risk if directly ingested (hypothetical onsite residential scenario). However, groundwater ingestion is an incomplete pathway for all current and possible future receptors in OU-2.

- ~~Cumulative HIs were below 1 for the future industrial/office worker in the 30-acre maximum exposure area, indicating no threat of adverse noncarcinogenic effects. RME (2E-04) and CT (5E-06) cancer risk estimates for this receptor are at or within EPA's target cancer risk range of 1E-06 to 1E-04. Ingestion of Pu-239/240 in surface soil was the greatest contributor to overall risk (see Attachment H3). However, RME cancer risk estimates are likely to significantly overestimate actual risk for this receptor because (1) two extreme values in the Pu-239/240 sample set for surface soil bias concentration terms in this exposure area and (2) intake factors for ingestion and inhalation of soil are overestimated because of overly conservative exposure assumptions.~~
- ~~Cumulative HIs were below 1 for the future industrial/office worker in the 30-acre maximum exposure area, indicating no threat of adverse noncarcinogenic effects. The CT cancer risk estimate for this receptor is within EPA's target risk range of 1E-06 to 1E-04, whereas the RME cancer risk estimate (2E-04) exceeds this range. RME cancer risk estimates for this receptor are likely to significantly overestimate actual risk because overly conservative assumptions resulted in overestimation of intake values for ingestion and inhalation of soil. Ingestion of Pu-239/240 in surface soil was the greatest contributor to overall risk (see Attachment 3). However, the concentration term for Pu-239/240 in surface soil in the 30-acre maximum exposure area was biased by an extreme~~

value in one sample and other samples in the data set had significantly lower concentrations.

- Cumulative HIs were below 1 and cancer risk estimates were within EPA's target risk range of 1E-06 to 1e-04 for the future ecological worker in the 50-acre maximum exposure area. ~~were below levels of concern.~~

AOC No. 2: Cumulative HIs were below 1 and cancer risk estimates were below ~~levels of concern~~ 1E-06 for onsite receptors in AOC No. 2 (including the hypothetical onsite resident).

Offsite Receptors: HIs and cancer risk estimates for offsite residential receptors were negligible.

~~In general, cancer risk levels that do not exceed 1E-04, combined with HIs that do not exceed 1, may be used to support a decision that remediation is not warranted for the protection of public health (EPA 1991d).~~ ~~Thus,~~ for all current and possible future receptors in OU-2, conservative estimates of cancer risk were 2E-04 or below and HIs were 8E-02 or below. ~~These results suggest that remediation of surface and subsurface soil in OU-2 may not be necessary for protection of human health.~~

Concentrations of chlorinated solvents in UHSU groundwater in AOC No. 1 would pose an unacceptable health risk if used as a drinking water supply on site. However, UHSU groundwater is not used as a water supply and is not expected to provide drinking water in the future because of the availability of a public water supply at RFETS. All UHSU groundwater discharges on site in surface seeps. Migration of groundwater contaminants via surface water to offsite locations is not significant, even using conservative modeling assumptions.

COCs are organic chemicals, metals, and radionuclides in soil or groundwater in OU-2 with concentration distributions that differed significantly from background distributions and that are likely to contribute significantly to overall risk. COCs, which are a subset of all chemicals detected in the field investigations, are selected for quantitative evaluation in the risk assessment and are the focus of transport modeling, risk assessment, and remedy selection. This section describes the process for determining COCs in surface soil, subsurface soil, and groundwater. The process was developed and agreed upon by EPA, CDPHE, and DOE (DOE 1994b,d). More detail is provided in the TM 9 (DOE 1994b).

H3.1 PROCESS FOR SELECTING OU-WIDE COCs

COCs in each medium were determined on an OU-wide basis; that is, all sample results from each medium were pooled for the evaluation. Risk-based and other screening methods were used to identify COCs; i.e., the chemicals that are likely to pose the greatest potential risk to human health. The COC selection process is illustrated in Figure H3-1 and summarized in the sections below.

H3.1.1 Background Comparison

Analytical results for metals and radionuclides detected in soil and groundwater in OU-2 were compared to background results using four statistical tests: the Quantile test, Slippage test, Student's t-test, and the Gehan test (Gilbert 1993). In addition, analytical results were compared to the 99th percentile upper tolerance limit ($UTL_{99/99}$) of the background data. Any analyte that failed one or more of the statistical tests or that had one or more results exceeding the $UTL_{99/99}$ was retained as a potential COC. A detailed description of the statistical methodology used in the background comparison and tables showing results of the statistical tests are presented in Appendix A of TM 9 (DOE 1994b); summary tables also accompany Section 4.1 of the RFI/RI Report.

- Surface soil: benzoic acid and PAHs
- Subsurface soil: Ba and Mn
- Groundwater: aluminum, antimony, beryllium, manganese, and vanadium

The evaluations and conclusions are described in detail in the TM 9 (DOE 1994b). However, to address concerns that some analytes, whether contaminants or not, could pose a health risk under long-term exposure to maximum detected concentrations, the following constituents were retained for consideration in a separate risk evaluation in Section H10.2 of the uncertainty section of the HHRA (CDPHE 1994; EPA 1994b; DOE 1994d):

- Surface soil: PAHs
- Groundwater: As, Sb, Be, and Mn

Arsenic (As) was included in the separate evaluation even though it had been excluded as a COC based on the results of the concentration/toxicity screens for UHSU groundwater.

H3.1.6 Evaluation of Infrequently Detected Compounds

For organic compounds and metals detected at less than 5 percent frequency, maximum concentrations were compared to screening levels equivalent to 1,000 times the risk-based concentrations (RBCs) to determine whether there was potential risk to human health on the basis of high concentration and toxicity even though the chemicals were rarely detected and exposure potential was low. RBCs were defined as chemical concentrations associated with an excess lifetime cancer risk of 1E-06 (1 in 1 million) or a hazard index of 1 for noncarcinogenic effects. RBCs for chemicals in surface soil were calculated assuming residential exposure via ingestion of soil, inhalation of airborne particulates, and external irradiation. RBCs for chemicals in subsurface soil were calculated assuming construction worker exposure via soil ingestion and inhalation of particulates and VOCs. RBCs for chemicals in groundwater were calculated assuming residential exposure via ingestion of water and inhalation of VOCs during water use.

Infrequently detected chemicals whose maximum concentrations exceeded 1,000 times the RBC were retained as special-case COCs for separate evaluation in the risk assessment. The

risk-based evaluation of infrequently detected chemicals is described in detail in Appendix B of the TM 9 (DOE 1994b).

Only vinyl chloride in groundwater was identified as exceeding 1,000 times the RBC.

H3.1.7 Chemicals Without EPA Toxicity Values

Detected chemicals that do not have EPA-established toxicity values are listed in Table H3-1. These compounds cannot be evaluated in a toxicity or risk-based screen to select COCs. However, their potential contribution to overall risk was evaluated qualitatively Section H10.1.4 of in the uncertainties section of the risk assessment.

H3.2 SURFACE SOIL COCs

The sample set used to characterize extent of contamination and select COCs in surface soil is summarized in Section H2.0. COCs were identified using the process outlined in Section H3.1.

H3.2.1 Concentration/Toxicity Screens

Detection frequencies and metals with concentration distributions statistically significantly different from background distributions are shown in Tables H3-2 and H3-3. Concentration/toxicity screens for analytes above background levels and detected at a frequency of 5 percent or greater are shown in Tables H3-4 through H3-6. In the screens, analytes that contributed 1 percent or more of the total risk factor were identified as COCs.

OU-Wide Chemicals of Concern
Surface Soil

Aroclor-1254
Aroclor-1260
Bis(2-ethylhexyl)phthalate
Cr
Am-241
Pu-239/240

PAHs were not included in the concentration/toxicity screens because their presence in surface soil may be related to anthropogenic sources not attributable to chemical waste releases or waste disposal practices at Rocky Flats. Instead, they are addressed as special-case COCs in the uncertainty section of the risk assessment (Section H3.2.2).

The following paragraphs discuss several factors pertinent to the selection of COCs in surface soil.

Pb and Cr were the only two metals with concentration distributions in OU2 that were significantly different than background (other than calcium and Fe, which were removed from further evaluation in Section H3.1.2). The maximum detected concentration of lead in surface soil (145 mg/kg) was less than EPA's screening level for residential soil (400 mg/kg; EPA 1994d). Because Pb does not have EPA-approved toxicity factors, it cannot be evaluated quantitatively in toxicity-based screens. However, it was retained for qualitative evaluation in Section H8.0, Risk Characterization.

The formal statistical tests indicated that the Cr distribution in OU-2 was not significantly different than background (Appendix A of TM 9, DOE 1994b). However, two sample results for chromium (26 mg/kg and 29.5 mg/kg) slightly exceeded the background $UTL_{99/99}$ of 24.8 mg/kg. One result is associated with a sampling site located on the western edge of IHSS 1450 (Reactive Metal Destruction Site) and the other is associated with a sampling site located on the southern edge of the Southeast Trenches Source Area (not associated with any IHSS) (Plate 4.2.3). The 26 mg/kg result was associated with sampling site SS200193, located on the western edge of IHSS 1450 (Reactive Metal Destruction Site), and the 29.5 mg/kg result was associated with sampling site SS200893, located on the southern edge of the Southeast Trenches Source Area (see Plate 4.2.3). Because two results exceeded the background $UTL_{99/99}$, chromium was retained as an OU-wide potential COC and was identified as a COC based on the results of the concentration/toxicity screen (Table H3-4). However, Cr does not appear to be an OU-wide contaminant because only two results slightly exceeded background levels.

Bis(2-ethylhexyl)phthalate (BEHP), a common laboratory and field contaminant, was detected in 23 percent of surface soil samples widely distributed across OU-2. The frequency of detection and concentrations observed in OU-2 samples (49J to 510J µg/kg) and in

background samples (35J to 140 μg/kg) were similar, suggesting that BEHP in OU-2 samples is not an environmental contaminant. (See discussion in Section 4.2 of this RFI/RI Report and in DOE 1994b.) However, it was retained as a potential COC because the maximum concentration (0.51 mg/kg) occurred in a sample from a contaminated area (the 903 Pad). This was the only concentration that exceeded the background range. BEHP was identified as an OU-wide COC based on the results of concentration/toxicity screen (Table H3-4).

Future Open Space Use: An open space exposure scenario was developed to estimate risks from recreational use of open space areas at RFETS. Future open space use by children and adults is assumed to include recreational activities such as hiking and wading in creeks and to involve contact with surface soil, surface water, and sediments. An open space use scenario was evaluated in AOC No. 1 and AOC No. 2.

Future Onsite Construction Worker: The future onsite construction worker is assumed to contact subsurface soil during excavation activities associated with construction of commercial buildings in AOC No. 1 and AOC No. 2.

Hypothetical Onsite Residents: EPA, CDPHE, and DOE have agreed that evaluation of a future onsite residential scenario is not required in the HHRA because future land use at RFETS will not include residential development (DOE 1995b, EPA 1995a; CDPHE 1995). Nevertheless, an onsite residential exposure was evaluated in the HHRA as a hypothetical scenario to provide an upperbound estimate of risk that may support risk management decisions for low-hazard areas within OU-2. Because residential development is not a reasonable future land use in OU-2, ~~cleanup levels will not be based on estimates of risk to this hypothetical receptor~~actual risks to current and possible future receptors in OU-2 will be lower than those estimated for this scenario. Hypothetical residential exposures were evaluated in AOC No. 1, AOC No. 2, and in the 10-acre maximum exposure area in AOC No. 1.

Future Offsite Residents: Two hypothetical future residences located at Indiana Street were assessed: at Woman Creek at the southern boundary of OU-2 and at Walnut Creek at the northern boundary of OU-2. These receptor locations are at the RFETS property boundary, adjacent to surface water being discharged from the site and are located in the direction of the prevailing winds. Future offsite receptor locations are shown in Figure H4-1.

The nonresidential onsite receptors described above were selected to represent the potentially exposed populations based on current and probable future use. The onsite resident is an unlikely scenario and was evaluated only to provide an upperbound estimate of risk from exposure to COCs in soil and groundwater to help support risk management decisions for low-hazard areas in OU-2. Onsite industrial/office workers, open space use, and the onsite

ecological researcher provide more realistic, yet still conservative, estimates of potential risk under various future-use scenarios.

H4.4.1 Site-wide Incomplete or Negligible Exposure Pathways

The CSM indicates that the following exposure pathways are incomplete or negligible for all receptors. These pathways were not evaluated further in the risk assessment.

- Ingestion of fish in Woman Creek or Walnut Creek is an incomplete exposure pathway for all receptors because subsistence fishing is unlikely (due to intermittent flow in the creeks) and has not been observed to occur in the area.

- Ingestion of livestock is ~~probably~~ a negligible pathway for all receptors because beef ingestion is not an exposure pathway for occupational and open space use receptors and, even if nearby residents were to purchase and consume a locally grazed animal, exposure of cattle to contaminants from RFETS ~~is negligible. Small herds of cattle are grazed temporarily in fields near RFETS and are then shipped out of the area each season. The cattle eat little local vegetation and receive large amounts of supplemental feed. Furthermore, the intermittent flow in the creeks does not support consistent livestock watering.~~ may be negligible (e.g., the intermittent flow in the creeks does not support consistent livestock watering). However, to further evaluate possible impacts, the beef ingestion pathway will be assessed in the residential scenario of the HHRA for OU-3.

- Inhalation of VOCs released to outdoor air through volatilization from soil or groundwater is a negligible pathway for all receptors because volatile chemicals in surface soils, if once present, will have already volatilized and volatile chemicals released from groundwater will be significantly retarded through the subsurface soil and diluted in the ambient air.

- Dermal uptake of metals and radionuclides from soil and sediment is considered a negligible pathway for all receptors because their permeability constants are low (EPA 1989a) and binding to a soil matrix further reduces absorption potential.

- Exposure to groundwater in the LHSU is incomplete for all receptors. This is discussed further in the following paragraphs. Additional information on the LHSU is presented in Section H4.5 of the RFI/RI report.

- Surface soil ingestion and dermal contact, following airborne deposition of particulates on soil

- Ingestion of vegetables following surface deposition of particulates

Receptor-Specific Negligible or Incomplete Pathways (not evaluated):

- Root uptake by garden produce of contaminants deposited on soil is considered negligible because this route is not expected to contribute measurably to overall risk estimated for offsite receptors. Current levels of the radionuclides Am-241 and Pu-239/240 in soil adjacent to RFETS are below health-protective risk-based levels (DOE 1994f, 1994g), and future concentrations would not be expected to increase due to windborne deposition from sources in OU-2. (See results of air modeling in Section H5.0.)

- Exposure to contaminants via contact with surface water/sediment in Walnut and Woman Creeks is considered ~~incomplete~~ ~~a negligible pathway~~ for current offsite residents because, under the RFETS surface water management plan, surface water is monitored and discharged at concentrations that meet applicable federal and state surface water requirements. Therefore, ~~the creeks do not provide a means of current offsite exposure to contaminants potentially released from OU-2. (Exposure to modeled concentrations of COCs in the creeks is evaluated for the future offsite residential scenario.)~~ ~~the water management plan eliminates or minimalizes transport of potential OU-2 contaminants from creeks to offsite receptors.~~

- Ingestion of groundwater is considered ~~incomplete~~ ~~a negligible pathway~~ for offsite residents (who reside in the Walnut and Woman Creek drainage areas) because UHSU groundwater does not discharge offsite as groundwater, ~~and transport of potential OU2 contaminants first into surface water, followed by percolation into offsite groundwater, is likely negligible or incomplete.~~

- External irradiation exposures to offsite residents resulting from deposition of radionuclides in airborne particulate matter is considered a negligible pathway

because current concentrations of radionuclides in offsite soil are below protective risk-based levels (DOE 1994f, 1994g). Modeled concentrations of radionuclides in air and soil at offsite locations resulting from wind erosion of OU-2 surface soil are even lower. (See results of air modeling in Section

Exposure point concentrations of COCs were calculated for each exposure area and exposure medium (surface soil, subsurface soil, groundwater, air, surface water/suspended sediment, and garden produce) evaluated in the risk assessment. The exposure point concentration of a chemical in a sampled medium (soil and groundwater) is usually the 95 percent upper confidence limit (95% UCL) on the arithmetic mean. The 95% UCL on the mean is a conservative estimate of the average concentration to which people would be exposed over time in the exposure area. Sometimes the maximum detected concentration was used as the exposure concentration if the data set did not permit a good estimate of the mean. This can occur with small data sets or in data sets with a high frequency of non-detects. If the calculated 95% UCL concentration exceeded the maximum detected concentration, the maximum was used as the exposure concentration (EPA 1989a). For convenience in this report, the 95% UCL or maximum concentration was referred to as the RME concentration. RME concentrations of COCs were used in estimating risk for both the CT and RME exposure conditions for each scenario described in Section H4.0.

H5.1 CALCULATING THE CONCENTRATION TERM

Tables H5-1 through H5-3 summarize the exposure concentrations of COCs in surface soil, subsurface soil, and groundwater for each exposure area evaluated in the HHRA. Attachment H1 shows analytical results used in the calculations. In calculating exposure concentrations from chemical analytical results, one-half the SQL was used to represent the concentration in samples that were "non-detect" for a chemical, provided that the chemical was detected in at least one other sample in the data set (EPA 1989a). An exception to this rule is when the nondetect SQL is unusually high due to sample dilution. The SQL for diluted samples can far exceed the measured concentrations of the chemical in other samples. EPA (1989a) recommends removal of unusually high nondetect SQLs from the data set when they would cause the calculated exposure concentration to exceed the maximum concentration. ~~These~~ Therefore, samples were excluded from the calculation of the concentration term if they caused the arithmetic mean concentration to exceed the maximum detected concentration.

The same principle was applied when a compound was detected in very few samples and only at estimated quantities below the CRQL. If using one-half the CRQL for non-detects caused

TABLE H5-3
EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF CONCERN IN GROUNDWATER

	AOC No.1		AOC No. 2		AOC No. 1 Maximum Exposure Areas 10-Acre		AOC No. 1 Maximum Exposure Areas 30-Acre
1,1-Dichloroethene (ug/L)							
Number of Wells Sampled	99		--		16		32
Number of Wells where Detected	41		--		12		19
Minimum Well Average[a]	0.1		--		0.1		0.1
Maximum Well Average[a]	351		--		351		351
95%UCL[a]	4	ln	--		68	n,d	
RME Concentration	4		--				
Carbon Tetrachloride (ug/L)							
Number of Wells Sampled	100		--		17		33
Number of Wells where Detected	75		--		17		26
Minimum Well Average	0.1		--		0.1		0.08
Maximum Well Average	16,000		--		16,000		16,000
95%UCL	3,478	ln	--		3,569	n,d	
RME Concentration	3,478		--				
Chloroform (ug/L)							
Number of Wells Sampled	100		11		17		33
Number of Wells where Detected	78		2		16		25
Minimum Well Average	0.1		0.2	sr	0.1		0.1
Maximum Well Average	30,667		0.4	sr	30,667		30,667
95%UCL	104	ln			5,178	n,d	
RME Concentration	104		0.4				
Methylene Chloride (ug/L)							
Number of Wells Sampled	100		11		17		33
Number of Wells where Detected	47		4		6		16
Minimum Well Average	0.20		0.3	sr	0.70		0.40
Maximum Well Average	20,433		3.3	sr	20,433		20,433
95%UCL	13.6	ln			3,346	n,d	
RME Concentration	13.6		3.3				
Tetrachloroethene (ug/L)							
Number of Wells Sampled	100		11		17		33
Number of Wells where Detected	81		4		17		30
Minimum Well Average	0.1		0.1	sr	0.3		0.1
Maximum Well Average	11,033		0.62	sr	11,033		11,033
95%UCL	1,148	ln			2,022	n,d	
RME Concentration	1,148		0.62				
Trichloroethene (ug/L)							
Number of Wells Sampled	100		11		17		33
Number of Wells where Detected	79		3		15		27
Minimum Well Average	0.07		0.2	sr	0.1		0.07
Maximum Well Average	97,000		0.7	sr	97,000		97,000
95%UCL	1,103	ln			16,025	n,d	
RME Concentration	1,103		0.7				

TABLE H5-3
EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF CONCERN IN GROUNDWATER

	AOC No.1		AOC No. 2		AOC No. 1 Maximum Exposure Areas 10-Acre		AOC No. 1 Maximum Exposure Areas 30-Acre
Americium-241 (pCi/L)							
Number of Wells Sampled	69		5		14		NE
Number of Wells where Detected	69		5		14		NE
Minimum Well Average	-0.01		0.00		0.01		NE
Maximum Well Average	31.5		0.22		31.5		NE
95%UCL	0.19	ln	42.2	ln	6.7	n,d	NE
RME Concentration	0.19		0.22				NE
Plutonium-239/240 (pCi/L)							
Number of Wells Sampled	70		5		15		NE
Number of Wells where Detected	70		5		15		NE
Minimum Well Average	0.00		0.00		0.01		NE
Maximum Well Average	225		1.13		225		NE
95%UCL	2.4	ln	1.6E+05	ln	43.7	n,d	NE
RME Concentration	2.4		1.13				NE

-- Not detected in this area.
ln - Based on lognormal distribution.
n - Based on normal distribution.
d - See discussion in Attachment H1.
sr - Sample result (not a well average).
NE - Inorganic chemicals in groundwater were not evaluated in the 30-acre exposure area.
(1) Sampling results from each well were averaged (arthimetic mean) and those values were used to determine minimum, maximum, and 95% UCL values.

ubiquitously contaminated with PCBs; instead, contamination is limited to the area near IHSS 113. Therefore, exposure potential is minimal and overall risk in the exposure areas will be overestimated by assuming the entire area is contaminated with RME concentrations of PCBs.

- Cr was not statistically different than background concentrations (Appendix A, TM 9, DOE 1994b). Nevertheless, in keeping with the COC selection process, it was identified as an OU-wide COC because two sample results exceeded the background $UTL_{99/99}$ of 24.8 mg/kg. These sample results were 26 mg/kg and 29.5 mg/kg. The samples were collected approximately 1,500 to 2,000 feet southeast and east of the 903 Pad Area, in plots PT36 and PT46 (Figure H5-2). These two results only slightly exceed the background $UTL_{99/99}$. Table H5-1 shows that the RME concentrations of Cr range from about 13 to 17 mg/kg, depending on the exposure area. These levels are well within background range (the background mean and maximum are 15 mg/kg and 20 mg/kg, respectively). Therefore, the risk calculated for exposure to Cr in surface soil is equivalent to risk at background levels.

- The RME concentration for Pu-239/240 in surface soil is lower in the 10-acre maximum exposure area than it is in AOC No. 1 or in the 30- and 50-acre areas. This is because two extreme values for Pu-239/240 (5,700 pCi/g and 7,300 pCi/g) were measured in two samples outside the 10-acre maximum exposure area. The sample locations were plots PT36 and PT46 (where slightly elevated Cr was detected). The next highest concentration was 950 pCi/g in plot PT29, closer to the 903 Pad. The extreme values in the two samples "drive" the 95% UCL concentrations for AOC No. 1 and for the 30- and 50-acre exposure areas.

The exposure concentrations in surface soil were used to estimate health risks associated with soil ingestion and dermal contact by onsite workers, future ecological researchers, future open space users, and hypothetical onsite residents. In addition, the concentrations were used in

maximum exposure area in AOC No. 1. COCs are VOCs in groundwater, namely, 1,1-DCE, CCl_4, $CHCl_3$, CH_2Cl_2, PCE, and TCE.

The indoor air concentrations were estimated using a simple model in which RME concentrations of VOCs in groundwater were multiplied by a constant volatilization factor (VF) to convert a water concentration (mg/L) to an air concentration (mg/m^3) (Andelman 1990). The model was derived primarily from experimental data on the volatilization of radon from household use of water. In the derivation, all uses of household water were considered (e.g., showering, laundering, dish washing.) Certain assumptions were made in water use by a family of four, the volume of the dwelling, and the air exchange rate. Furthermore, it was assumed that the average transfer efficiency weighted by the type of water use is 50 percent (i.e., half of the concentration of each chemical in water will be transferred into air by all types of water uses). A CT value was chosen for the volatilization factor since risks are evaluated for chronic exposure. This CT value would therefore best represent a chronic exposure situation.

To estimate an RME air concentration, a CT value for VF of 0.065 mg/m^3 air per mg/L water was multiplied by the RME concentration in groundwater to yield the RME indoor air concentration.

H5.7 SURFACE WATER/SEDIMENT

Currently, under the RFETS surface water management plan, both Woman and Walnut creeks are monitored, and surface water discharges meet applicable federal and state surface water quality requirements. The current water management plan eliminates or minimalizes transport of potential OU-2 contaminants from creeks to offsite receptors. Thus, there was assumed to be ~~no~~ negligible current risk associated with contact with surface water in the creeks offsite. For hypothetical future exposure scenarios, however, it was assumed that the surface water is not monitored, intercepted by dams or diversion structures, or treated. A screening-level model was used to estimate future reasonable maximum 30-year average concentrations of COCs that could result from migration of OU-2 contaminants in UHSU groundwater to surface water and from transport of contaminated surface soil in storm runoff. Concentrations were estimated for Woman and Walnut creeks at Indiana Street. These were used as exposure concentrations for both onsite and offsite receptors. The 30-year averaging period

incremental lifetime cancer risk from the lifetime average daily intake of a chemical. This represents an estimation of an upperbound probability that an individual will develop cancer as a result of exposure to the potential carcinogen. This model provides a conservative (protective) estimate of cancer risk at low doses and is likely to overestimate the actual cancer risk. ~~The EPA acknowledges that actual SFs are likely to be between zero and the estimate provided by the linearized multistage model (EPA 1989a).~~ SFs for chemicals of concern in OU-2 are presented in Table H7-1.

H7.4 SLOPE FACTORS FOR RADIONUCLIDES

EPA's Health Effects Assessment Summary Tables (EPA 1994c) list cancer SFs for selected radionuclides of potential concern at Superfund sites. These values were calculated by the Office of Radiation Programs and are intended for use in human health risk assessments. EPA classifies all radionuclides as Group A (human) carcinogens based on the extensive weight-of-evidence provided by epidemiological studies of radiation-induced cancers in humans.

Radionuclides that enter the body may become incorporated into body tissues and emit alpha, beta, or gamma radiation for the duration of the radionuclide's lifetime. The potential adverse effects of radiation are proportional to energy deposition. The energy deposited in tissues is proportional to the decay rate and the type of radiation (alpha, beta, gamma) rather than the mass of the radionuclide (EPA 1989a). Radionuclide intake is typically expressed in terms of activity, either Curies (Ci) or Becquerels (Bqs) rather than mass (mg). Activity refers to the number of nuclear disintegrations per unit time. The historic unit of activity is the Ci, which is equal to 3.7×10^{10} disintegrations per second. The SI (Systeme Internationale) unit of activity is the Bq, equal to one disintegration per second (1 Bq = 2.7×10^{-11} Ci). EPA SFs are provided in both units, risk per picocurie (pCi or 1×10^{-12} Ci) and risk per Bq. Table H7-2 shows the SFs for radionuclides of concern expressed in risk per pCi.

EPA SFs for radionuclides are characterized as best estimates (median or 50th percentile) of the age-averaged, lifetime excess total cancer incidence (fatal and nonfatal) risk per unit exposure to a radionuclide. The SFs are based on the unique chemical, metabolic, and radiological properties of individual radionuclides. They were calculated using a non-threshold, linear dose-response model. The model accounts for the amount of radionuclide

generally concentration levels that represent an excess upperbound lifetime cancer risk of between 10^{-4} and 10^{-6}." Additionally, where cumulative carcinogenic risk to an individual based on RME exposure is less than 10^{-4} and the total HI does not exceed 1, action is generally not warranted for protection of public health (EPA 1991d). EPA recommends that cancer risk be evaluated separately for radionuclides and nonradionuclides (EPA 1989a). In the current assessment, separate estimates of radionuclide and nonradionuclide cancer risk were presented in Attachment H3, Health Risk Calculations. However, to reduce complexity in the following sections, cancer risks from radionuclide and nonradionuclide exposures were added and reported as total cancer risk.

H8.3 AOC No. 1

As discussed in Section H4.4, health hazard/risks for onsite receptors were evaluated in two AOCs identified in the operable unit, AOC No. 1 and AOC No. 2. Onsite receptors evaluated in these exposure areas include current workers, future industrial/office workers, future ecological workers, future open space users, future construction workers, and hypothetical residents. Hazards/risks for hypothetical future residents, future industrial/office workers, and future ecological workers were also estimated in 10-, 30-, and 50-acre maximum exposure areas, respectively, in AOC No. 1. Risk results for the maximum exposure areas are discussed in Section H8.4.

AOC No. 1 includes the 903 Pad, Mound, Northeast Trenches, and Southeast Trenches, which contain all of the IHSSs that were investigated in OU-2. Hazard/risks results for current and future receptors evaluated in AOC No. 1 are summarized in Table H8-1 and detailed in Attachment H3.

H8.3.1 Noncarcinogenic Hazard Index

The cumulative HIs for noncarcinogenic health effects for current and future onsite nonresidential receptors in AOC No.1 are 4E-02 or less for the average and RME conditions (Table H8-1). Because the HIs are less than 1, no adverse noncancer health effects are expected even for sensitive individuals exposed under RME conditions. Results for each receptor are discussed below:

Current Worker: Exposure pathways evaluated for the current worker were:

- Inhalation of airborne particulates
- Surface soil ingestion and dermal contact
- External irradiation from decay of radionuclides in surface soil

Future Construction Worker: The future construction worker was evaluated for the following exposure pathways:

- Inhalation of airborne particulates from subsurface and surface soil
- Subsurface soil ingestion and dermal contact
- External irradiation from decay of radionuclides in subsurface soil

The cumulative hazard indexes for noncarcinogenic health effects for the future construction worker are 4E-03 and 2E-02 for the average and RME conditions, respectively (Table H8-1). These values are below 1, indicating that no adverse noncancer effects are expected for the future construction worker in AOC No. 1.

Hypothetical Onsite Resident: Future land use at RFETS will not include residential development (DOE 1995b; EPA 1995a; CDPHE 1995). Nevertheless, an onsite residential exposure was evaluated in the HHRA as a hypothetical scenario to provide an upperbound estimate of risk that may support risk management decisions for low-hazard areas within OU-2. Because residential development is not a reasonable future land-use scenario in OU-2, ~~cleanup levels will not be based on estimates of risk to this hypothetical receptor.~~ actual risks to current and possible future receptors in OU-2 will be lower than those estimated for this scenario. Exposure pathways evaluated were:

- Inhalation of airborne particulates
- Surface soil ingestion and dermal contact
- Surface water and sediment ingestion and dermal contact (Walnut and Woman creeks)
- Groundwater ingestion
- Inhalation of VOCs indoors
- Ingestion of homegrown produce (surface deposition of particulates and root uptake)
- External irradiation from surface soil

The cumulative HIs for noncarcinogenic health effects for the onsite residential exposure in AOC No. 1 are 2E+01 and 1.4E+02 for the average and RME conditions, respectively (Table

H8-1). Ingestion of groundwater is the only pathway that contributes significantly to the total HI. The cumulative HIs exceed 1, indicating possible cause for concern for potential

noncancer effects from ingestion of groundwater in AOC No. 1. HIs for other exposure pathways are negligible. Carbon tetrachloride, with an HQ for ingestion in groundwater of 1.4E+02, contributes the largest fraction (97 percent) of the total HI, while tetrachloroethene has an HQ of 3E+00 (see detail in Attachment H3). RME HQs for other COCs in groundwater were 3E-01 or less, indicating that no adverse noncancer health effects are expected from hypothetical long-term residential exposure to chemicals other than carbon tetrachloride and tetrachloroethene in groundwater in AOC No. 1.

H8.3.2 Carcinogenic Risk

Excess lifetime cancer risk estimates for onsite receptors in AOC No. 1 are summarized in Table H8-1 and detailed in Attachment H3. Results for each receptor and the chief contributors to risk are discussed below.

Current Worker: Exposure pathways evaluated for the current worker were the same as described in Section H8.3.1.

The estimated excess lifetime cancer risk for the current worker in AOC No. 1 is 6E-07 (6 in 10 million) under the average exposure condition and 1E-05 (1 in 100,000) under the RME condition (Table H8-1). These levels are less than or within the EPA target cancer risk range of 1E-06 to 1E-04 (1 in 1 million to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1989a). Exposure to Pu-239/240 in surface soil by the ingestion and inhalation pathways accounted for 90 percent of the estimated RME excess lifetime cancer risk for this receptor. (See detail in Attachment H3.)

Future Industrial/Office Worker: Exposure pathways evaluated for the future industrial/office worker were the same as for the current worker (Section H8.3.1), with the addition of inhalation of VOCs migrating from subsurface soil or groundwater to indoor air. The estimated excess lifetime cancer risk for the future industrial/office worker in AOC No. 1 is 2E-06 (2 in 1 million) under the average exposure condition and 8E-05 (8 in 100,000) under the RME condition (Table H8-1). These levels are within the EPA target risk range of 1E-06 to 1E-04 (1 in 1 million to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1989a). Exposure to Pu-239/240 in surface soil by the ingestion and

inhalation pathways accounted for 92% of the estimated RME excess lifetime cancer risk for this receptor. (See detail in Attachment H3.)

Future Ecological Worker: Exposure pathways evaluated for the ecological worker were described in Section H8.3.1. The estimated excess lifetime cancer risk for the future ecological worker in AOC No. 1 is 1E-06 (1 in 1 million) under the average exposure condition and 4E-06 (4 in 1 million) under the RME condition (Table H8-1). These levels are near the EPA "point of departure" of 1E-06 (1 in 1 million) for evaluating risk associated with exposure to chemicals released from hazardous waste sites (EPA 1989a) and indicate negligible risk for this receptor.

Future Open Space Use: Exposure pathways for future open space use were described in Section H8.3.1. The estimated excess lifetime cancer risk for future open space use in AOC No. 1 is 2E-07 (2 in 10 million) under the average exposure condition and 1E-05 (1 in 100,000) under the RME condition (Table H8-1). These levels are below or within the EPA target risk range of 1E-06 to 1E-04 (1 in 1 million to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1989a).

Future Construction Worker: Exposure pathways for the future construction worker were described in Section H8.3.1. The cumulative excess lifetime cancer risk is ~~1~~2E-07 (1 in 10 million) under the average exposure condition and 3E-07 (3 in 10 million) under the RME condition. These levels are below the EPA "point of departure" of 1E-06 (1 in 1 million) for evaluating risk associated with exposure to chemicals released from hazardous waste sites (EPA 1989a) and indicate negligible risk for this receptor.

Hypothetical Onsite Resident: As discussed in Section H8.3.1, future land use at RFETS will not include residential development. Because residential development is not a reasonable future land-use scenario in OU-2, ~~cleanup levels will not be based on estimates for risk to this hypothetical receptor~~actual risks to current and possible future receptors in OU-2 will be lower than those estimated for this scenario. However, the estimates do provide insight into potential sources of health risk in OU-2. The exposure pathways evaluated for the onsite resident are listed in Section H8.3.1. The estimated excess lifetime cancer risk assuming residential use is 4E-04 (4 in 10,000) under the average exposure condition and 8E-03 (8 in 1,000) under the RME condition. These levels exceed the EPA target risk range of 1E-06

to 1E-04 (1 in 1 million to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1989a).

Because future use will not include residential development, actual risks in this area will be lower than those estimated for this scenario.

Noncarcinogenic Hazard Index: The cumulative hazard indexes for noncarcinogenic health effects for future onsite residents are 2E+01 and 1.6E+02 for the average and RME conditions, respectively (Table H8-2). The HIs exceed 1, indicating possible cause for concern for noncancer effects from ingestion of groundwater from the 10-acre maximum exposure area. Ingestion of groundwater is the only pathway that contributes significantly to the total HIs. HIs for other exposure routes were negligible for the average exposure and RME conditions. Ingestion of carbon tetrachloride, chloroform, and tetrachloroethene account for most of the total average and RME HIs. (See detail in Attachment H3.)

Carcinogenic Risk: The estimated excess lifetime cancer risk is 1E-03 (1 in 1,000) under the average exposure conditions and 1.5E-02 (1.5 in 100) under RME conditions. These levels exceed the EPA target risk range of 1E-06 to 1E-04 (1 in 1 million to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1989a). Ingestion of groundwater, inhalation of indoor VOCs from domestic use of groundwater, and ingestion of surface soil are the pathways that contribute significantly to overall risk (Table H8-2). RME cancer risks from other exposure pathways are 3E-05 or less.

As in AOC No. 1, the average estimated cancer risk of 1E-05 for surface soil exposure routes is within EPA's target risk range. The RME cancer risk of 2E-04 for surface soil exposure routes ~~slightly~~ exceeds EPA's target risk range.

Chief contributors to hazard/risk estimates for groundwater exposure are carbon tetrachloride, chloroform, trichloroethene, tetrachloroethene, and 1,1-dichloroethene. The chief contributor to cancer risk estimates for soil exposures is plutonium. Chemical-specific risks from all pathways are detailed in Attachment H3.

H8.4.2 Future Industrial/Office Worker (30-acres)

Noncarcinogenic Hazard Index: The exposure pathways evaluated for the future onsite worker were surface soil ingestion and dermal contact, inhalation of PM_{10}, and inhalation of indoor VOCs. The cumulative HIs for this receptor in the 30-acre maximum exposure area

are 1E-02 for the average exposure condition and 8E-02 for the RME condition (Table H8-2). These values are below 1, indicating that no adverse noncancer health effects are expected for the future onsite industrial/office worker in this exposure area.

Carcinogenic Risk: The estimated excess lifetime cancer risk is 5E-06 (5 in 1 million) for the average exposure condition and 2E-04 (2 in 10,000) under the RME condition (Table H8-2). The RME cancer risk level ~~slightly~~ exceeds the EPA target risk range of 1E-06 to 1E-04 (1 in 1 million to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1989a), whereas the average risk estimate is within EPA's risk range. ~~RME cancer risks estimates for this receptor are likely to significantly overestimate actual risk because overly conservative assumptions resulted in overestimation of intake values for ingestion and inhalation of soil~~. Exposure to Pu-239/240 in surface soil by the ingestion and inhalation pathways accounted for most of the estimated excess lifetime cancer risk for this receptor. The exposure point concentration of Pu-239/240 of 1.8E+06 pCi/kg is ~~biased~~~~driven~~ by one high sample result (7.3E+06 pCi/kg) in the 30-acre maximum exposure area. The next highest concentration was 9.5E+05 pCi/kg. The single high value ~~biases~~ the estimates of exposure concentration and risk for the entire 30-acre area.

H8.4.3 Future Onsite Ecological Worker (50-acres)

Noncarcinogenic Hazard Index: Exposure pathways for the ecological worker are listed in Section H8.3.2. The cumulative HIs for this receptor in the 50-acre maximum exposure area are 8E-03 for the average exposure condition and 4E-02 for the RME condition (Table H8-2). These values are well below 1, indicating that no adverse noncancer health effects are expected for the future onsite ecological worker.

Carcinogenic Risk: The estimated excess lifetime cancer risk is 2E-06 (2 in 1 million) for the average exposure condition and ~~6~~7E-06 (6 in 1 million) for the RME condition (Table H8-2). These levels are ~~near the "point of departure" of 1E-06 (1 in 1 million) of excess cancer risk for evaluating risk associated with exposure to chemicals released from hazardous waste sites (EPA 1989a), and indicate negligible risk for this receptor.~~ ~~within EPA's target risk range of 1E-06 to 1E-04 for exposure to chemicals released from hazardous waste sites (EPA 1989a).~~

an upperbound estimate of risk that may support risk management decisions in this relatively low-hazard area.

The estimated excess lifetime cancer risk for the hypothetical future onsite receptor in AOC No. 2 is 8E-07 (8 in 10 million) under the average exposure condition and 1E-05 (1 in 100,000) under RME conditions (Table H8-3). These levels are within or below the EPA target risk range of 1E-06 to 1E-04 (1 in 1 million to 1 in 10,000) for exposure to chemicals released from hazardous waste sites (EPA 1989a). Ingestion and inhalation of Pu-239/240 in surface soil and ingestion of Pu-239/240 in groundwater accounted for most of the estimated excess lifetime cancer risk for this receptor. (See detail in Attachment H3.) Cancer risk results for each receptor are listed below.

Cancer Risk Estimates for Receptors in AOC No. 2

Receptor	CT	RME
Current Worker	9.09E-09	1.92E-07
Future Industrial/Office Worker	3.59E-08	1.12E-06
Future Ecological Worker	2.34E-08	6.57E-08
Future Open Space Use	5.78E-09	2.6E-07
Future Construction Worker	2.8E-08	1.4E-07
Hypothetical Onsite Resident	7.56E-07	1.3E-05

H8.6 OFFSITE RESIDENTS

Current and future offsite residential receptors were evaluated for exposure to chemicals transported in air from AOC No. 1 and from AOC No. 2. Current offsite receptors selected for evaluation are the closest residence to RFETS (Current Resident, Indiana South) and the closest residence to RFETS in the prevailing southeast wind direction (Current Resident, Southeast), each located east of Indiana Street near RFETS southeast corner. Exposure pathways evaluated for current offsite residents were inhalation of airborne particulates from AOC No. 1 and AOC No. 2 and ingestion of particulate matter deposited on surface soil and homegrown produce. Future offsite receptors were evaluated at two hypothetical residences, located on Indiana Street adjacent to Walnut Creek (Future Resident, Walnut Creek/Indiana)

Concentrations of Lead in Groundwater, µg/L

Sample Type	Background Mean	Site Mean	Background Maximum	Site Maximum	$UTL_{99/99}$	No. > $UTL_{99/99}$
Unfiltered	3.8	29	52.5	675	19.3	97
Filtered	2.4	1.5	64	13.8	15.8	0

Total suspended solids (TSS) in OU-2 groundwater samples were much higher than in background samples. As a result, unfiltered groundwater samples collected in OU-2 had elevated levels of numerous metals, including lead, that are associated with TSS. Based on comparing concentrations of lead in unfiltered and filtered samples, lead in groundwater in OU-2 is not considered to be a site contaminant but rather the result of high TSS in the samples.

H8.8 SUMMARY OF CUMULATIVE HAZARD/RISK RESULTS

Hazard/risk characterization was performed for six onsite receptors in two AOCs in RFETS OU-2. In addition, residential, industrial, and ecological researcher scenarios were evaluated in 10-, 30-, and 50-acre maximum exposure areas, respectively. Four offsite receptor locations were also evaluated. Results are summarized in Tables H8-1 through H8-5 and detailed in Attachment H3.

AOC No. 1 and Maximum Exposure Areas: Cumulative HIs were less than 1 and cancer risk estimates were below 2E-04 for all nonresidential receptors.

HIs for the onsite residential scenario ranged from 2E+01 (CT, AOC No. 1) to 1.6E+02 (RME, 10-acre area) and cancer risk estimates ranged from 4E-04 (CT, AOC No. 1) to 2E-02 (RME, 10-acre area), chiefly due to VOCs in groundwater. These results for the residential scenario indicate that hazard/risks from domestic use of groundwater in AOC No. 1 and the 10-acre maximum exposure area would be expected to exceed levels of concern. However, total HIs associated with other exposure pathways were less than 1, and cancer risk estimates ranged from 1.3E-05 (CT, 10-acre area) to 34E-04 (RME, AOC No. 1) for other exposure pathways. Residential use of groundwater will not occur in OU-2 because future land use

at RFETS will not include residential development (DOE 1995b; EPA 1995a; CDPHE 1995). Drinking water for current onsite workers is provided by a municipal water supply, and it is expected that drinking water for future onsite receptors will also be provided from a public water supply. Therefore, since direct ingestion of groundwater is an incomplete pathway for all current and possible future receptors in OU-2, chemicals in groundwater do not pose a risk to human health.

The next highest hazard/risk estimates were associated with future industrial/office worker exposures in AOC No. 1 and in the 30-acre maximum exposure area. This receptor is the reasonable maximum exposed individual under credible future use scenarios. Hazard/risk results for this receptor are summarized below.

Hazard/Risk Summary for Future Onsite Industrial/Office Worker

	Hazard Index		Cancer Risk		Risk Driver
	CT	RME	CT	RME	
AOC No. 1	6E-03	4E-02	~~2~~3E-06	8E-05	Pu-239/240 in surface soil
30-Acres	1E-02	8E-02	5E-06	2E-04	Pu-239/240 in surface soil

The low HIs for the future industrial/office worker in OU-2 indicate that no noncancer health effects are expected from inhalation of airborne particulates, ingestion of surface soil, or dermal contact with surface soil. Groundwater exposures were not evaluated for nonresidential receptors because it is expected that public supplies will continue to be provided to industrial and commercial future users.

However, excess lifetime cancer risk for future industrial/office workers under RME condition in the 30-acre maximum exposure area ~~slightly~~ exceeds the EPA target risk range of 1E-06 to 1E-04 (1 in 1 million to 1 in 10,000). ~~RME cancer risk estimates for this receptor are likely to significantly overestimate actual risk because overly conservative assumptions results in overestimation of intake values for ingestion and inhalation of soil.~~

Exposure to plutonium in surface soil via the ingestion and inhalation pathways accounts for 94 percent of the estimated RME excess lifetime cancer risk for this receptor. ~~The cancer risk to future industrial/office workers in the 30-acre maximum exposure area may be~~

~~exaggerated by~~~~As discussed in Section H8.4.2,~~ one relatively high concentration value for Pu-239/240 in surface soil ~~(Section H8.4.2). This single concentration biases~~ ~~drives~~ estimates of Pu-239/240 exposure point

concentrations for the entire 30 acres, which ~~also drives~~affects estimates of cancer risk ~~for future industrial/office workers. Other samples in the data set had significantly lower concentrations~~ ~~; the excess lifetime cancer risk when this one relatively high value is excluded from the calculation of exposure point concentrations is 2E-05, which is within EPA's target risk range of 1E-06 to 1E-04.~~

The average exposure and RME cancer risks for the future industrial/office worker in AOC No. 1 are each less than 1E-04.

Hazard/risk results for other receptors evaluated in AOC No. 1 (current worker, future ecological worker, future open space use, and future construction worker) did not exceed generally accepted levels of risk.

Area of Concern No. 2: Hazard/risk results are summarized in Table H8-3 and detailed in Attachment H3. A hypothetical onsite residential receptor was evaluated in AOC No. 2 to provide an upperbound estimate of risk to support risk management decisions in low hazard areas. Hazard/risk estimates for this "worst case scenario" did not exceed generally accepted levels of risk: the RME HI was 6E-03, well below 1, and the RME cancer risk was 1E-05, well within EPA's target risk range of 1E-06 to 1E-04. Hazard/risk estimates for other receptors evaluated in AOC No. 2 were well below levels of potential concern.

Offsite Receptors: Hazard/risk results are summarized in Table H8-4 and detailed in Attachment H3. Total HIs and lifetime cumulative excess cancer risk for offsite receptors were very low (HI of 6E-04 or less, cancer risk of 2E-07 or less), indicating that no adverse noncancer health effects are expected and cancer risk is negligible for these receptors. These results reflect insignificant impacts from airborne particulate matter from OU-2 sources and negligible risk associated with modeled concentrations of OU-2 COCs in surface water/sediment in Walnut Creek and Woman Creek.

Onsite receptors are current workers, future industrial/office workers, future ecological workers, future open space users, future construction workers, and hypothetical residents. Although no residential development is expected at RFETS, the hypothetical residential scenario was evaluated to provide an upper-bound estimate of risk that may support risk management decisions for low-hazard areas within OU-2.

This section describes the results of annual radiation dose estimates for receptors in AOC No. 1. AOC No. 1 includes the 903 Pad, Mound, Northeast Trenches, and Southeast Trenches, which contain all of the IHSSs that were investigated in OU-2. Annual radiation dose results for the maximum exposure areas are discussed in Section H9.3; results for AOC No. 2 are discussed in Section H9.4.

Current Worker: The following radionuclide exposure pathways were evaluated for the current worker:

- Inhalation of airborne particulates
- Ingestion of surface soil
- External irradiation from radionuclides in surface soil

The total annual radiation dose for the current worker in AOC No. 1 is 1 mrem/year for the average exposure condition and 2 mrem/year for the RME condition (Table H9-2). These values are below the DOE limits of 100 mrem/year for members of the public and 5,000 mrem/year for radiological workers exposures.

Future Industrial/Office Worker: Radionuclide exposure pathways evaluated for the future industrial/office worker were the same as for the current worker. The total annual radiation dose for the future industrial/office worker in AOC No. 1 is 4 mrem/year for the average exposure condition and 9 mrem/year for the RME condition (Table H9-2). Inhalation of Pu-239/240 was the major contributor to total annual radiation dose. These values are below the DOE limit of 100 mrem/year for members of the public.

Future Ecological Worker: Radionuclide exposure pathways evaluated for the ecological worker were:

- Ingestion of surface soil
- Inhalation of airborne particulates from surface soil
- Ingestion of surface water/sediment (Walnut and Woman creeks)
- External irradiation from radionuclides in surface soil

The total annual radiation dose for the ecological worker in AOC No. 1 is 2 mrem/year for the average exposure condition and 4 mrem/year for the RME condition (Table H9-2). These doses are below the DOE limit of 100 mrem/year for members of the public.

Future Open Space Use: Radionuclide exposure pathways evaluated for future open space use were:

- Ingestion of surface soil
- Inhalation of airborne particulates from surface soil
- Ingestion of surface water/sediment (Walnut and Woman creeks)
- External irradiation from surface soil

The total annual radiation dose for open space use in AOC No. 1 is 0.2[illegible] mrem/year for the average exposure condition and 7[illegible] mrem/year for the RME condition (Table H9-2). These doses are below the DOE limit of 100 mrem/year for members of the public.

Future Construction Worker: The future construction worker was evaluated for the following exposure pathways:

- Subsurface soil ingestion
- Inhalation of airborne particulates from subsurface and surface soil
- External irradiation from radionuclides in subsurface soil

The total annual radiation dose for the construction worker in AOC No. 1 is 1 mrem/year for both the average and RME exposure conditions (Table H9-2). This level is below the DOE limit of 100 mrem/year for members of the public.

Hypothetical Resident: Future land use at RFETS will not include residential development (DOE 1995b; EPA 1995a; CDPHE 1995). Nevertheless, onsite residential exposure was evaluated in the HHRA as a hypothetical scenario to provide an upper-bound estimate of risk that may support risk management decisions for low-hazard areas within OU-2. Because residential development is not a reasonable future land-use scenario in OU-2, cleanup levels will not be based on estimates of risk to this hypothetical receptor.

Annual radiation doses were estimated for onsite residential exposure in AOC No.1, a 10-acre maximum exposure area in AOC No. 1, and AOC No. 2. The hypothetical resident was evaluated for the following exposure pathways:

- Surface soil ingestion
- External irradiation from radionuclides in surface soil
- Inhalation of airborne particulates
- Groundwater ingestion
- Ingestion of surface water and sediment (Walnut Creek and Woman Creek)
- Ingestion of homegrown produce (surface deposition of particulates and root uptake)

The total annual radiation dose for the onsite resident in AOC No. 1 is 11~~3~~ mrem/year for the average exposure condition and 38~~42~~ mrem/year for the RME condition. Inhalation of airborne particulates (22 mrem/year), external irradiation from surface soil (9 mrem/year), and ingestion of surface soil (6 mrem/year) are the primary pathways contributing to the total RME annual radiation dose (Table H9-2). The annual radiation dose for all exposure pathways is below the DOE limit of 100 mrem/year for members of the public.

H9.3 MAXIMUM EXPOSURE AREAS IN AOC No. 1

Annual radiation doses, in terms of TEDE for one year of exposure (mrem/year), were also estimated for receptors in three maximum exposure areas in AOC No. 1:

- a 10-acre hypothetical residential neighborhood at the area of maximum soil and groundwater contamination in OU-2

- a 30-acre industrial/office park incorporating the maximum contaminated area in OU-2

- a 50-acre ecological study area incorporating the maximum contaminated area in OU-2.

Annual radiation doses for each receptor/exposure area are summarized in Table H9-3 and are discussed below. Detailed radionuclide- and pathway-specific results are presented in Attachment H4.

H9.3.1 Hypothetical Onsite Resident (10-acres)

The total annual radiation dose was estimated for a hypothetical onsite residential exposure in a 10-acre maximum exposure area, approximately equivalent to the 903 Pad Area. Pathways evaluated are the same as listed for the onsite resident in AOC No. 1 (Section H9.2.6). The total annual radiation dose for the onsite resident in the 10-acre maximum exposure area in AOC No. 1 is 16 mrem/year for the average exposure condition and 66 mrem/year for the RME condition. External irradiation from surface soil (20 mrem/year), groundwater ingestion (19 mrem/year), ingestion of surface soil (14 mrem/year), and inhalation of airborne particulates (9 mrem/year) were the primary pathways contributing to the total RME annual radiation dose (Table H9-3). The total annual dose is below the DOE limit of 100 mrem/year for members of the public.

H9.3.2 Future Industrial/Office Worker (30-acres)

Pathways evaluated were surface soil ingestion, particulate inhalation, and external irradiation. The total annual radiation dose for the future industrial/office worker in the 30-acre maximum exposure area in AOC No. 1 is 9 mrem/year for the average exposure condition and 18 mrem/year for the RME condition (Table H9-3). Inhalation of plutonium contributed to most of the annual dose. These doses are below the DOE limit of 100 mrem/year for members of the public.

H9.3.3 Future Onsite Ecological Worker (50-acres)

Pathways evaluated are the same as listed for the future ecological worker in AOC No. 1 (Section H9.2.3). The total annual dose for the future ecological worker in the 30-acre maximum exposure area in AOC No. 1 is 3 mrem/year for the average exposure condition and 6[illegible] mrem/year for the RME condition (Table H9-3). These doses are below the DOE limit of 100 mrem/year for members of the public.

H9.4 AOC No. 2

AOC No. 2 is the East of IHSSs area, located in the buffer zone between the IHSSs and Indiana Street. No IHSSs or other waste disposal areas are present in AOC No. 2. Annual radiation doses for current and future receptors located in AOC No. 2 are summarized in Table H9-4 and detailed in Attachment H4.

Exposure pathways evaluated for current and future onsite receptors in AOC No. 2 were the same as those evaluated in AOC No. 1. The total annual radiation dose, in terms of TEDE for one year of exposure, for current and future onsite nonresidential receptors in AOC No. 2 are 0.3 mrem/year or less for the average and RME conditions. Radiation dose results for each receptor are discussed below.

Current Onsite Worker: The total annual radiation dose for the current worker in AOC No. 2 is 0.02 mrem/year for the average exposure condition and 0.04 mrem/year for the RME condition.

Future Industrial/Office Worker: The total annual radiation dose for the future industrial office worker in AOC No. 2 is ~~0.09~~[illegible] mrem/year for the average exposure condition and 0.2 mrem/year for the RME condition.

Future Ecological Worker: The total annual radiation dose for the future ecological worker in AOC No. 2 is 0.05 mrem/year for the average exposure condition and 0.1 mrem/year for the RME condition.

Future Open Space Use: The total annual radiation dose for future open space use in AOC No. 2 is 0.007~~2~~ mrem/year for the average exposure condition and ~~0.30~~ 0.03 mrem/year for the RME condition.

Future Construction Worker: The total annual radiation dose for the future construction worker in AOC No. 2 is 0.03 mrem/year for the average exposure condition and 0.07~~8~~ mrem/year for the RME condition.

Hypothetical Onsite Resident: The total annual radiation dose for the hypothetical onsite resident in AOC No. 2 is 0.4 mrem/year for the average exposure condition and 2 mrem/year for the RME condition.

H9.5 OFFSITE RESIDENTS

Current and future offsite residential receptors were evaluated for exposure to radionuclides transported in air from AOC No. 1 and from AOC No. 2. Current offsite receptor locations selected for evaluation are the closest residence to RFETS (Current Resident, Indiana South) and the closest residence to RFETS in the prevailing southeast wind direction (Current Resident, Southeast), each located east of Indiana Street near RFETS southeast corner. Exposure pathways evaluated for current offsite residents include inhalation of airborne particulates from AOC No. 1 and AOC No. 2 and ingestion of particulate matter deposited on soil or on homegrown produce.

Future offsite residential receptors were evaluated at two locations, both on Indiana Street adjacent to either Walnut Creek (Future Resident, Walnut Cr./Indiana) or Woman Creek (Future Resident, Woman Cr./Indiana). Exposure pathways for future offsite receptors include those for current offsite receptors, plus oral exposure to surface water/sediments in Woman Creek or Walnut Creek. Radiation dose results for current and future offsite receptors are summarized in Table H9-5 and detailed in Attachment H4.

The total annual radiation doses for offsite receptors were 0.003~~4~~ mrem/year or less for the average and RME conditions (Table H9-5). When impacts from AOC No. 1 and AOC No. 2 are combined, the total annual radiation dose for offsite residents is 0.004 mrem/year or less.

These levels indicate negligible exposure to radionuclides in air, deposited particulate matter, or in surface water/suspended sediments in the creeks.

H9.6 SUMMARY OF RESULTS

Annual radiation dose, in terms of total effective dose equivalent (TEDE) for one year of exposure, was estimated for six onsite receptors in two AOCs in RFETS OU-2. In addition, residential, industrial, and ecological researcher scenarios were evaluated in 10-, 30-, and 50-acre maximum exposure areas, respectively. Four offsite receptor locations were also evaluated. Results are summarized in Tables H9-2 through H9-5 and detailed in Attachment H4.

H9.6.1 AOC No. 1

Annual radiation dose estimates for AOC No. 1 are summarized in Table H9-2. Estimated annual radiation doses were ~~18~~20 mrem or lower for all non-residential receptors evaluated in AOC No. 1. These doses are below the DOE limit of 100 mrem/year for protection of public health and 5,000 mrem/year for radiological worker exposure. Estimated annual radiation doses for hypothetical residents ranged from ~~11~~13 mrem/year (CT, AOC No. 1) to 66~~7~~ mrem/year (RME, 10-acre).

These levels are also below DOE limits for protection of the public. Because onsite residential development will not occur in OU-2, the estimates of annual radiation dose to hypothetical onsite residents do not reflect actual doses expected under current and probable future land use at RFETS.

The next highest radiation dose results were associated with future industrial/office worker exposures in the 30-acre maximum exposure area. These were 9~~1~~0 mrem/year and ~~18~~20 mrem/year for the CT and RME scenarios, respectively. These values are below the DOE limit of 100 mrem/year for members of the public. Exposure to Pu-239/240 in surface soil accounts for most of the estimated RME annual dose for this receptor (approximately 12~~3~~ mrem/year). Annual radiation dose for the future industrial/office worker in the 30-acre maximum exposure area ~~may be exaggerated~~is biased by one relatively high value for Pu-239/240 in surface soil (7.3E+06 pCi/kg). This concentration, which is 7 times higher than any other

detected concentration, may bias the estimate of mean exposure concentration of Pu-239/240 in surface soil in the 30-acre maximum exposure area and also bias the estimate of annual radiation doses. ~~For example, the RME annual radiation dose for the future industrial/office worker in the 30-acre maximum exposure area is 18 mrem/year when the extreme value is included in the data set, but is only 9 mrem/year when the extreme value is excluded from the data set.~~

H9.6.2 AOC No. 2

Radiation dose calculations for AOC No. 2 are summarized in Table H9-4. Total annual radiation doses were 2 mrem/year or less for all onsite receptors in AOC No. 2, indicating that exposure to radionuclides in AOC No. 2 is negligible.

H9.6.3 Offsite Receptors

Total radiation doses for offsite receptors are very low (0.004 mrem/year or less). These results reflect insignificant impacts from airborne particulate matter from OU-2 sources and from radionuclides transported from OU-2 sources in surface water/sediment in Walnut and Woman Creeks.

H10.0
UNCERTAINTIES AND LIMITATIONS

This section discusses the chief uncertainties and limitations of the risk assessment and how they affect the results and conclusions. It also provides an assessment of risk from exposure to special-case COCs and discusses their potential contribution to overall site risk.

Uncertainties and limitations are inherent in the risk assessment process. The level of certainty associated with the conclusions of the risk assessment are conditional upon the quality of data and models used to identify COCs and estimate chemical concentrations, the assumptions made in estimating exposure conditions, the methods used to develop toxicity values, and the methods used to characterize risk. Uncertainties in the risk assessment process could result in an overestimation or underestimation of risk. However, it is standard in risk assessment to adopt conservative approaches when uncertainty about a particular assumption exists, so as not to underestimate potential risk. Therefore, the risk assessment process is skewed toward overestimating rather than underestimating risk.

In the current assessment, there are uncertainties that could result in an overestimation or underestimation of risk. Sources of uncertainty that may contribute to an underestimation of risk include COCs for which risk could not be assessed because their toxicity is unknown and the use of unadjusted oral toxicity factors to estimate risk from dermal exposure (Section H10.1.4). However, in most cases of uncertainty, conservative assumptions were used so as not to underestimate risk. In doing this, it is likely that overall risk was overestimated. At all stages of this risk assessment, however, reasonable conservative assumptions were made so as not to underestimate potential risk. Furthermore, estimates of toxicity and carcinogenicity (RfDs and SFs) are very conservative and may result in an overestimate of risk. Therefore, the conclusions regarding identification of chief contaminants of concern, levels of potential health risk associated with direct and indirect exposures, and offsite migration potential are considered reliable.

The chief sources of uncertainty are discussed in Section H10.1. An evaluation of risk from special-case COCs is presented in Section H10.2.

Concentrations of Copper in Groundwater, µg/L

Sample Type	Background Mean	Site Mean	Background Maximum	Site Maximum	$UTL_{99/99}$	No. > $UTL_{99/99}$
Unfiltered	11.4	55.3	105	1310	45.3	69
Filtered	10.7	9.8	175	20.9	53.8	0

Copper in unfiltered groundwater samples is not considered to be a site contaminant, but rather the result of high TSS in the samples. (Refer to discussion in TM No. 9, DOE 1994b).

1,1,1-TCA in groundwater: A provisional RfC for 1,1,1-TCA has been published by EPA but was not available at this writing. 1,1,1-TCA was detected in 25 percent of groundwater samples, ranging in concentration from 0.00018 mg/L to 1 mg/L (mean concentration of 0.026 mg/L). Because this concentration is relatively low compared to concentrations of carbon tetrachloride (3.5 mg/L) and tetrachloroethene (1.2 mg/L), which contribute 99 percent of the noncarcinogenic HI for groundwater ingestion, the exclusion of 1,1,1-TCA from the quantitative risk assessment will not result in an underestimate of risk.

H10.1.5 Toxicity Assessment - Dermal Toxicity Factors

EPA recommends using oral toxicity factors, adjusted, if possible by gastrointestinal absorption fraction, to evaluate toxic effects from dermal absorption of chemicals from contaminated media (EPA 1989a, 1992c). Unadjusted oral toxicity factors were used in the current assessment to estimate effects from dermal absorption of organic chemicals, an approach that may underestimate risk. Cancer risk from dermal exposure for the office worker in the 30-acre maximum exposure are in AOC No. 1 was 4E-06 and risks for other receptors were lower. Because these risk estimates for dermal exposure were within or below EPA's target risk range of 1E-06 to 1E-04 and represented only a small percentage of overall risk, it is unlikely that the use of adjusted oral toxicity factors to assess dermal exposure would have a significant impact on estimates of overall risk.

H10.2 EVALUATION OF RISK ASSOCIATED WITH SPECIAL-CASE COCs

Special-case COCs are (1) compounds that were infrequently detected (< 5 percent) but that exceeded 1000 times the RBC, and (2) compounds that are probably not environmental contaminants but were retained for separate consideration because of toxicity. A detailed discussion of the selection of special-case COCs is presented in the TM 9 (DOE 1994b). In addition, parties to the IAG agreed to evaluate hazard/risk for four metals (antimony, arsenic, beryllium, manganese) in groundwater that are probably not environmental contaminants, but may pose a health risk under long-term exposure to maximum detected concentrations (CDPHE 1994, EPA 1994b, DOE 1994d). Hazard/risk results for special-case COCs are summarized in Table H10-1 and detailed in Attachment H3.

H10.2.1 Metals in Groundwater in OU-2

Four metals were selected for separate evaluation of potential hazard/risk associated with hypothetical ingestion of groundwater: antimony, arsenic, beryllium, and manganese. None of these metals was identified as a COC in OU-2 groundwater, primarily because they do not appear to be contaminants but rather associated with high concentrations of TSS in unfiltered groundwater samples. However, their maximum concentrations exceeded RBCs for

groundwater ingestion (DOE 1994g). To address concerns that these metals could pose a health risk under long-term exposure to maximum detected concentrations, parties to the IAG agreed that ~~arsenic they~~ will be evaluated separately in the uncertainties section of the HHRA (CDPHE 1994; EPA 1994b; DOE 1994d).

Hazard/risk results for ingestion of these four metals in groundwater, assuming residential use, are shown in Table H10-1 and detailed in Attachment H3. Results from unfiltered samples were used in the risk evaluation.

Noncarcinogenic Hazard Index: The total HIs for noncarcinogenic health effects from exposure to these four metals in groundwater in AOC No. 1 are 2 and 14 for the average and RME conditions, respectively (Table H10-1). In AOC No. 2, the total hazard indexes are 1 for the average exposure condition and 8 for the RME condition. Manganese contributes most of the total HIs. HQs for the other metals were near or less than 1.

In the two AOCs, the HIs differ by approximately a factor of two, indicating that the concentrations of metals in groundwater in each AOC differ by only a factor of two. The small difference in metals concentrations in the two AOCs suggests that these metals are present in groundwater samples as a result of naturally occurring conditions, rather than from site-related activities. On the other hand, concentrations of COCs in groundwater (e.g., radionuclides and VOCs) are substantially higher near source areas (e.g., IHSSs in AOC No. 1) than they are distant from source areas (e.g., in AOC No. 2).

As stated above, the magnitude of the HIs are driven by manganese. However, the HIs may not be a sound guide to potential health hazards (assuming unfiltered UHSU groundwater is ingested chronically) because significant uncertainty exists with regard to the toxicity of manganese ingested in water. The toxicity value for manganese in water, represented by the RfD (0.005 mg/kg-day, EPA 1995b), is probably significantly overestimated. This RfD is 28-times smaller than the RfD for manganese in food (0.14 mg/kg-day, EPA 1995b); it is an order of magnitude less than the "Estimated Safe and Adequate Daily Dietary Intake" of 0.03 to 0.07 mg Mn/kg-day (manganese is an essential element) recommended by the National Research Council (NRC 1989); and it is well below the dose (0.129 mg/kg/day) considered by World Health Organization (WHO) to be "perfectly safe" (WHO 1973).

chloride, tetrachloroethene, and trichloroethene were more widely detected in groundwater and resulted in excess lifetime cancer risk estimates in the range of 1E-03 to 1E-02. Incremental risk from vinyl chloride would not significantly affect the total cancer risk estimate for exposure to groundwater.

H10.2.4 PAHs in Surface Soil

As discussed in the COC TM for OU-2 (DOE 1994a), PAHs were retained for separate evaluation as special-case COCs because their presence in surface soil is more likely due to common sources such as vehicle emissions rather than waste releases at OU-2. PAHs are ~~common combustion byproducts~~ structurally similar compounds formed from burning coal, wood, tobacco, and petroleum based fuels. Different PAHs have the potential to produce similar toxic effects, although potency may vary widely. PAHs may be noncarcinogenic (anthracene), weakly carcinogenic (benzo[k]fluoranthene), or strongly carcinogenic (benzo[a]pyrene). Adverse noncancer effects observed in test animals include inhibition of growth, and toxicity to the liver, kidney, and blood and immune systems. Noncancer effects are observed at exposure levels several orders of magnitude higher than those associated with unacceptable cancer risk. Hazard/risk results for exposure of hypothetical onsite residents to PAHs ingested in surface soil are summarized in Table H10-1 and detailed in Attachment H3. Calculations of the concentration terms are shown in Attachment H1.

Noncarcinogenic Hazard: The total HIs for onsite residential exposure to fluoranthene and pyrene in AOC No. 1 or AOC No. 2 via the soil ingestion pathway are 9E-05 or less for the average and RME exposure conditions. Because these HIs are well below 1, no adverse noncarcinogenic health effects are expected for onsite receptors from ingestion of PAHs in surface soil.

Carcinogenic Risk: The estimated lifetime excess cancer risks for onsite residential ~~exposure to~~ ingestion of the carcinogenic PAHs benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene in AOC No. 1 and AOC No. 2 via the soil ingestion pathway is 3E-06 (3 in 1,000,000) or less for average and RME exposure conditions. Estimated risk under the industrial/office worker scenario would be approximately ~~10~~5 times less (i.e., about ~~5E-06~~6E-07) and would not contribute significantly to overall risk from exposure to surface soils for this receptor.

The risk characterization process combines average and reasonable maximum estimates of exposure with upperbound estimates of toxicity to yield conservative (protective) estimates of health risk. Estimates of health risk for CT and RME conditions are provided so that risk management decisions can be based on a range of potential risk for different exposure scenarios.

Results of the risk assessment for each exposure area are summarized in Table H11-1 and described briefly below.

AOC No. 1: HIs and cancer risk estimates were below levels of concern for all current and possible future land use scenarios in AOC No. 1; those for the hypothetical resident exceeded levels of concern. These results are described below.

- The future industrial/office worker is the maximum exposed individual under current and possible future land use scenarios in AOC No. 1. Pathways evaluated were exposure to surface soil, airborne PM_{10}, and indoor VOCs from soil gas. Cumulative HIs were below 1, indicating no threat of adverse noncarcinogenic effects. RME (8E-05) and CT (2E-06) cancer risk estimates for this receptor in AOC No. 1 are within EPA's target cancer risk range of 1E-06 to 1E-04. Ingestion of Pu-239/240 in surface soil was the greatest contributor to overall risk (Attachment H3).

  ~~RME cancer risk estimates are likely to significantly overestimate actual risk for this receptor because (1) the concentration terms for Pu-239/240 in surface soil in AOC NO. 1 and the 30-acre maximum exposure area are biased by two extreme values in the sample set and (2) the estimates are based on ingesting 50 mg/day contaminated soil and inhaling PM_{10} outdoors 8 hours/day for 25 years, with no landscaping, paving, or indoor work to reduce exposure to surface soil.~~

- Cumulative HIs were below 1 for current workers and for future ecological workers, open space users, and construction workers in AOC No. 1 indicating that no adverse noncarcinogenic health hazards are expected for these nonresidential exposure scenarios. RME cancer risk estimates for these

receptors ranged from 2E-07 to 1E-05. These values are within or below EPA's target cancer risk range of 1E-06 to 1E-04. The contaminants that contributed most to estimated health risk for nonresidential onsite receptors are Pu-239/240 and Am-241 in surface soil.

- Chlorinated solvents in groundwater in AOC No. 1 would pose unacceptable risk if directly ingested (hypothetical onsite residential scenario). However, drinking water for current onsite workers is provided by a municipal water supply, and it is expected that drinking water for future onsite receptors will also be provided from a public water supply. Therefore, ingestion of UHSU groundwater is an incomplete pathway for all current and possible future receptors in OU-2. Additionally, migration of groundwater via surface water to offsite locations is not significant, even using conservative modeling assumptions.

Maximum Exposure Areas: HIs were below levels of concern and cancer risk estimates were at or below levels of concern for future industrial/office workers and ecological researchers in 30- and 50-acre maximum exposure areas. Hazard/risk estimates for hypothetical onsite residents in a 10-acre maximum exposure area exceeded levels of concern. These results are described below.

- Chlorinated solvents in groundwater in the 10-acre maximum exposure area in AOC No.1 would pose an unacceptable risk if directly ingested (hypothetical onsite residential scenario). However, groundwater ingestion is an incomplete pathway for all current and possible future receptors in OU-2.

- Cumulative HIs were below 1 for the future industrial/office worker in the 30-acre maximum exposure area, indicating no threat of adverse noncarcinogenic effects. The CT cancer risk estimate for this receptor is within EPA's target risk range of 1E-06 to 1E-04, whereas the RME cancer risk estimate (2E-04) exceeds this range. RME cancer risk estimates for this receptor are likely to significantly overestimate actual risk because overly conservative assumptions resulted in overestimation of intake values for ingestion and inhalation of soil. Ingestion of Pu-239/240 in surface soil was the greatest contributor to overall

~~risk (see Attachment 1). However, the concentration term for Pu-239/240 in surface soil in the 30-acre maximum exposure area was biased by an extreme value in one sample and other samples in the data set had significantly lower concentrations.~~

- Cumulative HIs ~~were below 1~~ and cancer risk estimates ~~were within EPA's target risk range of 1E-06 to 1E-04~~ for the future ecological worker in the 50-acre maximum exposure area. ~~were below levels of concern.~~

AOC No. 2: Cumulative HIs ~~were below 1~~ and cancer risk estimates were ~~equal to or~~ below ~~levels of concern 1E-06~~ for onsite receptors in AOC No. 2 (including the hypothetical onsite resident).

Offsite Receptors: HIs and cancer risk estimates for offsite residential receptors were negligible.

H11.2 CONCLUSIONS

The industrial/office worker is the maximum exposed individual under possible future land use scenarios at RFETS. The maximum RME cancer risk estimate for this receptor was 2E-04 (30-acre maximum exposure area). This level ~~slightly~~ exceeds EPA's target cancer risk range of 1E-06 to 1E-04. This estimate of RME cancer risk very likely overestimates potential risk in the 30-acre maximum exposure area because of the overly conservative exposure assumptions (e.g., daily contact with surface soil for 25 years, with no paving, grading, or indoor work to reduce exposure). ~~and because of the high bias to the estimate of the concentration term for Pu-239/240 in surface soil.~~

RME cancer risk estimates for the future industrial/office worker in AOC No. 1, AOC No. 2, and for all other nonresidential receptors were within or below EPA's target cancer risk range. HIs were also below 1, indicating no adverse noncarcinogenic health effects are expected.

HIs and cancer risk estimates for offsite residents were negligible.

~~In general, cancer risk levels that do not exceed 1E-04, combined with HIs that do not exceed 1, may be used to support a decision that remediation is not warranted for the protection of public health (EPA 1991d). The results of the HHRA suggest that remediation of surface and subsurface soil in OU-2 may not be necessary for protection of human health.~~

Concentrations of chlorinated solvents in UHSU groundwater in AOC No. 1 would pose an unacceptable risk if directly ingested. However, direct ingestion of groundwater is an incomplete exposure pathway for all current and possible future receptors in OU-2. Therefore, chemicals in groundwater do not pose a risk to human health under current and possible future land use scenarios.

TABLE H5-4
AIR CONCENTRATIONS AND DEPOSITION RATES OF CHEMICALS OF CONCERN AT ONSITE EXPOSURE AREAS

	Aroclor-1254		Aroclor-1260		Bis(2-ethylhexyl)phthalate		Chromium		Americium-241		Plutonium-239/240	
Year	Air Concentration (mg/m^3)	Deposition Rate (mg/m^2-year)	Air Concentration (mg/m^3)	Deposition Rate (mg/m^2-year)	Air Concentration (mg/m^3)	Deposition Rate (mg/m^2-year)	Air Concentration (mg/m^3)	Deposition Rate (mg/m^2-year)	Air Concentration (pCi/m^3)	Deposition Rate (pCi/m^2-year)	Air Concentration (pCi/m^3)	Deposition Rate (pCi/m^2-year)
AOC No. 1 50-Acre Maximum Exposure Area												
1989	5.68E-11	NA	4.18E-11	NA	3.62E-11	NA	1.41E-09	NA	6.42E-06	NA	1.37E-04	NA
1990	6.43E-09	NA	4.73E-09	NA	4.10E-09	NA	1.60E-07	NA	7.28E-04	NA	1.55E-02	NA
1991	3.03E-10	NA	2.23E-10	NA	1.93E-10	NA	7.52E-09	NA	3.42E-05	NA	7.28E-04	NA
1992	1.34E-10	NA	9.84E-11	NA	8.52E-11	NA	3.32E-09	NA	1.51E-05	NA	3.22E-04	NA
1993	3.63E-10	NA	2.67E-10	NA	2.31E-10	NA	9.00E-09	NA	4.09E-05	NA	8.71E-04	NA
Average	1.46E-09	NA	1.07E-09	NA	9.29E-10	NA	3.63E-08	NA	1.65E-04	NA	3.52E-03	NA
Maximum	6.43E-09	NA	4.73E-09	NA	4.10E-09	NA	1.60E-07	NA	7.28E-04	NA	1.55E-02	NA

Notes:

Air concentrations and deposition rates are based on five annual simulations detailed in Appendix G of this RFI/RI Report.
Deposition rates reported as ug/m^2-day in Appendix G were converted to mg/m^2-year using a conversion factor of 0.365 days-mg/year-ug.
Radionuclides reported in ug were converted to pCi using specific activities for Am-241 of 3.435E+06 pCi/ug and for Pu-239/240 of 7.32E+04 pCi/ug. The specific activity for Pu is the sum of the relative activities for Pu-238, Pu-239, and Pu-240 based on isotopic composition of Pu used at Rocky Flats (EG&G 1993e, Table 6-1).
– Aroclors were not detected in these areas.
NA - Not applicable for exposure assessment *because deposition onto home grown produce is an incomplete pathway for the 30- and 50-acre exposure acres.*

TABLE H5-5
AIR CONCENTRATIONS AND DEPOSITION RATES OF CHEMICALS OF CONCERN AT OFFSITE EXPOSURE POINTS

Year	Aroclor-1254 Air Concentration (mg/m³)	Aroclor-1254 Deposition Rate (mg/m²-year)	Aroclor-1260 Air Concentration (mg/m³)	Aroclor-1260 Deposition Rate (mg/m²-year)	Bis(2-ethylhexyl)phthalate Air Concentration (mg/m³)	Bis(2-ethylhexyl)phthalate Deposition Rate (mg/m²-year)	Chromium Air Concentration (mg/m³)	Chromium Deposition Rate (mg/m²-year)	Americium-241 Air Concentration (pCi/m³)	Americium-241 Deposition Rate (pCi/m²-year)	Plutonium-239/240 Air Concentration (pCi/m³)	Plutonium-239/240 Deposition Rate (pCi/m²-year)
Impacts from AOC No. 1												
Current: Southeast												
1989	8.96E-14	0	7.02E-14	0	7.32E-14	0	4.08E-12	0	8.86E-09	0	2.44E-07	0
1990	6.57E-13	0	5.15E-13	0	5.36E-13	0	2.99E-11	0	6.49E-08	0	1.79E-06	0
1991	1.19E-13	0	9.36E-14	0	9.75E-14	0	5.44E-12	0	1.18E-08	0	3.26E-07	0
1992	0	0	0	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0	0	0	0	0
Average	1.73E-13	0	1.36E-13	0	1.41E-13	0	7.88E-12	0	1.71E-08	0	4.73E-07	0
Maximum	6.57E-13	0	5.15E-13	0	5.36E-13	0	2.99E-11	0	6.49E-08	0	1.79E-06	0
Future: Woman/Indiana												
1989	5.97E-14	0	4.68E-14	0	4.88E-14	0	2.72E-12	0	5.91E-09	0	1.63E-07	0
1990	3.88E-13	0	3.04E-13	0	3.17E-13	0	1.77E-11	0	3.85E-08	0	1.06E-06	0
1991	5.97E-14	0	4.68E-14	0	4.88E-14	0	2.72E-12	0	5.91E-09	0	1.63E-07	0
1992	0	0	0	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0	0	0	0	0
Average	1.01E-13	0	7.95E-14	0	8.29E-14	0	4.63E-12	0	1.01E-08	0	2.78E-07	0
Maximum	3.88E-13	0	3.04E-13	0	3.17E-13	0	1.77E-11	0	3.85E-08	0	1.06E-06	0
Impacts from AOC No. 2												
Current: Southeast												
1989	–	–	–	–	9.90E-14	0	1.18E-11	0	1.30E-09	0	9.22E-09	0
1990	–	–	–	–	7.26E-13	3.47E-07	8.65E-11	4.13E-05	9.51E-09	4.55E-03	6.76E-08	3.23E-02
1991	–	–	–	–	1.21E-13	0	1.44E-11	0	1.59E-09	0	1.13E-08	0
1992	–	–	–	–	0	0	0	0	0	0	0	0
1993	–	–	–	–	3.30E-14	0	3.93E-12	0	4.33E-10	0	3.07E-09	0
Average	–	–	–	–	1.96E-13	6.94E-08	2.33E-11	8.26E-06	2.57E-09	9.10E-04	1.82E-08	6.46E-03
Maximum	–	–	–	–	7.26E-13	3.47E-07	8.65E-11	4.13E-05	9.51E-09	4.55E-03	6.76E-08	3.23E-02
Current: Indiana South												
1989	–	–	–	–	0	0	0	0	0	0	0	0
1990	–	–	–	–	0	0	0	0	0	0	0	0
1991	–	–	–	–	0	0	0	0	0	0	0	0
1992	–	–	–	–	0	0	0	0	0	0	0	0
1993	–	–	–	–	1.10E-14	0	1.31E-12	0	1.44E-10	0	1.02E-09	0
Average	–	–	–	–	2.20E-15	0	2.62E-13	0	2.89E-11	0	2.05E-10	0
Maximum	–	–	–	–	1.10E-14	0	1.31E-12	0	1.44E-10	0	1.02E-09	0

(4040-1040-0098-862)(R7T-H54.XL2)(Off-site air)(9/28/95 10:22 AM)

Note: Change from Draft Final to Final shown in italics/bold.

TABLE H5-5
AIR CONCENTRATIONS AND DEPOSITION RATES OF CHEMICALS OF CONCERN AT OFFSITE EXPOSURE POINTS

Year	Aroclor-1254 Air Concentration (mg/m³)	Aroclor-1254 Deposition Rate (mg/m²-year)	Aroclor-1260 Air Concentration (mg/m³)	Aroclor-1260 Deposition Rate (mg/m²-year)	Bis(2-ethylhexyl)phthalate Air Concentration (mg/m³)	Bis(2-ethylhexyl)phthalate Deposition Rate (mg/m²-year)	Chromium Air Concentration (mg/m³)	Chromium Deposition Rate (mg/m²-year)	Americium-241 Air Concentration (pCi/m³)	Americium-241 Deposition Rate (pCi/m²-year)	Plutonium-239/240 Air Concentration (pCi/m³)	Plutonium-239/240 Deposition Rate (pCi/m²-year)
Future: Walnut/Indiana												
1989	--	--	--	--	0	0	0	0	0	0	0	0
1990	--	--	--	--	0	0	0	0	0	0	0	0
1991	--	--	--	--	3.30E-14	0	3.93E-12	0	4.33E-10	0	3.07E-09	0
1992	--	--	--	--	0	0	0	0	0	0	0	0
0 1993	--	--	--	--	0	0	0	0	0	0	0	0
Average	--	--	--	--	6.60E-15	0	7.86E-13	0	8.66E-11	0	6.15E-10	0
Maximum	--	--	--	--	3.30E-14	0	3.93E-12	0	4.33E-10	0	3.07E-09	0
Future: Woman/Indiana												
1989	--	--	--	--	5.50E-14	0	6.55E-12	0	7.21E-10	0	5.12E-09	0
1990	--	--	--	--	4.07E-13	3.47E-07	4.85E-11	4.13E-05	5.32E-09	4.55E-03	3.79E-08	3.23E-02
1991	--	--	--	--	6.60E-14	0	7.86E-12	0	8.66E-10	0	6.15E-09	0
1992	--	--	--	--	0	0	0	0	0	0	0	0
0 1993	--	--	--	--	2.20E-14	0	2.62E-12	0	2.89E-10	0	2.05E-09	0
Average	--	--	--	--	1.10E-13	6.94E-08	1.31E-11	8.26E-06	1.44E-09	9.10E-04	1.02E-08	6.46E-03
Maximum	--	--	--	--	4.07E-13	3.47E-07	4.85E-11	4.13E-05	5.32E-09	4.55E-03	3.79E-08	3.23E-02

Notes:

Air concentrations and deposition rates are based on five annual simulations detailed in Appendix G of the RFI/RI report for OU2.

Deposition rates reported as ug/m²-day in Appendix G were converted to mg/m²-year using a conversion factor of 0.365 days-mg/year-ug.

Deposition rates for radionuclides reported as ug/mg²-day were converted to pCi/m2-year using specific activities for Am-241 of 3.425E+06 pCi/ug and for Pu-239/240 of 7.32E+04 pCi/ug and 1 year/365 days.

Radionuclides reported in ug were converted to pCi using specific activities for Am-241 of 3.435E+06 pCi/ug and for Pu-239/240 of 7.32E+04 pCi/ug. The specific activity for Pu is the sum of the relative activities for Pu-238, Pu-239, and Pu-240 based on isotopic composition of Pu used at Rocky Flats (1993e, Table 6-1).

-- Aroclors were not detected in AOC No. 2.

0 - No measurable impacts *(The model reports "0" when modeled PM_{10} concentrations are less than 0.001 ug/m³).*

TABLE H5-7
5-YEAR MAXIMUM ANNUAL AVERAGE AIR CONCENTRATIONS
CONSTRUCTION SCENARIO, AOC NO. 2

	Surface Soil Wind Erosion Maximum (1990) (ug/m³)	10-Acre Disturbed Construction Area Wind Erosion Maximum (1990) (ug/m³)	Heavy Construction Emissions (ug/m³)	Construction Total (ug/m³)	Construction Total (pci/m³) (1)
Semivolatile Organics					
Bis(2-ethylhexyl)phthalate	1.62E-06	-	-	1.62E-06	
Metals					
Arsenic	-	1.43E-08	1.20E-07	1.34E-07	
Cadmium	-	5.87E-10	4.95E-09	5.54E-09	
Chromium	1.93E-04	-	-	1.93E-04	
Radionuclides					
Americium-241	6.20E-12	2.96E-16	2.50E-15	6.21E-12	2.13E-05
Plutonium-239/240	2.09E-09	3.77E-14	3.18E-13	2.09E-09	1.53E-04
Uranium-233,234	-	2.33E-13	1.96E-12	2.20E-12	1.36E-08
Uranium-235	-	3.92E-11	3.30E-10	3.70E-10	7.92E-10
Uranium-238	-	3.99E-09	3.37E-08	3.76E-08	1.25E-08

Note: The construction scenario includes air impacts from wind erosion of surface soil in the AOC; wind erosion from subsurface soil in a 10-acre excavation, and emissions from heavy construction activities. ***Concentrations are based on the maximums of five annual simulations from 1989 through 1993.*** See Appendix G for more detail.

(1) Air modeling results reported as ug/m³ were converted to pCi/m³ using the following specific activities:
Am-241 = 3.435E+06 pCi/ug
Pu-239/240 = 7.32E+04 pCi/ug (sum of relative specific activities for Rocky Flats plutonium; EG&G 1993e, Table 6-1)
U-233,234 = 6.19E+03 pCi/ug
U-235 = 2.14E+00 pCi/ug
U-238 = 3.33E-01 pCi/ug

- Not a chemical of concern in this medium.

TABLE H5-6
ANNUAL AVERAGE AIR CONCENTRATIONS
CONSTRUCTION SCENARIO, AOC NO. 1

	Surface Soil Wind Erosion Maximum (1990) (ug/m³)	Subsurface Soil Wind Erosion Maximum (1990) (ug/m³)	Heavy Construction Emissions (ug/m³)	Construction Total (ug/m³)	Construction Total (pci/m³) (1)
Semivolatile Organics					
Aroclor-1254	4.15E-06	-	-	4.15E-06	
Aroclor-1260	3.25E-06	-	-	3.25E-06	
Bis(2-ethylhexyl)phthalate	3.39E-06	-	-	3.39E-06	
Metals					
Arsenic	-	7.67E-09	6.47E-08	7.24E-08	
Cadmium	-	1.44E-09	1.21E-08	1.35E-08	
Chromium	1.89E-04	-	-	1.89E-04	
Mercury	-	1.08E-10	9.10E-10	1.02E-09	
Radionuclides					
Americium-241	1.19E-10	2.96E-16	2.50E-15	1.19E-10	4.09E-04
Plutonium-239/240	1.55E-07	6.81E-14	5.75E-13	1.55E-07	1.13E-02
Uranium-233,234	-	1.59E-13	1.34E-12	1.50E-12	9.29E-09
Uranium-235	-	3.92E-11	3.30E-10	3.70E-10	7.92E-10
Uranium-238	-	3.13E-09	2.64E-08	2.95E-08	9.82E-09

Note: The construction scenario includes air impacts from wind erosion of surface soil in the AOC; wind erosion from subsurface soil in a 10-acre excavation, and emissions from heavy construction activities. ***Concentrations are based on the maximums of five annual simulations from 1989 through 1993.*** See Appendix G for more detail.

(1) Air modeling results reported as ug/m³ were converted to pCi/m³ using the following specific activities:
Am-241 = 3.435E+06 pCi/ug
Pu-239/240 = 7.32E+04 pCi/ug (sum of relative specific activities for Rocky Flats plutonium; EG&G 1993e, Table 6-1)
U-233,234 = 6.19E+03 pCi/ug
U-235 = 2.14E+00 pCi/ug
U-238 = 3.33E-01 pCi/ug

- Not a chemical of concern in this medium.

TABLE H5-8
SUMMARY OF AIR CONCENTRATIONS OF CHEMICALS OF CONCERN
CONSTRUCTION SCENARIO

Chemical of Concern	AOC No. 1	AOC No. 2
Aroclor-1254 (mg/m^3)	4.15E-09	--
Aroclor-1260 (mg/m^3)	3.25E-09	--
Bis(2-ethylhexyl)phthalate (mg/m^3)	3.39E-09	1.62E-09
Arsenic (mg/m^3)	7.12E-11	1.34E-10
Cadmium (mg/m^3)	1.35E-11	5.54E-09
Chromium (mg/m^3)	1.89E-07	1.93E-07
Mercury (mg/m^3)	1.30E-11	--
Americium-241 (pCi/m^3)	4.12E-04	2.13E-05
Plutonium-239/240 (pCi/m^3)	1.13E-02	1.53E-04
Uranium-233, -234 (pCi/m^3)	9.29E-09	1.36E-08
Uranium-235 (pCi/m^3)	7.92E-10	7.92E-10
Uranium-238 (pCi/m^3)	9.82E-09	1.25E-08

NOTE:
The construction scenario includes air impacts from wind erosion of surface soil in the AOC; wind erosion from subsurface soil in a 10-acre excavation, and emissions from heavy construction activities. Concentrations are based on the maximums of five annual simulations from 1989 through 1993. See Appendix G for more detail.

-- Not detected in this area.

TABLE H5-13
ESTIMATED FRACTION OF HOMEGROWN PRODUCE AFFECTED BY DEPOSITION

Produce Category	50th Percentile Homegrown Intake (g/day) (1)		% Individuals Consuming (1)	Weighted Homegrown Intake (g/day)
Raw vegetables				
White potatoes	7.4		74.4	5.5
Cabbage, coleslaw	3.2		9.7	0.3
Carrots	2.7		5	0.1
Cucumbers	9.1		5.6	0.5
Lettuce	1.3		50.7	0.7
Onions	0.7		8.5	0.1
Tomatoes	14.6		27.8	4.1
Cooked vegetables				
Broccoli	2.1		6.2	0.1
Cabbage	8.1		4.7	0.4
Carrots	4		9.8	0.4
Corn	60.9		25	15.2
Lima Beans	21.8		2.8	0.6
Mixed Veg	15.5	(2)	3.4	0.5
Peas	22	(2)	2.9	0.6
Green peas	14	(2)	18.3	2.6
Spinach	6.8		4.5	0.3
String beans	15.1		27.3	4.1
Summer squash	18	(2)	2.8	0.5
Sweet potatoes	6.7		4.1	0.3
Cucumber pickles	4.3		9.2	0.4
Total homegrown vegetable intake (g/day)				37
Exposed vegetable intake (g/day)				11
Ratio exposed/total				0.3
Fruits				
Grapefruit	10.1		4.7	0.5
Oranges	4.5		9	0.4
Apples	7.6		18.2	1.4
Applesauce	7.1		9.8	0.7
Cantaloupe	9.6		3.3	0.3
Peaches	15.1		4.5	0.7
Pears	15.7		3.1	0.5
Strawberries	12.3		2.1	0.3
Total homegrown fruit intake (g/day)				4.8
Total exposed fruit intake (g/day)				3.6
Ratio exposed/total				*0.7454*

(1) From Exposure Factors Handbook (USEPA 1989b), Table 2-10.

(2) Homegrown fraction is not available. Therefore, the amount is estimated using 50th percentile total average daily intake from Table 2-10 (USEPA 1989b) and assuming 50 percent is homegrown.

Exposed edible surface

G code: The chemical is not a radionuclide or carbonate, and the value in the result field (reported concentration) is zero. These same records were not accompanied with a U (not detected) qualifier.

H code: ~~The result was not used based on professional judgement. These consisted of one or two metals analyses where the order of magnitude was unreasonably high (it looked as if a unit conversion was incorrectly made).~~ These results were not used based on professional judgement and consist of 174 VOCs and 78 metals records, all subsurface soil results. The units for these records were not consistent with all other subsurface soil records for VOCs and metals. The H qualified VOCs were reported as ug/g (Table 6.3-1A), all other VOCs were reported in ug/kg (Table 6.3-1B). The H qualified metals were reported as ug/kg, all other metals were reported in mg/kg.

All but one of the H qualified VOCs records were associated with samples collected from B215389. All of the H qualified metals data are associated with samples collected from BH3087 (Table 6.3-1C). Laboratory data packages were not available to verify the correct units for these data. Additionally, the numerical analytical results for the H qualified VOCs and H qualified metals are of same order of magnitude as the non-H qualified data for the respective sample locations (Tables 6.3-1C and 6.3-1D). Therefore, as reported, the H qualified VOCs concentrations reported in ug/g are approximately 1000 times greater than results reported in ug/kg, and that H qualified metals concentrations reported in ug/kg are approximately 1000 times less than results reported in mg/kg.

The H qualified results were considered non-usable because the units for these data are not consistent with the otherwise comparable data, and because the analytical results appear to be incorrect as reported with the apparently incorrect units.

TABLE 6.3-1A
H QUALIFIED DATA UNITS COMPARISION
H QUALIFIED VOC DATA

site	location	fieldid	date_sampled	qaqctype	method	ANALYTE	RESULT	REP_LIM	units	qual_lab	Data Useability Code	qual_wc
216.2	12391	BH00143WCU2	23-Dec-91	REAL	VOACLP	METHYLENE CHLORIDE	6	5	UG/G	U	H	JA
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	1,1,1-TRICHLOROETHANE	3	5	UG/G	J	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	1,1,2,2-TETRACHLOROETHANE	5	5	UG/G	U	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	1,1,2-TRICHLOROETHANE	5	5	UG/G	U	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	1,1-DICHLOROETHANE	5	5	UG/G	U	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	1,1-DICHLOROETHENE	5	5	UG/G	U	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	1,2-DICHLOROETHANE	5	5	UG/G	U	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	1,2-DICHLOROETHENE	5	5	UG/G	U	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	1,2-DICHLOROPROPANE	5	5	UG/G	U	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	2-BUTANONE	9	10	UG/G	J	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	2-HEXANONE	10	10	UG/G	U	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	4-METHYL-2-PENTANONE	10	10	UG/G	U	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	ACETONE	27	10	UG/G	B	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	BENZENE	5	5	UG/G	U	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	BROMODICHLOROMETHANE	5	5	UG/G	U	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	BROMOFORM	5	5	UG/G	U	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	BROMOMETHANE	10	10	UG/G	U	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	CARBON DISULFIDE	5	5	UG/G	U	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	CARBON TETRACHLORIDE	5	5	UG/G	U	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	CHLOROBENZENE	5	5	UG/G	U	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	CHLOROETHANE	10	10	UG/G	U	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	CHLOROFORM	5	5	UG/G	U	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	CHLOROMETHANE	10	10	UG/G	U	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	cis-1,3-DICHLOROPROPENE	5	5	UG/G	U	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	DIBROMOCHLOROMETHANE	5	5	UG/G	U	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	ETHYLBENZENE	5	5	UG/G	U	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	METHYLENE CHLORIDE	4	5	UG/G	J	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	STYRENE	5	5	UG/G	U	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	TETRACHLOROETHENE	5	5	UG/G	U	H	

TABLE 6.3-1A
H QUALIFIED DATA UNITS COMPARISION
H QUALIFIED VOC DATA

site	location	fieldid	date_sampled	qaqctype	method	ANALYTE	RESULT	REP_LIM	units	qual_lab	Data Useability Code	qual_wc
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	TOLUENE	5	5	UG/G	U	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	TOTAL XYLENES	5	5	UG/G	U	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	trans-1,3-DICHLOROPROPENE	5	5	UG/G	U	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	TRICHLOROETHENE	5	5	UG/G	U	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	VINYL ACETATE	10	10	UG/G	U	H	
111.6	B215389	B2153891819	31-Oct-89	REAL	RFVO	VINYL CHLORIDE	10	10	UG/G	U	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	1,1,1-TRICHLOROETHANE	5	5	UG/G	U	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	1,1,2,2-TETRACHLOROETHANE	5	5	UG/G	U	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	1,1,2-TRICHLOROETHANE	5	5	UG/G	U	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	1,1-DICHLOROETHANE	5	5	UG/G	U	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	1,1-DICHLOROETHENE	5	5	UG/G	U	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	1,2-DICHLOROETHANE	5	5	UG/G	U	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	1,2-DICHLOROETHENE	5	5	UG/G	U	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	1,2-DICHLOROPROPANE	5	5	UG/G	U	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	2-BUTANONE	10	10	UG/G	U	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	2-HEXANONE	11	10	UG/G		H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	4-METHYL-2-PENTANONE	10	10	UG/G	U	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	ACETONE	10	10	UG/G	U	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	BENZENE	5	5	UG/G	U	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	BROMODICHLOROMETHANE	5	5	UG/G	U	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	BROMOFORM	5	5	UG/G	U	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	BROMOMETHANE	10	10	UG/G	U	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	CARBON DISULFIDE	5	5	UG/G	U	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	CARBON TETRACHLORIDE	5	5	UG/G	U	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	CHLOROBENZENE	5	5	UG/G	U	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	CHLOROETHANE	10	10	UG/G	U	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	CHLOROFORM	5	5	UG/G	U	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	CHLOROMETHANE	10	10	UG/G	U	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	cis-1,3-DICHLOROPROPENE	5	5	UG/G	U	H	

TABLE 6.3-1A
H QUALIFIED DATA UNITS COMPARISION
H QUALIFIED VOC DATA

site	location	fieldid	date_sampled	qaqctype	method	ANALYTE	RESULT	REP_LIM	units	qual_lab	Data Useability Code	qual_wc
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	DIBROMOCHLOROMETHANE	5	5	UG/G	U	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	ETHYLBENZENE	5	5	UG/G	U	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	METHYLENE CHLORIDE	4	5	UG/G	JB	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	STYRENE	5	5	UG/G	U	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	TETRACHLOROETHENE	5	5	UG/G	U	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	TOLUENE	5	5	UG/G	U	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	TOTAL XYLENES	5	5	UG/G	U	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	trans-1,3-DICHLOROPROPENE	5	5	UG/G	U	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	TRICHLOROETHENE	5	5	UG/G	U	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	VINYL ACETATE	10	10	UG/G	U	H	
NA	B217589	5789BR1722FB	17-Oct-89	FB	RFVO	VINYL CHLORIDE	10	10	UG/G	U	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	1,1,1-TRICHLOROETHANE	5	5	UG/G	U	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	1,1,2,2-TETRACHLOROETHANE	5	5	UG/G	U	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	1,1,2-TRICHLOROETHANE	5	5	UG/G	U	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	1,1-DICHLOROETHANE	5	5	UG/G	U	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	1,1-DICHLOROETHENE	5	5	UG/G	U	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	1,2-DICHLOROETHANE	5	5	UG/G	U	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	1,2-DICHLOROETHENE	5	5	UG/G	U	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	1,2-DICHLOROPROPANE	5	5	UG/G	U	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	2-BUTANONE	9	9	UG/G	U	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	2-HEXANONE	9	9	UG/G	U	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	4-METHYL-2-PENTANONE	9	9	UG/G	U	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	ACETONE	52	9	UG/G		H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	BENZENE	5	5	UG/G	U	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	BROMODICHLOROMETHANE	5	5	UG/G	U	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	BROMOFORM	5	5	UG/G	U	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	BROMOMETHANE	9	9	UG/G	U	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	CARBON DISULFIDE	2	5	UG/G	J	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	CARBON TETRACHLORIDE	5	5	UG/G	U	H	

TAB... 6.3-1A
H QUALIFIED DATA UNITS COMPARISION
H QUALIFIED VOC DATA

site	location	fieldid	date_sampled	qaqctype	method	ANALYTE	RESULT	REP_LIM	units	qual_lab	Data Useability Code	qual_wc
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	CHLOROBENZENE	5	5	UG/G	U	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	CHLOROETHANE	9	9	UG/G	U	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	CHLOROFORM	5	5	UG/G	U	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	CHLOROMETHANE	9	9	UG/G	U	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	cis-1,3-DICHLOROPROPENE	5	5	UG/G	U	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	DIBROMOCHLOROMETHANE	5	5	UG/G	U	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	ETHYLBENZENE	5	5	UG/G	U	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	METHYLENE CHLORIDE	17	5	UG/G	B	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	STYRENE	5	5	UG/G	U	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	TETRACHLOROETHENE	5	5	UG/G	U	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	TOLUENE	5	5	UG/G	U	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	TOTAL XYLENES	5	5	UG/G	U	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	trans-1,3-DICHLOROPROPENE	5	5	UG/G	U	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	TRICHLOROETHENE	5	5	UG/G	U	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	VINYL ACETATE	9	9	UG/G	U	H	
216.3	B218189	B2181892526	6-Nov-89	REAL	RFVO	VINYL CHLORIDE	9	9	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	1,1,1-TRICHLOROETHANE	5	5	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	1,1,2,2-TETRACHLOROETHANE	5	5	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	1,1,2-TRICHLOROETHANE	5	5	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	1,1-DICHLOROETHANE	5	5	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	1,1-DICHLOROETHENE	5	5	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	1,2-DICHLOROETHANE	5	5	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	1,2-DICHLOROETHENE	5	5	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	1,2-DICHLOROPROPANE	5	5	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	2-BUTANONE	10	10	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	2-HEXANONE	10	10	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	4-METHYL-2-PENTANONE	10	10	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	ACETONE	10	10	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	BENZENE	5	5	UG/G	U	H	

TABLE 6.3-1A
H QUALIFIED DATA UNITS COMPARISION
H QUALIFIED VOC DATA

site	location	fieldid	date_sampled	qaqctype	method	ANALYTE	RESULT	REP_LIM	units	qual_lab	Data Useability Code	qual_wc
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	BROMODICHLOROMETHANE	5	5	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	BROMOFORM	5	5	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	BROMOMETHANE	10	10	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	CARBON DISULFIDE	5	5	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	CARBON TETRACHLORIDE	5	5	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	CHLOROBENZENE	5	5	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	CHLOROETHANE	10	10	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	CHLOROFORM	5	5	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	CHLOROMETHANE	10	10	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	cis-1,3-DICHLOROPROPENE	5	5	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	DIBROMOCHLOROMETHANE	5	5	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	ETHYLBENZENE	5	5	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	METHYLENE CHLORIDE	12	5	UG/G	B	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	STYRENE	5	5	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	TETRACHLOROETHENE	5	5	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	TOLUENE	5	5	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	TOTAL XYLENES	5	5	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	trans-1,3-DICHLOROPROPENE	5	5	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	TRICHLOROETHENE	5	5	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	VINYL ACETATE	10	10	UG/G	U	H	
NA	B318889	B3188890002	17-Nov-89	REAL	RFVO	VINYL CHLORIDE	10	10	UG/G	U	H	
111.5	B319789	B3197890406	18-Jan-90	REAL	RFVO	1,2-DICHLOROPROPANE	5	5	UG/G	U	H	
111.5	B319789	B3197892830	18-Jan-90	REAL	RFVO	CHLOROBENZENE	6	6	UG/G	U	H	
111.5	B319789	B3197893234	18-Jan-90	REAL	RFVO	1,2-DICHLOROETHANE	6	6	UG/G	U	H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	1,1,1-TRICHLOROETHANE	6	6	UG/G	U	H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	1,1,2,2-TETRACHLOROETHANE	6	6	UG/G	U	H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	1,1,2-TRICHLOROETHANE	6	6	UG/G	U	H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	1,1-DICHLOROETHANE	6	6	UG/G	U	H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	1,1-DICHLOROETHENE	6	6	UG/G	U	H	

TABLE 6.3-1A
H QUALIFIED DATA UNITS COMPARISION
H QUALIFIED VOC DATA

site	location	fieldid	date_sampled	qaqctype	method	ANALYTE	RESULT	REP_LIM	units	qual_lab	Data Useability Code	qual_wc
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	1,2-DICHLOROETHANE	6	6	UG/G	U	H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	1,2-DICHLOROETHENE	6	6	UG/G	U	H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	1,2-DICHLOROPROPANE	6	6	UG/G	U	H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	2-BUTANONE	13	13	UG/G	U	H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	2-HEXANONE	13	13	UG/G	U	H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	4-METHYL-2-PENTANONE	13	13	UG/G	U	H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	ACETONE	43	13	UG/G		H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	BENZENE	6	6	UG/G	U	H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	BROMODICHLOROMETHANE	6	6	UG/G	U	H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	BROMOFORM	6	6	UG/G	U	H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	BROMOMETHANE	13	13	UG/G	U	H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	CARBON DISULFIDE	6	6	UG/G	U	H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	CARBON TETRACHLORIDE	6	6	UG/G	U	H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	CHLOROBENZENE	6	6	UG/G	U	H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	CHLOROETHANE	13	13	UG/G	U	H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	CHLOROFORM	6	6	UG/G	U	H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	CHLOROMETHANE	13	13	UG/G	U	H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	cis-1,3-DICHLOROPROPENE	6	6	UG/G	U	H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	DIBROMOCHLOROMETHANE	6	6	UG/G	U	H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	ETHYLBENZENE	6	6	UG/G	U	H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	METHYLENE CHLORIDE	17	6	UG/G		H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	STYRENE	6	6	UG/G	U	H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	TETRACHLOROETHENE	6	6	UG/G	U	H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	TOLUENE	6	6	UG/G	U	H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	TOTAL XYLENES	6	6	UG/G	U	H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	trans-1,3-DICHLOROPROPENE	6	6	UG/G	U	H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	TRICHLOROETHENE	6	6	UG/G	U	H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	VINYL ACETATE	13	13	UG/G	U	H	
111.5	B319789	B3197893840	22-Jan-90	REAL	RFVO	VINYL CHLORIDE	13	13	UG/G	U	H	

TABLE 6.3-1B
H QUALIFIED DATA UNITS COMPARISION
B215389 VOC DATA

site	location	fieldid	date_sampled	qaqctype	method	ANALYTE	RESULT	REP_LIM	units	qual_lab	Data Useability Code	qual_wc
111.6	B215389	B2153890204	10/31/89	REAL	RFVO	1,1,1-TRICHLOROETHANE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153890204	10/31/89	REAL	RFVO	1,1,2,2-TETRACHLOROETHANE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153890204	10/31/89	REAL	RFVO	1,1,2-TRICHLOROETHANE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153890204	10/31/89	REAL	RFVO	1,1-DICHLOROETHANE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153890204	10/31/89	REAL	RFVO	1,1-DICHLOROETHENE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153890204	10/31/89	REAL	RFVO	1,2-DICHLOROETHANE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153890204	10/31/89	REAL	RFVO	1,2-DICHLOROETHENE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153890204	10/31/89	REAL	RFVO	1,2-DICHLOROPROPANE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153890608	10/31/89	REAL	RFVO	1,1,1-TRICHLOROETHANE	3.000	5.000	UG/KG	J	H	A
111.6	B215389	B2153890608	10/31/89	REAL	RFVO	1,1,2,2-TETRACHLOROETHANE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153890608	10/31/89	REAL	RFVO	1,1,2-TRICHLOROETHANE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153890608	10/31/89	REAL	RFVO	1,1-DICHLOROETHANE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153890608	10/31/89	REAL	RFVO	1,1-DICHLOROETHENE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153890608	10/31/89	REAL	RFVO	1,2-DICHLOROETHANE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153890608	10/31/89	REAL	RFVO	1,2-DICHLOROETHENE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153890608	10/31/89	REAL	RFVO	1,2-DICHLOROPROPANE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153891011	10/31/89	REAL	RFVO	1,1,1-TRICHLOROETHANE	3.000	5.000	UG/KG	J	H	A
111.6	B215389	B2153891011	10/31/89	REAL	RFVO	1,1,2,2-TETRACHLOROETHANE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153891011	10/31/89	REAL	RFVO	1,1,2-TRICHLOROETHANE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153891011	10/31/89	REAL	RFVO	1,1-DICHLOROETHANE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153891011	10/31/89	REAL	RFVO	1,1-DICHLOROETHENE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153891011	10/31/89	REAL	RFVO	1,2-DICHLOROETHANE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153891011	10/31/89	REAL	RFVO	1,2-DICHLOROETHENE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153891011	10/31/89	REAL	RFVO	1,2-DICHLOROPROPANE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153891416	10/31/89	REAL	RFVO	1,1,1-TRICHLOROETHANE	3.000	5.000	UG/KG	J	H	A
111.6	B215389	B2153891416	10/31/89	REAL	RFVO	1,1,2,2-TETRACHLOROETHANE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153891416	10/31/89	REAL	RFVO	1,1,2-TRICHLOROETHANE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153891416	10/31/89	REAL	RFVO	1,1-DICHLOROETHANE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153891416	10/31/89	REAL	RFVO	1,1-DICHLOROETHENE	5.000	5.000	UG/KG	U	H	V

TABLE 6.3-1B
H QUALIFIED DATA UNITS COMPARISION
B215389 VOC DATA

site	location	fieldid	date_sampled	qaqctype	method	ANALYTE	RESULT	REP_LIM	units	qual_lab	Data Useability Code	qual_wc
111.6	B215389	B2153891416	10/31/89	REAL	RFVO	1,2-DICHLOROETHANE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153891416	10/31/89	REAL	RFVO	1,2-DICHLOROETHENE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153891416	10/31/89	REAL	RFVO	1,2-DICHLOROPROPANE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153892224	11/1/89	REAL	RFVO	1,1,1-TRICHLOROETHANE	3.000	5.000	UG/KG	J	H	A
111.6	B215389	B2153892224	11/1/89	REAL	RFVO	1,1,2,2-TETRACHLOROETHANE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153892224	11/1/89	REAL	RFVO	1,1,2-TRICHLOROETHANE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153892224	11/1/89	REAL	RFVO	1,1-DICHLOROETHANE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153892224	11/1/89	REAL	RFVO	1,1-DICHLOROETHENE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153892224	11/1/89	REAL	RFVO	1,2-DICHLOROETHANE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153892224	11/1/89	REAL	RFVO	1,2-DICHLOROETHENE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153892224	11/1/89	REAL	RFVO	1,2-DICHLOROPROPANE	5.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153892628	11/2/89	REAL	RFVO	1,1,1-TRICHLOROETHANE	6.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153892628	11/2/89	REAL	RFVO	1,1,2,2-TETRACHLOROETHANE	6.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153892628	11/2/89	REAL	RFVO	1,1,2-TRICHLOROETHANE	6.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153892628	11/2/89	REAL	RFVO	1,1-DICHLOROETHANE	6.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153892628	11/2/89	REAL	RFVO	1,1-DICHLOROETHENE	6.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153892628	11/2/89	REAL	RFVO	1,2-DICHLOROETHANE	6.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153892628	11/2/89	REAL	RFVO	1,2-DICHLOROETHENE	6.000	5.000	UG/KG	U	H	V
111.6	B215389	B2153892628	11/2/89	REAL	RFVO	1,2-DICHLOROPROPANE	6.000	5.000	UG/KG	U	H	V

TABLE 6.3-1C
H QUALIFIED DATA UNITS COMPARISION
H QUALIFIED METALS DATA

site	location	fieldid	date_sampled	qaqctype	method	ANALYTE	RESULT	REP_LIM	units	qual_lab	Data Useability Code	qual_wc
155	BH3087	BH30871020	6/16/87	REAL	SMETCLP	ALUMINUM	8282		UG/KG		H	N
155	BH3087	BH30871020	6/16/87	REAL	SMETCLP	ANTIMONY	12		UG/KG	U	H	N
155	BH3087	BH30871020	6/16/87	REAL	SMETCLP	ARSENIC	8.9		UG/KG		H	N
155	BH3087	BH30871020	6/16/87	REAL	SMETCLP	BARIUM	44.2		UG/KG		H	N
155	BH3087	BH30871020	6/16/87	REAL	SMETCLP	BERYLLIUM	1		UG/KG		H	N
155	BH3087	BH30871020	6/16/87	REAL	SMETCLP	CADMIUM	3		UG/KG		H	N
155	BH3087	BH30871020	6/16/87	REAL	SMETCLP	CALCIUM	3502		UG/KG		H	N
155	BH3087	BH30871020	6/16/87	REAL	SMETCLP	CESIUM					BFH	N
155	BH3087	BH30871020	6/16/87	REAL	SMETCLP	CHROMIUM	9		UG/KG		H	N
155	BH3087	BH30871020	6/16/87	REAL	SMETCLP	COBALT	16.2		UG/KG		H	N
155	BH3087	BH30871020	6/16/87	REAL	SMETCLP	COPPER	12.4		UG/KG		H	N
155	BH3087	BH30871020	6/16/87	REAL	SMETCLP	IRON	10696		UG/KG		H	N
155	BH3087	BH30871020	6/16/87	REAL	SMETCLP	LEAD	13.9		UG/KG		H	N
155	BH3087	BH30871020	6/16/87	REAL	SMETCLP	MAGNESIUM	1454		UG/KG		H	N
155	BH3087	BH30871020	6/16/87	REAL	SMETCLP	MANGANESE	47.6		UG/KG		H	N
155	BH3087	BH30871020	6/16/87	REAL	SMETCLP	MERCURY	0.04		UG/KG	U	H	N
155	BH3087	BH30871020	6/16/87	REAL	SMETCLP	MOLYBDENUM					BFH	N
155	BH3087	BH30871020	6/16/87	REAL	SMETCLP	NICKEL	21.2		UG/KG		H	N
155	BH3087	BH30871020	6/16/87	REAL	SMETCLP	POTASSIUM	500		UG/KG	J	H	N
155	BH3087	BH30871020	6/16/87	REAL	SMETCLP	SELENIUM	1		UG/KG	U	H	N
155	BH3087	BH30871020	6/16/87	REAL	SMETCLP	SILVER	2		UG/KG	U	H	N
155	BH3087	BH30871020	6/16/87	REAL	SMETCLP	SODIUM	344		UG/KG	J	H	N
155	BH3087	BH30871020	6/16/87	REAL	SMETCLP	STRONTIUM	19		UG/KG	J	H	N
155	BH3087	BH30871020	6/16/87	REAL	SMETCLP	THALLIUM	2		UG/KG	U	H	N
155	BH3087	BH30871020	6/16/87	REAL	SMETCLP	VANADIUM	23.6		UG/KG		H	N
155	BH3087	BH30871020	6/16/87	REAL	SMETCLP	ZINC	57.8		UG/KG		H	N
155	BH3087	BH308720WT	6/16/87	REAL	SMETCLP	ALUMINUM	7798		UG/KG		H	N
155	BH3087	BH308720WT	6/16/87	REAL	SMETCLP	ANTIMONY	12		UG/KG	U	H	N
155	BH3087	BH308720WT	6/16/87	REAL	SMETCLP	ARSENIC	8.8		UG/KG		H	N
155	BH3087	BH308720WT	6/16/87	REAL	SMETCLP	BARIUM	30.7		UG/KG	J	H	N
155	BH3087	BH308720WT	6/16/87	REAL	SMETCLP	BERYLLIUM	1		UG/KG		H	N

TABLE 6.3-1C
H QUALIFIED DATA UNITS COMPARISION
H QUALIFIED METALS DATA

site	location	fieldid	date_sampled	qaqctype	method	ANALYTE	RESULT	REP_LIM	units	qual_lab	Data Useability Code	qual_wc
155	BH3087	BH308720WT	6/16/87	REAL	SMETCLP	CADMIUM	4		UG/KG		H	N
155	BH3087	BH308720WT	6/16/87	REAL	SMETCLP	CALCIUM	4000		UG/KG		H	N
155	BH3087	BH308720WT	6/16/87	REAL	SMETCLP	CESIUM					BFH	N
155	BH3087	BH308720WT	6/16/87	REAL	SMETCLP	CHROMIUM	10.3		UG/KG		H	N
155	BH3087	BH308720WT	6/16/87	REAL	SMETCLP	COBALT	10.5		UG/KG		H	N
155	BH3087	BH308720WT	6/16/87	REAL	SMETCLP	COPPER	7.6		UG/KG		H	N
155	BH3087	BH308720WT	6/16/87	REAL	SMETCLP	IRON	9013		UG/KG		H	N
155	BH3087	BH308720WT	6/16/87	REAL	SMETCLP	LEAD	3.6		UG/KG		H	N
155	BH3087	BH308720WT	6/16/87	REAL	SMETCLP	MAGNESIUM	1682		UG/KG		H	N
155	BH3087	BH308720WT	6/16/87	REAL	SMETCLP	MANGANESE	101		UG/KG		H	N
155	BH3087	BH308720WT	6/16/87	REAL	SMETCLP	MERCURY	0.04		UG/KG	U	H	N
155	BH3087	BH308720WT	6/16/87	REAL	SMETCLP	MOLYBDENUM					BFH	N
155	BH3087	BH308720WT	6/16/87	REAL	SMETCLP	NICKEL	21.3		UG/KG		H	N
155	BH3087	BH308720WT	6/16/87	REAL	SMETCLP	POTASSIUM	975		UG/KG	J	H	N
155	BH3087	BH308720WT	6/16/87	REAL	SMETCLP	SELENIUM	1		UG/KG	U	H	N
155	BH3087	BH308720WT	6/16/87	REAL	SMETCLP	SILVER	2		UG/KG	U	H	N
155	BH3087	BH308720WT	6/16/87	REAL	SMETCLP	SODIUM	290		UG/KG	J	H	N
155	BH3087	BH308720WT	6/16/87	REAL	SMETCLP	STRONTIUM	11.4		UG/KG	J	H	N
155	BH3087	BH308720WT	6/16/87	REAL	SMETCLP	THALLIUM	2		UG/KG	U	H	N
155	BH3087	BH308720WT	6/16/87	REAL	SMETCLP	VANADIUM	21		UG/KG		H	N
155	BH3087	BH308720WT	6/16/87	REAL	SMETCLP	ZINC	24.4		UG/KG		H	N
155	BH3087	BH308725BR	6/16/87	REAL	SMETCLP	ALUMINUM	7166		UG/KG		H	N
155	BH3087	BH308725BR	6/16/87	REAL	SMETCLP	ANTIMONY	12		UG/KG	U	H	N
155	BH3087	BH308725BR	6/16/87	REAL	SMETCLP	ARSENIC	6.7		UG/KG		H	N
155	BH3087	BH308725BR	6/16/87	REAL	SMETCLP	BARIUM	31.7		UG/KG	J	H	N
155	BH3087	BH308725BR	6/16/87	REAL	SMETCLP	BERYLLIUM	0.6		UG/KG	J	H	N
155	BH3087	BH308725BR	6/16/87	REAL	SMETCLP	CADMIUM	4		UG/KG		H	N
155	BH3087	BH308725BR	6/16/87	REAL	SMETCLP	CALCIUM	2749		UG/KG		H	N
155	BH3087	BH308725BR	6/16/87	REAL	SMETCLP	CESIUM					BFH	N
155	BH3087	BH308725BR	6/16/87	REAL	SMETCLP	CHROMIUM	10.6		UG/KG		H	N
155	BH3087	BH308725BR	6/16/87	REAL	SMETCLP	COBALT	10.8		UG/KG		H	N

TABLE 6.3-1C
H QUALIFIED DATA UNITS COMPARISION
H QUALIFIED METALS DATA

site	location	fieldid	date_sampled	qaqctype	method	ANALYTE	RESULT	REP_LIM	units	qual_lab	Data Useability Code	qual_wc
155	BH3087	BH308725BR	6/16/87	REAL	SMETCLP	COPPER	5.9		UG/KG		H	N
155	BH3087	BH308725BR	6/16/87	REAL	SMETCLP	IRON	6902		UG/KG		H	N
155	BH3087	BH308725BR	6/16/87	REAL	SMETCLP	LEAD	3.5		UG/KG		H	N
155	BH3087	BH308725BR	6/16/87	REAL	SMETCLP	MAGNESIUM	3545		UG/KG		H	N
155	BH3087	BH308725BR	6/16/87	REAL	SMETCLP	MANGANESE	198		UG/KG		H	N
155	BH3087	BH308725BR	6/16/87	REAL	SMETCLP	MERCURY	0.04		UG/KG	U	H	N
155	BH3087	BH308725BR	6/16/87	REAL	SMETCLP	MOLYBDENUM					BFH	N
155	BH3087	BH308725BR	6/16/87	REAL	SMETCLP	NICKEL	20.6		UG/KG		H	N
155	BH3087	BH308725BR	6/16/87	REAL	SMETCLP	POTASSIUM	545		UG/KG	J	H	N
155	BH3087	BH308725BR	6/16/87	REAL	SMETCLP	SELENIUM	1		UG/KG	U	H	N
155	BH3087	BH308725BR	6/16/87	REAL	SMETCLP	SILVER	2		UG/KG	U	H	N
155	BH3087	BH308725BR	6/16/87	REAL	SMETCLP	SODIUM	257		UG/KG	J	H	N
155	BH3087	BH308725BR	6/16/87	REAL	SMETCLP	STRONTIUM	7.7		UG/KG	J	H	N
155	BH3087	BH308725BR	6/16/87	REAL	SMETCLP	THALLIUM	2		UG/KG	U	H	N
155	BH3087	BH308725BR	6/16/87	REAL	SMETCLP	VANADIUM	14.7		UG/KG		H	N
155	BH3087	BH308725BR	6/16/87	REAL	SMETCLP	ZINC	44.7		UG/KG		H	N

TABLE 6.3-1D
H QUALIFIED DATA UNITS COMPARISION
BH3087 METALS DATA

site	location	fieldid	date_sampled	qaqctype	method	ANALYTE	RESULT	REP_LIM	units	qual_lab	Data Useability Code	qual_wc
155	BH3087	BH30870010	6/16/87	REAL	SMETCLP	ALUMINUM	5320.000		MG/KG		H	N
155	BH3087	BH30870010	6/16/87	REAL	SMETCLP	ANTIMONY	5.600		MG/KG	U	H	N
155	BH3087	BH30870010	6/16/87	REAL	SMETCLP	ARSENIC	7.880		MG/KG		H	N
155	BH3087	BH30870010	6/16/87	REAL	SMETCLP	BARIUM	66.000		MG/KG		H	N
155	BH3087	BH30870010	6/16/87	REAL	SMETCLP	BERYLLIUM	1.000		MG/KG	U	H	N
155	BH3087	BH30870010	6/16/87	REAL	SMETCLP	CADMIUM	1.000		MG/KG	U	H	N
155	BH3087	BH30870010	6/16/87	REAL	SMETCLP	CALCIUM	79000.000		MG/KG		H	N
155	BH3087	BH30870010	6/16/87	REAL	SMETCLP	CHROMIUM	6.200		MG/KG		H	N
155	BH3087	BH30870010	6/16/87	REAL	SMETCLP	COBALT	4.000		MG/KG	U	H	N
155	BH3087	BH30870010	6/16/87	REAL	SMETCLP	COPPER	6.400		MG/KG		H	N
155	BH3087	BH30870010	6/16/87	REAL	SMETCLP	IRON	6040.000		MG/KG		H	N
155	BH3087	BH30870010	6/16/87	REAL	SMETCLP	LEAD	5.180		MG/KG		H	N
155	BH3087	BH30870010	6/16/87	REAL	SMETCLP	LITHIUM	10.000		MG/KG	U	H	N
155	BH3087	BH30870010	6/16/87	REAL	SMETCLP	MAGNESIUM	1680.000		MG/KG		H	N
											H	
											H	

RV Real Value (based on the evaluation, the reported concentration was deemed present in the sample).

A summary of the evaluation of non-validated B-qualified results is shown in Table J6.3-2.

J7.0 PARCC PARAMETERS

The data were assessed using the data quality indicators of PARCC. Section J2.0 defined the baseline for data quality established under the site-wide QAPjP, and Section J3.0 summarized the project-specific CDQOs for OU-2. Section J7.1 defines the PARCC parameters, and describes how they were applied to the OU-2 data. Section J7.2 provides the results of the PARCC assessment.

J7.1 PARCC DEFINITION

Precision is a quantitative measure that refers to the reproducibility among replicate measurements of a single chemical. ~~The two basic activities performed in the assessment of precision are estimating the measurement error attributable to the data collection process and estimating sampling variability from the observed spatial variation. The estimate of measurement error~~ ~~Precision~~ is expressed as the relative percent difference (RPD) between the measured concentration of a chemical in a sample and sample duplicate. ~~RPD~~~~Precision~~ may refer to laboratory control samples or field duplicate samples. ~~Section J7.2.1 evaluates precision of the field duplicate samples collected for OU-2. The RPD between field duplicate samples may be an indication of sample homogeneity, sample matrix, sampling precision, and/or analytical method precision. The estimate of spatial variability is expressed as the coefficient of variation. Section J7.2.1 evaluates precision of the samples collected for OU-2.~~

Accuracy is a quantitative measure that refers to the degree of difference between the measured and true value. The closer to the true value (or concentration), the more accurate the measurement. Accuracy, or bias of a laboratory analysis, is evaluated by analyzing standards of a known concentration both before and during sample analysis (e.g., initial calibrations, continuing calibration, and laboratory control samples). Accuracy is also evaluated by spiking a sample with a known quantity of a chemical and comparing the actual to the expected recovery. Similarly, any bias introduced by laboratory contaminants are

detected during the method blank analysis. Accuracy may refer to laboratory control samples (e.g., blank spike) or field samples (e.g., matrix spike, surrogate spike). Section J7.2.2 discusses the accuracy of analytical results for OU-2 only in terms of the validation reason codes that were assigned during the validation process. Therefore, accuracy is assessed for only those data that were validated.

Representativeness is a qualitative measure of data quality defined by the degree to which the data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. The possible introduction of contaminants into OU-2 environmental samples during collection and handling is evaluated using data obtained from equipment rinsate blanks and trip blanks. Also included in this evaluation is a discussion regarding possible toluene contamination originating from electrical tape that was used during the borehole sampling process. Details of this evaluation are presented in Section J7.2.3.

Comparability is a qualitative measurement that expresses the confidence with which one data set can be compared to another data set measuring the same property. Comparability can be optimized through the use of established and approved analytical methods, consistency in the basis of analysis (e.g., dry weight and volume), consistency in reporting units (e.g., parts per billion [ppb] and ppm), and analysis of standard reference materials. Likewise, comparability is optimized through the use of established and approved sampling methods. Differences in field and laboratory procedures can greatly affect comparability. Comparability is assessed in Section J7.2.4 primarily by referring to the consistency of analytical methods used for OU-2.

Completeness is a quantitative measure of how much usable data were obtained from a sampling program. Completeness has been expressed in terms of the percentage of data returned from the laboratory, the percentage of validated data returned from the validation contractor, and the percentage of data that were accepted during validation. These percentages have been calculated for OU-2, and the results are discussed in Section J7.2.5.

J7.2 PARCC ASSESSMENT

The following sections describe the OU-2 data that were evaluated for each PARCC parameter, identify advisory criteria given in the workplan, and summarize the conclusion of the PARCC assessment. Subsections J7.2.1, J7.2.2, J7.2.3, J7.2.4, and J7.2.5 present precision, accuracy, representativeness, comparability, and completeness, respectively.

J7.2.1 Precision

Precision was assessed by evaluating the RPDs for field duplicate samples collected at OU-2 ~~and by measuring the statistical performance of the data (by analyte and medium) per EPA Guidance (EPA 1992d) (see Section 7.2.1.7).~~ Advisory RPDs for field duplicates were given in the OU-2 workplan as 30 percent for aqueous samples and 40 percent for non-aqueous samples (EG&G 1991c). These limits are similar to those set for laboratory control samples and cannot be strictly applied to environmental samples because of the natural matrix variance that may exist in field samples. Therefore, for the purpose of this discussion, the RPD values of 30 and 40 percent were referred to as advisory limits. The results of the ~~precision~~RPD assessment are presented by parameter group in subsections J7.2.1.1 through J7.2.1.6. The results show that the advisory limits for the field duplicate data were not consistently met; however, this does not affect the quality or usability of the data.

The RPD values were calculated using the following equation:

$$\text{Relative Percent Difference} = \frac{S - D}{\frac{S + D}{2}} X\ 100$$

where

S = Reported concentration of analyte in the field sample (REAL)
D = Reported concentration of analyte in the field duplicate (DUP)

Only data that were rejected during validation were removed from the dataset before calculating the RPDs; all other field duplicate data were used. There were several instances of missing results for one of the field duplicate pairs (i.e., either the REAL [S] or DUP [D]) and a RPD value could not be calculated. In these instances, an NA (not applicable) was placed in the RPD column. The RPD computations for the field duplicate samples are presented in Appendix J1 data tables.

As shown in Table J7.2-1, the sample population (i.e., the number of available field duplicate records) was generally greatest for subsurface soils, then groundwater, surface soils, seep sediments, and seep surface waters. Seep surface water and sediments are collected on a quarterly basis under the site-wide RFETS Surface Water Monitoring Program. The seep sediment locations ~~that were used to characterize OU 2 (SED031 and SED038) did not have field duplicate data available. The seep sediment field duplicate data that are tabulated in Appendix J1 represent samples that were not used in this RFI/RI.~~ SED031 and SED038 are the only seep sediment sampling sites located within OU2. The QA/QC samples associated with the site-wide seep and sediment sampling program are collected on a program basis and not on an OU-specific basis. There are no QA/QC sediment samples (and therefore, no field duplicate data) associated with samples collected at the SED031 or SED038 locations. Because no field sediment duplicate data are available for OU2, all available seep sediment duplicate data collected at locations outside of OU2 were used to evaluate the precision of the site-wide seep sediment data set as a whole. The seep sediment field duplicate data used in the precision assessment are tabulated in Appendix J1.

As presented in this section, the results of the field duplicate RPDs generally fall into one of the following three categories: The RPDs that exceeded advisory limits were caused by reported concentrations very near or below the associated SQL for one or both of the measured analytes (e.g., the S and D values). The RPDs exceeded the advisory limit because of measured concentrations that were high enough to necessitate a dilution. The RPDs exceeded the advisory limits but the reason was not readily apparent (i.e., variability indicates a non homogeneous sample, an anomalous matrix, or poor sampling and/or analytical precision).

The RPD computations for each field duplicate are located in Appendix J1. Table J7.2-1 summarizes the percentage of RPDs that were within advisory limits for each media sampled. Table J7.2-2 shows the analytes that had precision values that exceeded advisory limits. ~~The~~

~~following discussion~~ ~~Section J7.2.1.1 through J7.2.1.6~~ provide an overview, by analyte group, of the precision assessment.

J7.2.1.1 ~~Relative Percent Difference Values for~~ Pesticide/PCBs

~~Precision RPD~~ values for pesticide/PCBs were within the advisory limits for surface soils, subsurface soils, groundwater, and seep sediments. An exception was noted for one occurrence each of Endosulfan I and Aroclor-1254 exceeding the RPD in seep sediment samples. The high RPD for Endosulfan I was attributable to reported concentrations very near or below the SQL. The reason for the variability of Aroclor-1254 was not readily apparent. Although surface waters were analyzed for pesticide/PCBs, no associated field duplicate pesticide/PCB data were available.

J7.2.1.2 ~~Relative Percent Difference Values for~~ Semivolatile Organics

~~Precision RPD~~ values for semivolatiles in all matrices with available field duplicate data were generally within advisory limits. Exceptions include some instances of PAHs and phthalate esters, and two occurrences of benzoic acid in surface soils. The high RPDs for these compounds were attributable to reported concentrations very near or below the SQL. Although surface waters were analyzed for SVOCs, there were no associated field duplicate semivolatile data were available for seep surface waters.

J7.2.1.3 ~~Relative Percent Difference Values for~~ Volatile Organics

~~Precision RPD~~ values for VOCs in non-aqueous matrices were within advisory limits, with the exception of several instances of acetone, methylene chloride, and toluene. One or two occurrences each of 1,2-dichloroethene, chloroform, tetrachloroethene, total xylenes, and trichloroethene exceeded the RPD limit for non-aqueous matrices. The high RPDs occurred in subsurface soils and seep sediments and were mostly attributable to reported concentrations very near or below the SQL. The reason for variability in toluene RPDs was not readily apparent. Surface soils were not analyzed for VOCs.

~~Precision RPD~~ values for VOCs in water samples were within advisory limits, with the exception of three occurrences each of carbon tetrachloride (CCl_4), chloroform ($CHCl_3$),

methylene chloride ($CHCl_2$), and tetrachloroethene (PCE), and fewer occurrences of 1,1-dichloroethene (1,1-DCE) and trichloroethene (TCE) in groundwater. There were two instances of $CHCl_3$ and one occurrence of CCl_4 that exceeded the RPD limit because of measured concentrations that necessitated a dilution. There was one occurrence each of CCl_4 and PCE, where the reason for variability was not readily apparent. The other high RPD values as well as one instance of 1,1-dichloroethane (1,1-DCA) in seep surface water were attributable to reported concentrations very near or below the SQL.

J7.2.1.4 Relative Percent Difference Values for Metals

~~Precision RPD~~ values for metals showed a higher degree of variability (i.e., analytes exceeding the advisory RPD limit) than those for organic chemicals. Tables J7.2.1-1 and J7.2.1-2 show that, with the exception of filtered and unfiltered metals for groundwater, subsurface soils had the lowest percentage of RPDs within advisory limits. ~~Precision RPD~~ values for filtered and unfiltered seep surface waters showed less variability than those for subsurface soils but greater variability than seep sediments and surface soils.

For subsurface soils, analytes that exceeded the RPD limit because of reported concentrations very near or below the SQL included As, Be, Cs, Co, Li, Hg, Mo, Ni, Sr, and Sn. The reason for variability for Al, Ba, Ca, Co, Fe, Mg, Mn, Ni, K, and Si was not readily apparent. However, occurrences of high concentrations of Al, Ba, Ca, Co, Fe, Mg, Mn, Ni, K, and Si may have necessitated dilutions.

For unfiltered groundwater, analytes that exceeded the RPD limit due to reported concentrations very near or below the SQL included As, Be, Co, Cr, Li, Mo, Ni, Se, Sr, Sn, and Zn. The reason for variability for Al, Ca, Fe, Pb, Mg, Mn, K, Na, and V was not readily apparent. However, occurrences of high concentrations of Al, Ca, Fe, Mg, Mn, K, Na, Si, and Sr may have necessitated dilutions.

For filtered groundwater, analytes that exceeded the RPD limit due to reported concentrations very near or below the SQL, included Al, As, Co, Cu, Li, Mo, Ni, Pb, Se, Sn, V, and Zn. The reason for variability for Fe, Mn, K, and Na was not readily apparent. However, occurrences of high concentrations of Fe, Mn, K, and Na may have necessitated dilutions.

For surface soils, analytes that exceeded the RPD limit due to reported concentrations very near or below the SQL included Ag, Ni, and Sn. The reason for variability for Cr, Mn, Ba, Fe, and Si was not readily apparent. However, occurrences of high concentrations of Fe and Si may have necessitated dilutions.

For sediment samples, analytes that exceeded the RPD limit due to reported concentrations very near or below the SQL included Sn. The reason for variability for Ca, Mo, Si, and Sr was not readily apparent. However, occurrences of high concentrations of Ca, Si, and Sr may have necessitated dilutions.

For unfiltered seep surface waters, analytes that exceeded the RPD limit due to reported concentrations very near or below the SQL included Pb only. The reason for variability for Al, Ca, Mg, K, and Na was not readily apparent. However, occurrences of high concentrations of Ca, Mg, K, and Na may have necessitated dilutions.

For filtered seep surface waters, no analytes exceeded the RPD limit due to reported concentrations very near or below the SQL. The reason for variability for Ca, Fe, Mg, K, Na, and Zn was not readily apparent. However, occurrences of high concentrations of Ca, Mg, K, and Na may have necessitated dilutions.

J7.2.1.5 Relative Percent Values for Inorganics

~~Precision~~ RPD values for inorganics showed a high degree of variability in surface soils and groundwater. Only four field duplicate records were available for surface soils inorganics, and three of the calculated RPDs exceeded the limit of forty percent (40%). The reason for variability for those three analytes (Table J7.2-2) was not readily apparent. However, high concentrations indicated that dilutions may have been necessary. For groundwater, one analyte that exceeded the RPD limit due to reported concentrations very near or below the SQL was cyanide. The reason for variability for the other analytes listed in Table J7.2-2 was not readily apparent. Several occurrences of high concentrations of TSS, bicarbonate, and chloride may have necessitated dilutions. There was very little variability for inorganics in subsurface soil, seep surface water, and seep sediment.

J7.2.1.6 Relative Percent Difference Values for Radionuclides

~~Precision~~ RPD values for radionuclides were consistently more variable (i.e., showed the lowest percentage of RPD values within advisory limits) for all media sampled. Low RPD values have generally been attributed to analytical variability inherent in radiochemistry. Examples of this include counting errors and detector efficiency. Due to variability in isotopic particle size and specific activity, analytical difficulties are also encountered in attempting to prepare two representative aliquots for the same sample. As with the other chemical groups, many of the high RPD values were attributable to reported activity levels (i.e., pCi/G, pCi/L) that were very near or below the minimum detectable activity (MDA). Finally, there were several cases where activity levels were reported as a negative number. In these cases, only one value in the RPD equation was a negative number (i.e., either the REAL (S) or DUP (D)), causing the RPD value to be extraordinarily high.

J7.2.1.7 Statistical Performance

Samples used for risk assessment should meet a minimum statistical performance level represented by the following parameters: 80% confidence level, 90% power, and a 10% to 20% minimum detectable relative difference (EPA 1992d). To assess whether the OU-2 data met EPA's recommended minimum statistical performance level, OU-2 sample sizes (by analyte and medium) were compared to required sample sizes per EPA's guidance. In order to perform this comparison, the coefficient of variation (CV) was calculated based on the geometric mean for each transformed data set. The required number of samples was then calculated using the equation:

$$n = [(z_\alpha + z_\beta)/MDRD/CV)]^2 + 0.5Z^2_\alpha$$

where:

n = minimum required samples

$Z\alpha$ = percentile of the standard normal distribution ($Z\alpha$ = 0.842 for α = 0.20)

Z_β = percentile of the standard normal distribution (Z_β = 1.645 for β = 0.010)

MDRD = minimum detectable relative difference (20%), and

CV = the calculated coefficient of variation

Comparisons of the actual number of OU-2 samples and the minimum required number of samples per EPA's guidance are presented in Appendix J4. Table J4-1 presents a summary of the assessment results.

Of the 16 medium-analyte data groups (e.g., unfiltered metals in UHSU groundwater, VOCs in subsurface soil), nine groups passed the minimum sample size requirements. Of the 545 medium-analyte-specific data sets (e.g., PCE in subsurface soil), 505 data sets passed the minimum sample size requirements.

The medium-analyte-specific data sets that failed the minimum sample size requirements were reviewed to determine if they had been selected as COCs. The following COC data sets failed to meet the minimum statistical performance level based on EPA's recommended minimum number of samples required.

Medium	COC	Number of OU-2 Samples	Minimum Number of Samples Required
Surface Soil	Pu-239/240	72	84
Surface Soil	Am-241	61	2801
Subsurface Soil	Cadmium	254	652
UHSU Filter Groundwater	Pu-239/240	15	43
UHSU Filter Groundwater	Am-241	12	60
UHSU Groundwater	1,1-Dichloroethene	442	966

sample was evaluated using the 5x/10x rule for blank contamination, as established in the EPA CLP *National Functional Guidelines for Organic Data Review* (1991a). The common laboratory contaminants methylene chloride, 2-butanone, acetone, and phthalate esters were evaluated using the 10x rule, and other contaminants were evaluated using the 5x rule (Section 6.3.2.1). If the analyte of interest in the REAL sample had a reported concentration greater than or equal to the 5x/10x criteria, then the contaminant was deemed present in the sample and no qualification was necessary. If the analyte of interest was less than the 5x/10x criteria, then the contaminant was deemed an artifact of the sampling procedure (i.e., not present in the sample), and the reported concentration was qualified ND (not detected).

For OU-2, instances of ammonia, nitrate/nitrite, and total xylenes met the 3x criteria in the RNS samples. Ten subsurface soils were qualified ND for ammonia, one subsurface soil qualified ND for nitrate/nitrite, and one subsurface soil qualified ND for total xylenes. Table J7.2-3 shows the REAL samples and associated concentrations of ammonia, nitrate/nitrite, and total xylenes that were qualified ND.

Trip blanks were used to assess possible contamination originating from sample transport to and from the field and laboratory. Trip blanks were not collected for all of the OU-2 sampling programs. ~~Because of evaluation guidelines were not specified for trip blanks, the same guidelines required for the equipment rinsate blanks were applied. No analytes met the 3x criteria in trip blanks collected for OU-2; therefore, no further evaluation was required.~~ ~~There were 750 trip blank data records associated with 20 samples, which is approximately 0.3 percent of the total records. Of the 750 trip blank data records, 15 results exhibited detectable concentrations, only three of which exceeded the associated detection limit. These three results (5 µg/L, 0.2 µg/L, and 1 µg/L) were all associated with a groundwater sample collected from Well 22193 on June 2, 1993. No further evaluation of trip blank data is warranted.~~

Toluene concentrations in subsurface soils and seep sediments are considered suspect because the sampling SOP (SOP# GT.2) that was followed during the OU-2 investigation. The SOP specified collecting discrete soil samples in a stainless steel liner, capped with teflon and plastic caps, and sealed with black electrical tape. Analytical data revealed that toluene was consistently detected in subsurface soils but not in the OU-2 groundwater or surface soils. Likewise, the equipment rinsate blanks and laboratory method blanks associated with the

Table J4-1
Assessment of Data Precision-Sampling Variability[1]

Media	Unfiltered Metal	Filtered Metals	U Rads	F Rad	VOC	SVOC	Pesticides/PCBs
Subsurface Soil	4/29	NA	1/13	NA	0/36	0/65	0/27
Surface Soil	5/29	NA	7/12	NA	NA	0/65	0/27
UHSU Groundwater	0/59	0/29	9/11	4/11	0/69	0/66	0/27

Note:
[1] x/y; where x = the number of OU-2 data sets that failed to meet the minimum sample size requirements, and y = the total number of data sets within the medium-analyte group.

Assessment of Data Precision-Sampling Variability
OU2 Surface Soil Semivolatile Organic Compounds

ANALYTE	Number of Records	Number of Nondetects	Detection Frequency	Mean[1]	STD[1]	CV[1]	Number of Required Records[2]	REMARKS
1,2,4-TRICHLOROBENZENE	40	40	0.00	5.106	0.000	0.000		
1,2-DICHLOROBENZENE	40	40	0.00	5.106	0.000	0.000		
1,3-DICHLOROBENZENE	40	40	0.00	5.106	0.000	0.000		
1,4-DICHLOROBENZENE	40	40	0.00	5.106	0.000	0.000		
2,4,5-TRICHLOROPHENOL	40	40	0.00	6.685	0.000	0.000		
2,4,6-TRICHLOROPHENOL	40	40	0.00	5.106	0.000	0.000		
2,4-DICHLOROPHENOL	40	40	0.00	5.106	0.000	0.000		
2,4-DIMETHYLPHENOL	40	40	0.00	5.106	0.000	0.000		
2,4-DINITROPHENOL	40	40	0.00	6.685	0.000	0.000		
2,4-DINITROTOLUENE	40	40	0.00	5.106	0.000	0.000		
2,6-DINITROTOLUENE	40	40	0.00	5.106	0.000	0.000		
2-CHLORONAPHTHALENE	40	40	0.00	5.106	0.000	0.000		
2-CHLOROPHENOL	40	40	0.00	5.106	0.000	0.000		
2-METHYLNAPHTHALENE	40	40	0.00	5.106	0.000	0.000		
2-METHYLPHENOL	40	40	0.00	5.106	0.000	0.000		
2-NITROANILINE	40	40	0.00	6.685	0.000	0.000		
2-NITROPHENOL	40	40	0.00	5.106	0.000	0.000		
3,3'-DICHLOROBENZIDINE	40	40	0.00	5.799	0.000	0.000		
3-NITROANILINE	36	36	0.00	6.685	0.000	0.000		
4,6-DINITRO-2-METHYLPHENOL	40	40	0.00	6.685	0.000	0.000		
4-BROMOPHENYL PHENYL ETHER	40	40	0.00	5.106	0.000	0.000		
4-CHLORO-3-METHYLPHENOL	40	40	0.00	5.106	0.000	0.000		
4-CHLOROANILINE	40	40	0.00	5.106	0.000	0.000		
4-CHLOROPHENYL PHENYL ETHER	40	40	0.00	5.106	0.000	0.000		
4-METHYLPHENOL	40	40	0.00	5.106	0.000	0.000		
4-NITROANILINE	40	40	0.00	6.685	0.000	0.000		
4-NITROPHENOL	40	40	0.00	6.685	0.000	0.000		
ACENAPHTHENE	40	40	0.00	5.106	0.000	0.000		
ACENAPHTHYLENE	40	40	0.00	5.106	0.000	0.000		
ANTHRACENE	40	40	0.00	5.106	0.000	0.000		
BENZO(a)ANTHRACENE	40	33	0.18	4.985	0.312	0.063	0.8	
BENZO(a)PYRENE	40	33	0.18	5.013	0.252	0.050	0.6	

Assessment of Data Precision-Sampling Variability
OU2 Surface Soil Semivolatile Organic Compounds

ANALYTE	Number of Records	Number of Nondetects	Detection Frequency	Mean[1]	STD[1]	CV[1]	Number of Required Records[2]	REMARKS
BENZO(b)FLUORANTHENE	40	31	0.23	5.033	0.281	0.056	0.7	
BENZO(ghi)PERYLENE	40	39	0.03	5.073	0.205	0.040	0.5	
BENZO(k)FLUORANTHENE	40	38	0.05	5.065	0.182	0.036	0.5	
BENZOIC ACID	40	3	0.93	5.454	0.651	0.119	2.0	
BENZYL ALCOHOL	40	40	0.00	5.106	0.000	0.000		
BIS(2-CHLOROETHOXY)METHANE	40	40	0.00	5.106	0.000	0.000		
BIS(2-CHLOROETHYL)ETHER	40	40	0.00	5.106	0.000	0.000		
BIS(2-CHLOROISOPROPYL)ETHER	40	40	0.00	5.106	0.000	0.000		
BIS(2-ETHYLHEXYL)PHTHALATE	40	31	0.23	4.961	0.424	0.086	1.2	
BUTYL BENZYL PHTHALATE	40	40	0.00	5.106	0.000	0.000		
CHRYSENE	40	29	0.28	4.939	0.361	0.073	1.0	
DI-n-BUTYL PHTHALATE	40	39	0.03	5.151	0.285	0.055	0.7	
DI-n-OCTYL PHTHALATE	40	40	0.00	5.106	0.000	0.000		
DIBENZO(a,h)ANTHRACENE	40	40	0.00	5.106	0.000	0.000		
DIBENZOFURAN	40	40	0.00	5.106	0.000	0.000		
DIETHYL PHTHALATE	40	40	0.00	5.106	0.000	0.000		
DIMETHYL PHTHALATE	40	40	0.00	5.106	0.000	0.000		
FLUORANTHENE	40	21	0.48	4.999	0.372	0.074	1.0	
FLUORENE	40	40	0.00	5.106	0.000	0.000		
HEXACHLOROBENZENE	40	40	0.00	5.106	0.000	0.000		
HEXACHLOROBUTADIENE	40	40	0.00	5.106	0.000	0.000		
HEXACHLOROCYCLOPENTADIENE	40	40	0.00	5.106	0.000	0.000		
HEXACHLOROETHANE	40	40	0.00	5.106	0.000	0.000		
INDENO(1,2,3-cd)PYRENE	40	38	0.05	5.056	0.230	0.045	0.6	
ISOPHORONE	40	40	0.00	5.106	0.000	0.000		
N-NITROSO-DI-n-PROPYLAMINE	40	40	0.00	5.106	0.000	0.000		
N-NITROSODIPHENYLAMINE	40	40	0.00	5.106	0.000	0.000		
NAPHTHALENE	40	40	0.00	5.106	0.000	0.000		
NITROBENZENE	40	40	0.00	5.106	0.000	0.000		
PENTACHLOROPHENOL	40	40	0.00	6.685	0.000	0.000		
PHENANTHRENE	40	28	0.30	4.876	0.436	0.089	1.3	
PHENOL	40	40	0.00	5.106	0.000	0.000		

Assessment of Data Precision-Sampling Variability
OU2 Surface Soil Semivolatile Organic Compounds

ANALYTE	Number of Records	Number of Nondetects	Detection Frequency	Mean[1]	STD[1]	CV[1]	Number of Required Records[2]	REMARKS
PYRENE	40	18	0.55	4.898	0.443	0.090	1.3	

Note:
[1] The mean, standard deviation (STD) and coefficient of variance (CV) were calculated based on long-transformed data.

[2] Number of required records were calculated based on 80% confidence level, 90% power, 20% detectable relative difference and sample CV following EPAs guidance (EPA 1992).

Assessment of Data Precision-Sampling Varaibility
OU2 Surface Soil Pesticides/PCBs

ANALYTE	Number of Records	Number of Nondetects	Detection Frequency	Mean[1]	STD[1]	CV[1]	Number of Required Records[2]	REMARKS
4,4'-DDD	40	40	0.00	2.079	0.000	0.000		
4,4'-DDE	40	40	0.00	2.079	0.000	0.000		
4,4'-DDT	40	39	0.03	2.109	0.186	0.088	1.2	
ALDRIN	40	40	0.00	1.386	0.000	0.000		
AROCLOR-1016	40	40	0.00	3.689	0.000	0.000		
AROCLOR-1221	40	40	0.00	3.689	0.000	0.000		
AROCLOR-1232	40	40	0.00	3.689	0.000	0.000		
AROCLOR-1242	40	40	0.00	3.689	0.000	0.000		
AROCLOR-1248	40	40	0.00	3.689	0.000	0.000		
AROCLOR-1254	40	38	0.05	4.466	0.414	0.093	1.3	
AROCLOR-1260	40	38	0.05	4.462	0.372	0.083	1.1	
DIELDRIN	40	40	0.00	2.079	0.000	0.000		
ENDOSULFAN I	40	40	0.00	1.386	0.000	0.000		
ENDOSULFAN II	40	40	0.00	2.079	0.000	0.000		
ENDOSULFAN SULFATE	40	40	0.00	2.079	0.000	0.000		
ENDRIN	40	40	0.00	2.079	0.000	0.000		
ENDRIN KETONE	40	40	0.00	2.079	0.000	0.000		
HEPTACHLOR	40	40	0.00	1.386	0.000	0.000		
HEPTACHLOR EPOXIDE	40	40	0.00	1.386	0.000	0.000		
METHOXYCHLOR	40	40	0.00	3.689	0.000	0.000		
TOXAPHENE	40	40	0.00	4.382	0.000	0.000		
alpha-BHC	40	40	0.00	1.386	0.000	0.000		
alpha-CHLORDANE	40	40	0.00	3.689	0.000	0.000		
beta-BHC	40	40	0.00	1.386	0.000	0.000		
delta-BHC	40	39	0.03	1.430	0.277	0.193	4.6	
gamma-BHC (LINDANE)	40	40	0.00	1.386	0.000	0.000		
gamma-CHLORDANE	40	40	0.00	3.689	0.000	0.000		

Note:
[1] The mean, standard deviation (STD) and coefficient of variance (CV) were calculated based on long-transformed data.

[2] Number of required records were calculated based on 80% confidence level, 90% power, 20% detectable relative difference and sample CV following EPAs guidance (EPA 1992).

Assessment of Data Precision-Sampling Variability
OU2 Surface Soil Metals

ANALYTE	Number of Records	Number of Nondetects	Detection Frequency	Mean[1]	STD[1]	CV[1]	Number of Required Records[2]	REMARKS
ALUMINUM	69	0	1.00	9.185	0.328	0.036	0.5	
ANTIMONY	50	50	0.00	2.737	0.679	0.248	7.3	
ARSENIC	69	0	1.00	1.261	0.381	0.302	10.6	
BARIUM	69	0	1.00	4.783	0.271	0.057	0.7	
BERYLLIUM	69	55	0.20	0.101	0.783	7.729	6738.2	
CADMIUM	69	59	0.14	0.068	0.767	11.363	14562.0	
CALCIUM	69	0	1.00	8.726	0.897	0.103	1.5	
CESIUM	51	50	0.02	5.168	0.594	0.115	1.8	
CHROMIUM	69	0	1.00	2.429	0.345	0.142	2.6	
COBALT	69	0	1.00	1.903	0.233	0.123	2.1	
COPPER	69	0	1.00	2.533	0.240	0.095	1.4	
IRON	69	0	1.00	9.433	0.336	0.036	0.5	
LEAD	69	0	1.00	3.566	0.400	0.112	1.8	
LITHIUM	44	4	0.91	2.193	0.352	0.161	3.3	
MAGNESIUM	69	0	1.00	7.767	0.275	0.035	0.5	
MANGANESE	69	0	1.00	5.654	0.329	0.058	0.7	
MERCURY	44	44	0.00	-2.601	0.559	-0.215	5.6	
MOLYBDENUM	56	55	0.02	2.592	0.385	0.148	2.8	
NICKEL	69	9	0.87	2.285	0.423	0.185	4.2	
POTASSIUM	69	0	1.00	7.838	0.269	0.034	0.5	
SELENIUM	69	50	0.28	-0.438	0.451	-1.030	120.0	
SILICON	40	0	1.00	7.350	0.188	0.026	0.4	
SILVER	64	63	0.02	0.833	0.808	0.970	106.6	
SODIUM	69	51	0.26	5.793	0.790	0.136	2.5	
STRONTIUM	56	0	1.00	3.433	0.513	0.149	2.9	
THALLIUM	69	65	0.06	-0.067	0.281	-4.211	2000.8	
TIN	56	40	0.29	3.456	0.415	0.120	2.0	
VANADIUM	69	0	1.00	3.263	0.300	0.092	1.3	
ZINC	69	0	1.00	3.929	0.182	0.046	0.6	

Note:
[1] The mean, standard deviation (STD) and coefficient of variance (CV) were calculated based on long-transformed data.

[2] Number of required records were calculated based on 80% confidence level, 90% power, 20% detectable relative difference and sample CV following EPAs guidance (EPA 1992).

Assessment of Data Precision-Sampling Variability
OU2 Surface Soil Radionuclides

ANALYTE	Number of Records	Number of Nondetects	Detection Frequency	Mean[1]	STD[1]	CV[1]	Number of Required Records[2]	REMARKS
AMERICIUM-241	61	0	1.00	0.371	1.847	4.983	2801.2	
CESIUM-134	33	0	1.00	-5.936	0.499	-0.084	1.2	
CESIUM-137	40	0	1.00	-0.261	0.671	-2.572	746.6	
GROSS ALPHA	34	0	1.00	3.239	0.756	0.234	6.5	
GROSS BETA	40	0	1.00	3.490	0.166	0.048	0.6	
PLUTONIUM-239,240	72	0	1.00	2.423	2.087	0.862	84.1	
RADIUM-226	40	0	1.00	0.039	0.177	4.590	2376.0	
RADIUM-228	13	0	1.00	0.790	0.266	0.336	13.1	
STRONTIUM-89,90	29	0	1.00	-0.365	0.893	-2.449	676.7	
URANIUM-233,234	80	0	1.00	0.320	0.363	1.136	146.0	
URANIUM-235	80	0	1.00	-2.750	0.786	-0.286	9.6	
URANIUM-238	80	0	1.00	0.431	0.432	1.003	113.8	

Note:
[1] The mean, standard deviation (STD) and coefficient of variance (CV) were calculated based on long-transformed data.

[2] Number of required records were calculated based on 80% confidence level, 90% power, 20% detectable relative difference and sample CV following EPAs guidance (EPA 1992).

Assessment of Data Precision-Sampling Variability
OU2 Subsurface Soil Voltile Organic Compounds

ANALYTE	Number of Records	Number of Nondetects	Detection Frequency	Mean[1]	STD[1]	CV[1]	Number of Required Records[2]	REMARKS
1,1,1-TRICHLOROETHANE	381	364	0.04	1.502	1.220	0.812	74.8	
1,1,2,2-TETRACHLOROETHANE	368	367	0.00	1.365	0.717	0.525	31.5	
1,1,2-TRICHLOROETHANE	381	381	0.00	1.348	0.710	0.527	31.6	
1,1-DICHLOROETHANE	381	381	0.00	1.348	0.710	0.527	31.6	
1,1-DICHLOROETHENE	381	381	0.00	1.348	0.710	0.527	31.6	
1,2-DICHLOROETHANE	378	344	0.09	1.380	0.814	0.590	39.6	
1,2-DICHLOROETHENE	274	270	0.01	0.943	0.238	0.252	7.5	
1,2-DICHLOROPROPANE	380	380	0.00	1.349	0.710	0.527	31.6	
2-BUTANONE	334	315	0.06	2.146	0.846	0.394	17.9	
2-CHLOROETHYL VINYL ETHER	107	106	0.01	3.134	0.360	0.115	1.8	
2-HEXANONE	342	342	0.00	2.090	0.733	0.351	14.2	
4-METHYL-2-PENTANONE	344	343	0.00	2.090	0.732	0.350	14.2	
ACETONE	371	231	0.38	2.763	1.694	0.613	42.8	
BENZENE	381	380	0.00	1.348	0.710	0.527	31.6	
BROMODICHLOROMETHANE	381	381	0.00	1.348	0.710	0.527	31.6	
BROMOFORM	372	372	0.00	1.358	0.715	0.526	31.6	
BROMOMETHANE	365	365	0.00	2.060	0.719	0.349	14.1	
CARBON DISULFIDE	381	380	0.00	1.354	0.731	0.540	33.2	
CARBON TETRACHLORIDE	381	366	0.04	1.538	1.443	0.938	99.7	
CHLOROBENZENE	380	380	0.00	1.349	0.710	0.527	31.6	
CHLOROETHANE	378	378	0.00	2.044	0.712	0.348	14.0	
CHLOROFORM	381	370	0.03	1.376	0.826	0.600	41.0	
CHLOROMETHANE	378	378	0.00					
DIBROMOCHLOROMETHANE	381	381	0.00	1.350	0.710	0.526	31.5	
ETHYLBENZENE	381	375	0.02	1.356	0.715	0.527	31.7	
METHYLENE CHLORIDE	379	274	0.28	1.560	1.175	0.753	64.3	
cis-1,3-DICHLOROPROPENE	381	380	0.00	1.346	0.708	0.526	31.5	
STYRENE	381	380	0.00	1.349	0.711	0.527	31.7	
TETRACHLOROETHENE	381	333	0.13	1.711	1.801	1.053	125.3	
TOLUENE	381	236	0.38	2.295	1.448	0.631	45.3	
TOTAL XYLENES	381	365	0.04	1.383	0.768	0.556	35.2	
TRICHLOROETHENE	381	367	0.04	1.451	1.041	0.717	58.3	
VINYL ACETATE	344	344	0.00	2.071	0.750	0.362	15.1	
VINYL CHLORIDE	380	380	0.00	2.042	0.710	0.348	14.0	

Assessment of Data Precision-Sampling Variability
OU2 Subsurface Soil Voltile Organic Compounds

ANALYTE	Number of Records	Number of Nondetects	Detection Frequency	Mean[1]	STD[1]	CV[1]	Number of Required Records[2]	REMARKS
trans-1,2-DICHLOROETHE	108	108	0.00	2.425	0.386	0.159	3.2	
trans-1,3-DICHLOROPROP	372	372	0.00	1.358	0.715	0.526	31.6	

Note:
[1] The mean, standard deviation (STD) and coefficient of variance (CV) were calculated based on long-transformed data.

[2] Number of required records were calculated based on 80% confidence level, 90% power, 20% detectable relative difference and sample CV following EPAs guidance (EPA 1992).

Assessment of Data Precision-Sampling Frequency
OU2 Subsurface Soil Semivolatile Organic Compounds

ANALYTE	Number of Records	Number of Nondetects	Detection Frequency	Mean[1]	STD[1]	CV[1]	Number of Required Records[2]	REMARKS
1,2,4-TRICHLOROBENZENE	214	214	0.00	3.178	1.743	0.548	34.3	
1,2-DICHLOROBENZENE	214	214	0.00	3.178	1.743	0.548	34.3	
1,3-DICHLOROBENZENE	214	214	0.00	3.178	1.743	0.548	34.3	
1,4-DICHLOROBENZENE	214	213	0.00	3.188	1.740	0.546	34.0	
2,4,5-TRICHLOROPHENOL	214	214	0.00	4.774	1.728	0.362	15.1	
2,4,6-TRICHLOROPHENOL	214	214	0.00	3.178	1.743	0.548	34.3	
2,4-DICHLOROPHENOL	214	214	0.00	3.178	1.743	0.548	34.3	
2,4-DIMETHYLPHENOL	214	214	0.00	3.178	1.743	0.548	34.3	
2,4-DINITROPHENOL	208	208	0.00	4.818	1.732	0.359	14.9	
2,4-DINITROTOLUENE	214	214	0.00	3.178	1.743	0.548	34.3	
2,6-DINITROTOLUENE	214	214	0.00	3.178	1.743	0.548	34.3	
2-CHLORONAPHTHALENE	214	214	0.00	3.178	1.743	0.548	34.3	
2-CHLOROPHENOL	214	214	0.00	3.178	1.743	0.548	34.3	
2-METHYLNAPHTHALENE	214	211	0.01	3.240	1.783	0.550	34.5	
2-METHYLPHENOL	214	213	0.00	3.199	1.751	0.547	34.2	
2-NITROANILINE	214	214	0.00	4.774	1.728	0.362	15.1	
2-NITROPHENOL	214	214	0.00	3.178	1.743	0.548	34.3	
3,3'-DICHLOROBENZIDINE	200	200	0.00	3.981	1.751	0.440	22.2	
3-NITROANILINE	207	207	0.00	4.826	1.732	0.359	14.9	
4,6-DINITRO-2-METHYLPHENOL	214	214	0.00	4.774	1.728	0.362	15.1	
4-BROMOPHENYL PHENYL ETHER	114	114	0.00	1.609	0.000	0.000		
4-CHLORO-3-METHYLPHENOL	214	214	0.00	3.178	1.743	0.548	34.3	
4-CHLOROANILINE	213	213	0.00	3.185	1.744	0.547	34.2	
4-CHLOROPHENYL PHENYL ETHER	214	214	0.00	3.178	1.743	0.548	34.3	
4-METHYLPHENOL	214	213	0.00	3.208	1.770	0.552	34.7	
4-NITROANILINE	204	204	0.00	4.850	1.734	0.358	14.8	
4-NITROPHENOL	214	214	0.00	4.774	1.728	0.362	15.1	
ACENAPHTHENE	214	212	0.01	3.208	1.745	0.544	33.7	
ACENAPHTHYLENE	214	214	0.00	3.178	1.743	0.548	34.3	
ANTHRACENE	214	213	0.00	3.196	1.747	0.547	34.1	
BENZO(a)ANTHRACENE	212	211	0.00	3.215	1.754	0.546	33.9	
BENZO(a)PYRENE	212	210	0.01	3.233	1.757	0.543	33.7	

Assessment of Data Precision-Sampling Frequency
OU2 Subsurface Soil Semivolatile Organic Compounds

ANALYTE	Number of Records	Number of Nondetects	Detection Frequency	Mean[1]	STD[1]	CV[1]	Number of Required Records[2]	REMARKS
BENZO(b)FLUORANTHENE	212	211	0.00	3.217	1.758	0.546	34.0	
BENZO(ghi)PERYLENE	212	211	0.00	3.213	1.751	0.545	33.8	
BENZO(k)FLUORANTHENE	212	212	0.00	3.193	1.745	0.546	34.0	
BENZOIC ACID	195	194	0.01	4.939	1.734	0.351	14.3	
BENZYL ALCOHOL	214	214	0.00	3.178	1.743	0.548	34.3	
BIS(2-CHLOROETHOXY)METHANE	214	214	0.00	3.178	1.743	0.548	34.3	
BIS(2-CHLOROETHYL)ETHER	214	214	0.00	3.178	1.743	0.548	34.3	
BIS(2-CHLOROISOPROPYL)ETHER	197	197	0.00	3.313	1.752	0.529	31.9	
BIS(2-ETHYLHEXYL)PHTHALATE	213	132	0.38	4.185	2.209	0.528	31.8	
BUTYL BENZYL PHTHALATE	212	211	0.00	3.215	1.754	0.546	33.9	
CHRYSENE	212	210	0.01	3.231	1.755	0.543	33.6	
DI-n-BUTYL PHTHALATE	214	158	0.26	3.039	1.593	0.524	31.3	
DI-n-OCTYL PHTHALATE	212	212	0.00	3.193	1.745	0.546	34.0	
DIBENZO(a,h)ANTHRACENE	212	212	0.00	3.193	1.745	0.546	34.0	
DIBENZOFURAN	214	214	0.00	3.178	1.743	0.548	34.3	
DIETHYL PHTHALATE	214	214	0.00	3.178	1.743	0.548	34.3	
DIMETHYL PHTHALATE	214	214	0.00	3.178	1.743	0.548	34.3	
FLUORANTHENE	214	209	0.02	3.239	1.752	0.541	33.4	
FLUORENE	214	213	0.00	3.195	1.745	0.546	34.0	
HEXACHLOROBENZENE	214	214	0.00	3.178	1.743	0.548	34.3	
HEXACHLOROBUTADIENE	214	213	0.00	3.194	1.745	0.546	34.0	
HEXACHLOROCYCLOPENTADIENE	214	214	0.00	3.178	1.743	0.548	34.3	
HEXACHLOROETHANE	214	213	0.00	3.203	1.759	0.549	34.4	
INDENO(1,2,3-cd)PYRENE	212	211	0.00	3.212	1.750	0.545	33.8	
ISOPHORONE	214	214	0.00	3.178	1.743	0.548	34.3	
N-NITROSO-DI-n-PROPYLAMINE	214	214	0.00	3.178	1.743	0.548	34.3	
N-NITROSODIPHENYLAMINE	214	186	0.13	3.540	2.298	0.649	47.9	
NAPHTHALENE	214	212	0.01	3.222	1.767	0.548	34.3	
NITROBENZENE	214	214	0.00	3.178	1.743	0.548	34.3	
PENTACHLOROPHENOL	214	212	0.01	4.750	1.719	0.362	15.1	
PHENANTHRENE	214	209	0.02	3.284	1.791	0.545	33.9	
PHENOL	214	214	0.00	3.178	1.743	0.548	34.3	

Assessment of Data Precision-Sampling Frequency
OU2 Subsurface Soil Semivolatile Organic Compounds

ANALYTE	Number of Records	Number of Nondetects	Detection Frequency	Mean[1]	STD[1]	CV[1]	Number of Required Records[2]	REMARKS
PYRENE	212	207	0.02	3.278	1.765	0.538	33.1	

Note:
[1] The mean, standard deviation (STD) and coefficient of variance (CV) were calculated based on long-transformed data.

[2] Number of required records were calculated based on 80% confidence level, 90% power, 20% detectable relative difference and sample CV following EPAs guidance (EPA 1992).

Assessment of Data Precision-Sampling Variability
OU2 Subsurface Soil Pesticides/PCBs

ANALYTE	Number of Records	Number of Nondetects	Detection Frequency	Mean[1]	STD[1]	CV[1]	Number of Required Records[2]	REMARKS
4,4'-DDD	224	224	0.00	1.478	0.707	0.478	26.2	
4,4'-DDE	224	224	0.00	1.478	0.707	0.478	26.2	
4,4'-DDT	224	223	0.00	1.491	0.743	0.498	28.4	
ALDRIN	224	224	0.00	0.785	0.707	0.900	91.8	
AROCLOR-1016	224	224	0.00	3.076	0.690	0.224	6.0	
AROCLOR-1221	224	224	0.00	3.076	0.690	0.224	6.0	
AROCLOR-1232	224	224	0.00	3.076	0.690	0.224	6.0	
AROCLOR-1242	224	224	0.00	3.076	0.690	0.224	6.0	
AROCLOR-1248	224	224	0.00	3.076	0.690	0.224	6.0	
AROCLOR-1254	224	218	0.03	3.840	0.909	0.237	6.7	
alpha-BHC	224	224	0.00	0.785	0.707	0.900	91.8	
alpha-CHLORDANE	121	121	0.00	3.689	0.000	0.000		
AROCLOR-1260	224	224	0.00	3.769	0.690	0.183	4.1	
CHLORDANE	103	103	0.00	2.356	0.269	0.114	1.8	
DIELDRIN	224	224	0.00	1.478	0.707	0.478	26.2	
ENDOSULFAN I	224	224	0.00	0.785	0.707	0.900	91.8	
ENDOSULFAN II	223	223	0.00	1.475	0.708	0.480	26.3	
ENDOSULFAN SULFAT	224	224	0.00	1.478	0.707	0.478	26.2	
ENDRIN	224	224	0.00	1.478	0.707	0.478	26.2	
ENDRIN KETONE	224	224	0.00	1.478	0.707	0.478	26.2	
HEPTACHLOR	224	224	0.00	0.785	0.707	0.900	91.8	
HEPTACHLOR EPOXID	224	224	0.00	0.785	0.707	0.900	91.8	
METHOXYCHLOR	224	224	0.00	3.076	0.690	0.224	6.0	
TOXAPHENE	224	224	0.00	3.769	0.690	0.183	4.1	
beta-BHC	224	224	0.00	0.785	0.707	0.900	91.8	
delta-BHC	224	224	0.00	0.785	0.707	0.900	91.8	
gamma-BHC (LINDAN	224	224	0.00	0.785	0.707	0.900	91.8	
gamma-CHLORDANE	121	121	0.00	3.689	0.000	0.000		

Note:
[1] The mean, standard deviation (STD) and coefficient of variance (CV) were calculated based on long-transformed data.

[2] Number of required records were calculated based on 80% confidence level, 90% power, 20% detectable relative difference and sample CV following EPAs guidance (EPA 1992).

Assessment of Data Precision-Sampling Variability
OU2 Subsurface Soil Total Metals

ANALYTE	Number of Records	Number of Nondetects	Detection Frequency	Mean[1]	STD[1]	CV[1]	Number of Required Records[2]	REMARKS
ALUMINUM	300	0	1.00	9.081	0.497	0.055	0.7	
ANTIMONY	283	261	0.08	0.350	2.045	5.841	3848.5	
ARSENIC	300	18	0.94	1.469	0.825	0.562	35.9	
BARIUM	300	51	0.83	3.370	2.331	0.692	54.3	
BERYLLIUM	300	154	0.49	-0.992	0.988	-0.995	112.1	
CADMIUM	254	168	0.34	-0.393	0.944	-2.404	652.0	
CALCIUM	300	2	0.99	9.230	1.425	0.154	3.0	
CESIUM	196	74	0.62	2.161	1.963	0.908	93.4	
CHROMIUM	300	5	0.98	2.293	0.856	0.373	16.1	
COBALT	300	143	0.52	0.373	1.907	5.108	2943.1	
COPPER	300	43	0.86	1.736	1.538	0.886	88.8	
IRON	300	0	1.00	9.171	0.515	0.056	0.7	
LEAD	300	0	1.00	1.819	0.692	0.380	16.7	
LITHIUM	192	49	0.74	2.022	0.766	0.379	16.6	
MAGNESIUM	300	11	0.96	7.536	1.481	0.196	4.7	
MANGANESE	298	0	1.00	4.904	0.876	0.179	3.9	
MERCURY	294	221	0.25	-2.468	0.745	-0.302	10.6	
MOLYBDENUM	189	149	0.21	2.458	1.069	0.435	21.7	
NICKEL	298	53	0.82	1.848	1.713	0.927	97.3	
POTASSIUM	298	90	0.70	5.364	3.727	0.695	54.8	
SELENIUM	288	276	0.04	-1.258	0.781	-0.621	43.8	
SILICON	122	2	0.98	4.863	1.445	0.297	10.3	
SILVER	283	247	0.13	-0.770	1.248	-1.620	296.5	
SODIUM	298	148	0.50	2.806	3.619	1.289	187.9	
STRONTIUM	295	67	0.77	2.770	2.132	0.770	67.2	
THALLIUM	286	239	0.16	-1.001	1.051	-1.049	124.5	
TIN	194	153	0.21	2.999	0.735	0.245	7.1	
VANADIUM	300	8	0.97	3.008	0.808	0.269	8.5	
ZINC	300	1	1.00	3.201	0.739	0.231	6.4	

Note:
[1] The mean, standard deviation (STD) and coefficient of variance (CV) were calculated based on long-transformed data.

[2] Number of required records were calculated based on 80% confidence level, 90% power, 20% detectable relative difference and sample CV following EPAs guidance (EPA 1992).

Assessment of Data Precision-Sampling Variability
OU2 Subsurface Soil Total Radionuclides

ANALYTE	Number of Records	Number of Nondetects	Detection Frequency	Mean[1]	STD[1]	CV[1]	Number of Required Records[2]	REMARKS
AMERICIUM-241	267	0	1.00	-3.478	1.777	-0.511	29.8	
CESIUM-137	205	0	1.00	-2.216	0.842	-0.380	16.6	
GROSS ALPHA	248	0	1.00	2.910	1.055	0.362	15.2	
GROSS BETA	281	0	1.00	2.987	0.536	0.179	4.0	
PLUTONIUM-239,240	284	0	1.00	-2.890	2.219	-0.768	66.8	
RADIUM-226	139	0	1.00	-0.533	0.368	-0.691	54.2	
RADIUM-228	138	0	1.00	0.239	0.389	1.633	300.9	
STRONTIUM-89,90	234	0	1.00	-1.957	1.025	-0.524	31.3	
STRONTIUM-90	49	0	1.00	-1.945	0.838	-0.431	21.3	
TOTAL RADIOCESIUM	0	0						
TRITIUM	260	0	1.00	2.894	3.399	1.175	156.0	
URANIUM-233,234	272	0	1.00	-0.492	0.728	-1.480	247.4	
URANIUM-235	173	0	1.00	-3.115	0.896	-0.288	9.7	
URANIUM-238	279	0	1.00	-0.416	0.636	-1.531	264.7	

Note:
[1] The mean, standard deviation (STD) and coefficient of variance (CV) were calculated based on long-transformed data.

[2] Number of required records were calculated based on 80% confidence level, 90% power, 20% detectable relative difference and sample CV following EPAs guidance (EPA 1992).

Assessment of Data Precision-Sampling Variability
OU2 UHSU Groundwater Voilatile Organic Compounds

ANALYTE	Number of Records	Number of Nondetects	Detection Frequency	Mean[1]	STD[1]	CV[1]	Number of Required Records[2]	REMARKS
1,1,1,2-TETRACHLOROETHANE	283	275	0.03	-3.678	1.664	-0.452	23.4	
1,1,1-TRICHLOROETHANE	444	334	0.25	-1.111	2.752	-2.478	692.7	
1,1,2,2-TETRACHLOROETHANE	440	432	0.02	-1.937	2.607	-1.346	204.7	
1,1,2-TRICHLOROETHANE	445	438	0.02	-1.459	2.036	-1.395	219.9	
1,1-DICHLOROETHANE	447	388	0.13	-1.346	2.349	-1.745	343.9	
1,1-DICHLOROETHENE	442	326	0.26	-0.771	2.255	-2.926	965.6	
1,1-DICHLOROPROPENE	281	280	0.00	-3.538	1.159	-0.328	12.5	
1,2,3-TRICHLOROBENZENE	285	280	0.02	-2.954	0.867	-0.294	10.1	
1,2,3-TRICHLOROPROPANE	265	263	0.01	-3.279	1.485	-0.453	23.5	
1,2,4-TRICHLOROBENZENE	282	278	0.01	-2.727	0.858	-0.315	11.5	
1,2-DIBROMOETHANE	284	282	0.01	-2.291	0.435	-0.190	4.4	
1,2-DICHLOROBENZENE	285	285	0.00	-3.259	1.068	-0.328	12.5	
1,2-DICHLOROETHANE	444	436	0.02	-1.701	2.164	-1.272	182.9	
1,2-DICHLOROETHENE	152	100	0.34	1.577	1.292	0.819	76.1	
1,2-DICHLOROPROPANE	446	445	0.00	-1.698	2.177	-1.282	185.7	
1,3-DICHLOROBENZENE	284	280	0.01	-3.510	1.223	-0.348	14.0	
1,3-DICHLOROPROPANE	284	283	0.00	-3.409	1.257	-0.369	15.7	
1,4-DICHLOROBENZENE	285	283	0.01	-3.121	1.139	-0.365	15.4	
2,2-DICHLOROPROPANE	172	172	0.00	-2.747	0.697	-0.254	7.6	
2-BUTANONE	102	102	0.00	1.609	0.000	0.000		
2-HEXANONE	148	147	0.01	1.609	0.000	0.000		
4-METHYL-2-PENTANONE	159	157	0.01	1.604	0.139	0.087	1.2	
ACETONE	143	135	0.06	1.716	0.601	0.350	14.2	
BENZENE	448	428	0.04	-1.956	2.567	-1.312	194.6	
BENZENE, 1,2,4-TRIMETHYL	285	281	0.01	-3.320	1.343	-0.405	18.8	
BENZENE, 1,3,5-TRIMETHYL-	286	283	0.01	-3.319	0.996	-0.300	10.5	
BROMOBENZENE	283	280	0.01	-3.167	0.870	-0.275	8.9	
BROMOCHLOROMETHANE	269	264	0.02	-3.493	1.885	-0.540	33.2	
BROMODICHLOROMETHANE	441	416	0.06	-1.211	1.702	-1.405	223.0	
BROMOFORM	445	441	0.01	-1.177	1.752	-1.489	250.3	
BROMOMETHANE	387	386	0.00	-0.700	1.933	-2.761	860.1	
CARBON DISULFIDE	161	160	0.01	0.935	0.287	0.307	11.0	

Assessment of Data Precision-Sampling Variability
OU2 UHSU Groundwater Voilatile Organic Compounds

ANALYTE	Number of Records	Number of Nondetects	Detection Frequency	Mean[1]	STD[1]	CV[1]	Number of Required Records[2]	REMARKS
CARBON TETRACHLORIDE	434	173	0.60	1.769	3.646	2.061	479.5	
CHLOROBENZENE	444	439	0.01	-1.895	2.371	-1.251	176.9	
CHLOROETHANE	428	424	0.01	-0.802	1.990	-2.483	695.5	
CHLOROFORM	441	200	0.55	0.530	3.116	5.880	3900.0	
CHLOROMETHANE	411	406	0.01	-0.916	2.105	-2.299	596.6	
CUMENE	30	30	0.00	-4.391	0.817	-0.186	4.3	
DIBROMOCHLOROMETHANE	444	443	0.00	-1.433	1.970	-1.375	213.5	
DIBROMOMETHANE	248	247	0.00	-2.499	0.797	-0.319	11.8	
DICHLORODIFLUOROMETHANE	227	225	0.01	-1.771	0.287	-0.162	3.3	
ETHYLBENZENE	445	439	0.01	-1.672	2.110	-1.262	180.1	
HEXACHLOROBUTADIENE	283	278	0.02	-2.706	1.015	-0.375	16.2	
METHYLENE CHLORIDE	426	349	0.18	-0.784	2.762	-3.524	1401.4	
NAPHTHALENE	227	207	0.09	-2.684	1.636	-0.610	42.3	
cis-1,2-DICHLOROETHENE	284	157	0.45	-0.735	3.234	-4.402	2186.0	
cis-1,3-DICHLOROPROPENE	384	382	0.01	-1.408	2.144	-1.523	261.9	
m+p XYLENE	109	107	0.02	-4.547	0.432	-0.095	1.4	
m-XYLENE	124	121	0.02	-2.912	1.285	-0.441	22.3	
n-BUTYLBENZENE	284	280	0.01	-3.316	0.994	-0.300	10.5	
n-PROPYLBENZENE	284	284	0.00	-3.210	1.054	-0.328	12.5	
PROPANE, 1,2-DIBROMO-3-CHL	185	183	0.01	-1.997	0.470	-0.236	6.6	
STYRENE	445	437	0.02	-1.228	1.720	-1.400	221.5	
TETRACHLOROETHENE	440	142	0.68	1.804	3.184	1.765	351.6	
TOLUENE	447	402	0.10	-1.660	2.350	-1.416	226.5	
TOTAL XYLENES	221	219	0.01	0.199	1.302	6.550	4838.8	
TRICHLOROETHENE	436	169	0.61	1.473	3.418	2.320	607.2	
TRICHLOROFLUOROMETHANE	285	276	0.03	-2.057	0.552	-0.268	8.5	
VINYL ACETATE	139	139	0.00	1.609	0.000	0.000		
VINYL CHLORIDE	426	414	0.03	-1.570	3.003	-1.913	412.9	
o-CHLOROTOLUENE	284	283	0.00	-3.117	1.140	-0.366	15.4	
o-XYLENE	226	221	0.02	-3.567	1.386	-0.388	17.4	
p-CHLOROTOLUENE	285	284	0.00	-3.320	1.339	-0.403	18.7	
p-CYMENE	30	29	0.03	-4.305	0.921	-0.214	5.5	

Assessment of Data Precision-Sampling Variability
OU2 UHSU Groundwater Voilatile Organic Compounds

ANALYTE	Number of Records	Number of Nondetects	Detection Frequency	Mean[1]	STD[1]	CV[1]	Number of Required Records[2]	REMARKS
p-XYLENE	79	78	0.01	-2.027	0.421	-0.207	5.2	
sec-BUTYLBENZENE	283	273	0.04	-3.014	1.376	-0.456	23.9	
tert-BUTYLBENZENE	285	284	0.00	-2.757	0.805	-0.292	10.0	
trans-1,2-DICHLOROETHENE	297	274	0.08	-3.025	1.431	-0.473	25.6	
trans-1,3-DICHLOROPROPENE	381	379	0.01	-1.267	2.016	-1.592	286.1	

Note:
[1] The mean, standard deviation (STD) and coefficient of variance (CV) were calculated based on long-transformed data.

[2] Number of required records were calculated based on 80% confidence level, 90% power, 20% detectable relative difference and sample CV following EPAs guidance (EPA 1992).

Assessment of Data Precision-Sampling Variability
OU2 UHSU Groundwater Semivolatile Organic Compounds

ANALYTE	Number of Records	Number of Nondetects	Detection Frequency	Mean[1]	STD[1]	CV[1]	Number of Required Records[2]	REMARKS
1,2,4-TRICHLOROBENZENE	35	35	0.00	1.609	0.000	0.000		
1,2-DICHLOROBENZENE	35	35	0.00	1.609	0.000	0.000		
1,3-DICHLOROBENZENE	35	35	0.00	1.609	0.000	0.000		
1,4-DICHLOROBENZENE	35	35	0.00	1.609	0.000	0.000		
2,4,5-TRICHLOROPHENOL	35	35	0.00	3.219	0.000	0.000		
2,4,6-TRICHLOROPHENOL	35	35	0.00	1.609	0.000	0.000		
2,4-DICHLOROPHENOL	35	35	0.00	1.609	0.000	0.000		
2,4-DIMETHYLPHENOL	35	35	0.00	1.609	0.000	0.000		
2,4-DINITROPHENOL	29	29	0.00	3.219	0.000	0.000		
2,4-DINITROTOLUENE	35	35	0.00	1.609	0.000	0.000		
2,6-DINITROTOLUENE	35	35	0.00	1.609	0.000	0.000		
2-CHLORONAPHTHALENE	35	35	0.00	1.609	0.000	0.000		
2-CHLOROPHENOL	35	35	0.00	1.609	0.000	0.000		
2-METHYLNAPHTHALENE	35	35	0.00	1.609	0.000	0.000		
2-METHYLPHENOL	35	35	0.00	1.609	0.000	0.000		
2-NITROANILINE	35	35	0.00	3.219	0.000	0.000		
2-NITROPHENOL	35	35	0.00	1.609	0.000	0.000		
3,3'-DICHLOROBENZIDINE	32	32	0.00	2.303	0.000	0.000		
3-NITROANILINE	34	34	0.00	3.219	0.000	0.000		
4,6-DINITRO-2-METHYLPHENOL	35	35	0.00	3.219	0.000	0.000		
4-BROMOPHENYL PHENYL ETHER	6	6	0.00	1.609	0.000	0.000		
4-CHLORO-3-METHYLPHENOL	35	35	0.00	1.609	0.000	0.000		
4-CHLOROANILINE	32	32	0.00	1.609	0.000	0.000		
4-CHLOROPHENYL PHENYL ETHER	35	35	0.00	1.609	0.000	0.000		
4-METHYLPHENOL	30	30	0.00	1.609	0.000	0.000		
4-NITROANILINE	30	30	0.00	3.219	0.000	0.000		
4-NITROPHENOL	35	35	0.00	3.219	0.000	0.000		
ACENAPHTHENE	35	35	0.00	1.609	0.000	0.000		
ACENAPHTHYLENE	35	35	0.00	1.609	0.000	0.000		
ANTHRACENE	35	35	0.00	1.609	0.000	0.000		
BENZO(a)ANTHRACENE	35	35	0.00	1.609	0.000	0.000		
BENZO(a)PYRENE	35	35	0.00	1.609	0.000	0.000		

Assessment of Data Precision-Sampling Variability
OU2 UHSU Groundwater Semivolatile Organic Compounds

ANALYTE	Number of Records	Number of Nondetects	Detection Frequency	Mean[1]	STD[1]	CV[1]	Number of Required Records[2]	REMARKS
BENZO(b)FLUORANTHENE	35	35	0.00	1.609	0.000	0.000		
BENZO(ghi)PERYLENE	35	35	0.00	1.609	0.000	0.000		
BENZO(k)FLUORANTHENE	35	35	0.00	1.609	0.000	0.000		
BENZOIC ACID	33	32	0.03	3.243	0.140	0.043	0.6	
BENZYL ALCOHOL	35	35	0.00	1.609	0.000	0.000		
BIS(2-CHLOROETHOXY)METHANE	35	35	0.00	1.609	0.000	0.000		
BIS(2-CHLOROETHYL)ETHER	35	35	0.00	1.609	0.000	0.000		
BIS(2-CHLOROISOPROPYL)ETHER	32	32	0.00	1.609	0.000	0.000		
BIS(2-ETHYLHEXYL)PHTHALATE	35	25	0.29	1.622	0.335	0.206	5.2	
BUTYL BENZYL PHTHALATE	35	35	0.00	1.609	0.000	0.000		
CHRYSENE	35	35	0.00	1.609	0.000	0.000		
DI-n-BUTYL PHTHALATE	35	34	0.03	1.595	0.086	0.054	0.7	
DI-n-OCTYL PHTHALATE	35	35	0.00	1.609	0.000	0.000		
DIBENZO(a,h)ANTHRACENE	35	35	0.00	1.609	0.000	0.000		
DIBENZOFURAN	35	35	0.00	1.609	0.000	0.000		
DIETHYL PHTHALATE	35	31	0.11	1.733	0.738	0.426	20.8	
DIMETHYL PHTHALATE	35	35	0.00	1.609	0.000	0.000		
FLUORANTHENE	35	35	0.00	1.609	0.000	0.000		
FLUORENE	35	35	0.00	1.609	0.000	0.000		
HEXACHLOROBENZENE	35	35	0.00	1.609	0.000	0.000		
HEXACHLOROBUTADIENE	35	35	0.00	1.609	0.000	0.000		
HEXACHLOROCYCLOPENTADIENE	35	35	0.00	1.609	0.000	0.000		
HEXACHLOROETHANE	35	35	0.00	1.609	0.000	0.000		
INDENO(1,2,3-cd)PYRENE	35	35	0.00	1.609	0.000	0.000		
ISOPHORONE	35	35	0.00	1.609	0.000	0.000		
N-NITROSO-DI-n-PROPYLAMINE	35	35	0.00	1.609	0.000	0.000		
N-NITROSODIPHENYLAMINE	35	35	0.00	1.609	0.000	0.000		
NAPHTHALENE	35	35	0.00	1.609	0.000	0.000		
NITROBENZENE	35	35	0.00	1.609	0.000	0.000		
PENTACHLOROPHENOL	35	35	0.00	3.219	0.000	0.000		
PHENANTHRENE	35	35	0.00	1.609	0.000	0.000		
PHENOL	35	35	0.00	1.609	0.000	0.000		

Assessment of Data Precision-Sampling Variability
OU2 UHSU Groundwater Semivolatile Organic Compounds

ANALYTE	Number of Records	Number of Nondetects	Detection Frequency	Mean[1]	STD[1]	CV[1]	Number of Required Records[2]	REMARKS
PYRENE	35	35	0.00	1.609	0.000	0.000		
p-BROMODIPHENYL ETHER	29	29	0.00	1.609	0.000	0.000		

Note:
[1] The mean, standard deviation (STD) and coefficient of variance (CV) were calculated based on long-transformed data.

[2] Number of required records were calculated based on 80% confidence level, 90% power, 20% detectable relative difference and sample CV following EPAs guidance (EPA 1992).

Assessment of Data Precision-Sampling Variability
OU2 UHSU Groundwater Pesticides/PCBs

ANALYTE	Number of Records	Number of Nondetects	Detection Frequency	Mean[1]	STD[1]	CV[1]	Number of Required Records[2]	REMARKS
4,4'-DDD	35	35	0.00	-2.996	0.000	0.000		
4,4'-DDE	35	35	0.00	-2.996	0.000	0.000		
4,4'-DDT	35	35	0.00	-2.996	0.000	0.000		
ALDRIN	35	35	0.00	-3.689	0.000	0.000		
AROCLOR-1016	35	35	0.00	-1.386	0.000	0.000		
AROCLOR-1221	35	35	0.00	-1.386	0.000	0.000		
AROCLOR-1232	35	35	0.00	-1.386	0.000	0.000		
AROCLOR-1242	35	35	0.00	-1.386	0.000	0.000		
AROCLOR-1248	35	35	0.00	-1.386	0.000	0.000		
AROCLOR-1254	35	35	0.00	-0.693	0.000	0.000		
AROCLOR-1260	35	35	0.00	-0.693	0.000	0.000		
DIELDRIN	35	35	0.00	-2.996	0.000	0.000		
ENDOSULFAN I	35	35	0.00	-3.689	0.000	0.000		
ENDOSULFAN II	35	35	0.00	-2.996	0.000	0.000		
ENDOSULFAN SULFATE	35	35	0.00	-2.996	0.000	0.000		
ENDRIN	35	35	0.00	-2.996	0.000	0.000		
ENDRIN KETONE	35	35	0.00	-2.996	0.000	0.000		
HEPTACHLOR	35	35	0.00	-3.689	0.000	0.000		
HEPTACHLOR EPOXIDE	35	34	0.03	-3.662	0.162	-0.044	0.6	
METHOXYCHLOR	35	35	0.00	-1.386	0.000	0.000		
TOXAPHENE	35	35	0.00	-0.693	0.000	0.000		
alpha-BHC	35	35	0.00	-3.689	0.000	0.000		
alpha-CHLORDANE	35	35	0.00	-1.386	0.000	0.000		
beta-BHC	35	35	0.00	-3.689	0.000	0.000		
delta-BHC	35	35	0.00	-3.689	0.000	0.000		
gamma-BHC (LINDANE)	35	35	0.00	-3.689	0.000	0.000		
gamma-CHLORDANE	35	35	0.00	-1.386	0.000	0.000		

Note:
[1] The mean, standard deviation (STD) and coefficient of variance (CV) were calculated based on long-transformed data.

[2] Number of required records were calculated based on 80% confidence level, 90% power, 20% detectable relative difference and sample CV following EPAs guidance (EPA 1992).

Assessment of Data-Sampling Variability
OU2 UHSU Groundwater Filtered Metals

ANALYTE	Number of Records	Number of Nondetects	Detection Frequency	Mean[1]	STD[1]	CV[1]	Number of Required Records[2]	REMARKS
ALUMINUM	347	197	0.43	4.015	0.838	0.209	5.3	
ANTIMONY	345	291	0.16	3.129	0.601	0.192	4.5	
ARSENIC	346	311	0.10	1.085	0.916	0.844	80.7	
BARIUM	351	24	0.93	4.942	0.693	0.140	2.6	
BERYLLIUM	350	340	0.03	0.524	0.792	1.511	257.8	
CADMIUM	345	305	0.12	0.855	0.355	0.414	19.7	
CALCIUM	351	0	1.00	11.492	0.385	0.034	0.5	
CESIUM	300	289	0.04	5.974	0.459	0.077	1.0	
CHROMIUM	351	278	0.21	1.511	0.751	0.497	28.2	
COBALT	350	314	0.10	2.557	1.161	0.454	23.6	
COPPER	348	285	0.18	2.016	0.895	0.444	22.6	
IRON	343	209	0.39	3.800	1.136	0.299	10.4	
LEAD	347	326	0.06	0.313	0.461	1.474	245.4	
LITHIUM	346	102	0.71	2.898	1.153	0.398	18.2	
MAGNESIUM	351	0	1.00	9.588	0.543	0.057	0.7	
MANGANESE	350	95	0.73	3.322	2.120	0.638	46.3	
MERCURY	351	344	0.02	-2.285	0.124	-0.054	0.7	
MOLYBDENUM	337	253	0.25	3.627	1.365	0.376	16.3	
NICKEL	346	251	0.27	2.795	0.924	0.331	12.7	
POTASSIUM	350	43	0.88	7.618	0.664	0.087	1.2	
SELENIUM	351	235	0.33	0.956	1.048	1.096	135.8	
SILICON	221	0	1.00	8.884	0.159	0.018	0.4	
SILVER	345	320	0.07	1.309	0.586	0.448	23.0	
SODIUM	351	1	1.00	10.138	0.939	0.093	1.3	
STRONTIUM	351	0	1.00	6.289	0.475	0.076	1.0	
THALLIUM	351	339	0.03	1.151	0.840	0.730	60.4	
TIN	337	309	0.08	4.071	0.975	0.239	6.8	
VANADIUM	351	230	0.34	2.265	1.063	0.469	25.2	
ZINC	347	209	0.40	2.216	0.794	0.358	14.8	

Note:

[1] The mean, standard deviation (STD) and coefficient of variance (CV) were calculated based on long-transformed data.

[2] Number of required records were calculated based on 80% confidence level, 90% power, 20% detectable relative difference and sample CV following EPAs guidance (EPA 1992).

Assessment of Data Precision
OU2 UHSU Groundwater Filter Radionuclides

ANALYTE	Number of Records	Number of Nondetects	Detection Frequency	Mean[1]	STD[1]	CV[1]	Number of Required Records[2]	REMARKS
AMERICIUM-241	12	0	1.00	-3.598	2.625	-0.729	60.4	
CESIUM-137	13	0	1.00	-1.248	1.117	-0.895	90.6	
GROSS ALPHA	328	0	1.00	1.496	0.993	0.664	50.0	
GROSS BETA	346	0	1.00	1.484	0.805	0.543	33.6	
PLUTONIUM-239,240	15	0	1.00	-3.782	2.311	-0.611	42.5	
RADIUM-226	132	0	1.00	-0.879	0.636	-0.723	59.3	
STRONTIUM-89,90	285	0	1.00	-1.318	1.003	-0.761	65.6	
TOTAL RADIOCESIUM	78	0	1.00	-1.073	1.057	-0.984	109.6	
TRITIUM	0	0						
URANIUM-233,234	322	0	1.00	1.257	0.820	0.652	48.4	
URANIUM-235	322	0	1.00	-2.044	0.795	-0.389	17.4	
URANIUM-238	322	0	1.00	0.870	0.959	1.102	137.3	

Note:
[1] The mean, standard deviation (STD) and coefficient of variance (CV) were calculated based on long-transformed data.

[2] Number of required records were calculated based on 80% confidence level, 90% power, 20% detectable relative difference and sample CV following EPAs guidance (EPA 1992).

Assessment of Data Precision-Sampling Variability
OU2 UHSU Groundwater Total Metals

ANALYTE	Number of Records	Number of Nondetects	Detection Frequency	Mean[1]	STD[1]	CV[1]	Number of Required Records[2]	REMARKS
ALUMINUM	323	4	0.99	9.014	1.698	0.188	4.4	
ANTIMONY	304	236	0.22	3.351	0.553	0.165	3.4	
ARSENIC	296	118	0.60	1.193	0.668	0.560	35.7	
BARIUM	323	18	0.94	5.719	0.877	0.153	3.0	
BERYLLIUM	318	182	0.43	0.867	0.912	1.052	125.1	
CADMIUM	302	228	0.25	0.961	0.582	0.605	41.7	
CALCIUM	323	0	1.00	11.581	0.616	0.053	0.7	
CESIUM	282	276	0.02	5.992	0.444	0.074	1.0	
CHROMIUM	322	73	0.77	3.020	1.400	0.464	24.6	
COBALT	323	125	0.61	2.685	1.071	0.399	18.3	
COPPER	320	110	0.66	3.033	1.212	0.400	18.4	
IRON	323	1	1.00	9.251	1.666	0.180	4.0	
LEAD	321	22	0.93	2.340	1.324	0.566	36.5	
LITHIUM	322	44	0.86	3.252	0.951	0.292	10.0	
MAGNESIUM	323	0	1.00	9.826	0.612	0.062	0.8	
MANGANESE	323	4	0.99	5.626	1.493	0.265	8.3	
MERCURY	323	282	0.13	-2.104	0.586	-0.279	9.1	
MOLYBDENUM	319	240	0.25	3.624	1.383	0.381	16.8	
NICKEL	323	79	0.76	3.328	1.164	0.350	14.1	
POTASSIUM	323	30	0.91	8.423	0.864	0.103	1.5	
SELENIUM	305	206	0.32	1.027	0.981	0.954	103.1	
SILICON	218	0	1.00	10.219	0.869	0.085	1.2	
SILVER	310	273	0.12	1.322	0.614	0.465	24.7	
SODIUM	323	0	1.00	10.117	0.899	0.089	1.2	
STRONTIUM	321	0	1.00	6.425	0.516	0.080	1.1	
THALLIUM	323	282	0.13	1.116	0.813	0.729	60.2	
TIN	304	258	0.15	4.137	0.928	0.224	6.0	
VANADIUM	321	53	0.83	3.443	1.167	0.339	13.3	
ZINC	323	14	0.96	4.334	1.135	0.262	8.1	

Note:
[1] The mean, standard deviation (STD) and coefficient of variance (CV) were calculated based on long-transformed data.

[2] Number of required records were calculated based on 80% confidence level, 90% power, 20% detectable relative difference and sample CV following EPAs guidance (EPA 1992).

Assessment of Data Precision
OU2 UHSU Groundwater Total Radionuclides

ANALYTE	Number of Records	Number of Nondetects	Detection Frequency	Mean[1]	STD[1]	CV[1]	Number of Required Records[2]	REMARKS
CESIUM-137	186	0	1.00	-1.779	0.965	-0.542	33.5	
GROSS ALPHA	2	0	1.00	3.418	2.253	0.659	49.4	
GROSS BETA	2	0	1.00	3.454	0.648	0.188	4.3	
PLUTONIUM-239,240	294	0	1.00	-3.810	2.308	-0.606	41.8	
RADIUM-226	1	0	1.00	0.531				
STRONTIUM-89,90	15	0	1.00	-1.103	1.345	-1.219	168.0	
TOTAL RADIOCESIUM	7	0	1.00	-1.385	1.280	-0.924	96.6	
TRITIUM	407	0	1.00	3.640	2.804	0.770	67.3	
URANIUM-233,234	4	0	1.00	1.472	0.578	0.392	17.7	
URANIUM-235	4	0	1.00	-2.206	0.722	-0.327	12.4	
URANIUM-238	4	0	1.00	1.051	0.743	0.707	56.7	

Note:
[1] The mean, standard deviation (STD) and coefficient of variance (CV) were calculated based on long-transformed data.

[2] Number of required records were calculated based on 80% confidence level, 90% power, 20% detectable relative difference and sample CV following EPAs guidance (EPA 1992).

Table 5-16
Estimated Fraction of Produce Affected by Deposition

Produce Category	50th Percentile Homegrown g/day (1)		% Individuals Consuming (1)	Weighted Daily Intake Homegrown g/day
Raw vegetables				
White potatoes	7.4		74.4	5.5
Cabbage,coleslaw	3.2		9.7	0.3
Carrots	2.7		5	0.1
Cucumbers	9.1		5.6	0.5
Lettuce	1.3		50.7	0.7
Onions	0.7		8.5	0.1
Tomatoes	14.6		27.8	4.1
Cooked vegetables				
Broccoli	2.1		6.2	0.1
Cabbage	8.1		4.7	0.4
Carrots	4		9.8	0.4
Corn	60.9		25	15.2
Lima Beans	21.8		2.8	0.6
Mixed Veg	15.5	(2)	3.4	0.5
Peas	22	(2)	2.9	0.6
Green peas	14	(2)	18.3	2.6
Spinach	6.8		4.5	0.3
String beans	15.1		27.3	4.1
Summer squash	18	(2)	2.8	0.5
Sweet potatoes	6.7		4.1	0.3
Cucumber pickles	4.3		9.2	0.4
Total homegrown vegetable intake, g/day				37
Exposed vegetable intake, g/day				11
Ratio exposed/total				0.3
Fruits				
Grapefruit	10.1		4.7	0.47
Oranges	4.5		9	0.41
Apples	7.6		18.2	1.38
Applesauce	7.1		9.8	0.70
Cantaloupe	9.6		3.3	0.32
Peaches	15.1		4.5	0.68
Pears	15.7		3.1	0.49
Strawberries	12.3		2.1	0.26
Total homegrown fruit intake, g/day				4.70
Total exposed fruit intake, g/day				3.50
Ratio exposed/total				0.7454

(1) From Exposure Factors Handbook (EFH) (EPA 1989b), Table 2-10.

(2) Homegrown fraction is not available in EFH. Therefore, amount is estimated using 50th percentile total average daily intake from EFH Table 2-10 and assuming 50 percent is homegrown

TABLE 6.8-1
SUMMARY OF ESTIMATED HEALTH RISKS FOR AOC No. 1

Receptor/Exposure Pathway	Average Exposure		Reasonable Maximum Exposure	
	Carcinogenic Risk	Hazard Index	Carcinogenic Risk	Hazard Index
Current Industrial Worker				
-Ingestion of Surface Soil	2.6E-07	1.8E-04	1.0E-05	1.1E-03
-Inhalation of Particulates	***3.9E-07***		***3.1E-06***	
-Dermal Contact with Surface Soil	1.3E-08	1.4E-03	5.0E-07	9.0E-03
-External Irradiation from Surface Soil	9.8E-09		1.1E-07	
Total	***6.8E-07***	1.6E-03	1.4E-05	1.0E-02
Future Industrial/Office Worker				
-Ingestion of Surface Soil	7.7E-07	5.1E-04	6.1E-05	6.5E-03
-Inhalation of Particulates	***1.8E-06***		***1.8E-05***	
-Dermal Contact with Surface Soil	4.6E-08	5.2E-03	1.8E-06	3.3E-02
-Inhalation of VOCs from Infiltration of Soil Gas	1.6E-08	3.9E-12	1.7E-07	6.5E-12
-External Irradiation from Surface Soil	5.8E-08		6.5E-07	
Total	***2.6E-06***	5.7E-03	***8.2E-05***	3.9E-02
Future Ecological Worker				
-Ingestion of Surface Soil	9.4E-07	1.0E-03	3.4E-06	3.6E-03
-Inhalation of Particulates	***4.3E-07***		***8.1E-07***	
-Dermal Contact with Surface Soil	1.9E-08	3.4E-03	1.1E-07	1.9E-02
-Ingestion of Surface Water/Sediment	1.2E-10	3.3E-06	1.0E-09	2.8E-05
-Dermal Contact with Surface Water/Sediment	3.5E-09	1.6E-04	6.0E-09	2.7E-04
-External Irradiation from Surface Soil	1.7E-08		2.1E-08	
Total	***1.4E-06***	4.6E-03	***4.3E-06***	2.3E-02
Open Space Use				
-Ingestion of Surface Soil Child/Adult (Carcinogenic)	1.7E-07		8.8E-06	
-Ingestion of Surface Soil Child (Noncarcinogenic)		3.7E-04		6.1E-03
-Ingestion of Surface Soil Adult (Noncarcinogenic)		4.2E-05		6.5E-04
-Inhalation of Particulates	***5.0E-08***		***2.3E-06***	
-Dermal Contact with Surface Soil	7.4E-10	3.8E-05	2.7E-07	4.1E-03
-Ingestion of Surface Water/Sediment	3.9E-10	2.9E-06	1.6E-08	3.5E-05
-Dermal Contact with Surface Water/Sediment	2.2E-09	2.7E-05	8.9E-08	3.3E-04
-External Irradiation from Surface Soil	3.2E-09		6.5E-08	
Total	***2.3E-07***	4.7E-04	***1.2E-05***	1.1E-02
Future Construction Worker				
-Ingestion of Subsurface Soil	2.5E-08	3.1E-03	1.4E-07	1.7E-02
-Inhalation of Particulates	***1.2E-07***	***1.2E-10***	***1.5E-07***	***1.5E-10***
-Dermal Contact with Subsurface Soil	5.6E-09	7.5E-04	3.1E-08	4.2E-03
-External Irradiation from Subsurface Soil	1.2E-09		1.6E-09	
Total	***1.5E-07***	3.8E-03	***3.2E-07***	2.2E-02

TABLE 6.8-1
SUMMARY OF ESTIMATED HEALTH RISKS FOR AOC No. 1

Receptor/Exposure Pathway	Average Exposure		Reasonable Maximum Exposure	
	Carcinogenic Risk	Hazard Index	Carcinogenic Risk	Hazard Index
Hypothetical Resident				
-Ingestion of Surface Soil Child/Adult (Carcinogenic)	1.8E-05		2.5E-04	
-Ingestion of Surface Soil Child (Noncarcinogenic)		4.7E-02		1.7E-01
-Ingestion of Surface Soil Adult (Noncarcinogenic)		3.9E-03		1.8E-02
-Inhalation of Particulates	***8.8E-06***		***9.3E-05***	
-Dermal Contact with Surface Soils	7.4E-08	3.7E-03	7.7E-06	1.2E-01
-Ingestion of Groundwater	2.6E-04	2.0E+01	6.2E-03	1.4E+02
-Inhalation of VOCs from Infiltration of Soil Gas	8.1E-08	8.6E-12	6.4E-07	2.1E-11
-Inhalation of VOCs from Groundwater Use	1.5E-04	8.5E-05	1.2E-03	2.0E-04
-Ingestion of Garden Produce (Root Uptake)	1.1E-06	1.6E-02	1.3E-05	5.5E-02
-Ingestion of Garden Produce (Deposition)	1.4E-07	4.0E-05	3.3E-06	2.9E-04
-Ingestion of Surface Water/Sediment	3.1E-10	2.3E-06	1.9E-08	4.2E-05
-Dermal Contact with Surface Water/Sediment	8.9E-09	1.1E-04	2.1E-07	7.9E-04
-External Irradiation from Surface Soil	3.5E-07		3.7E-06	
Total	4.4E-04	2.0E+01	7.7E-03	1.4E+02

Notes:

Changes from draft final to final are shown in italics/bold
Chemical- and pathway specific results are detailed in Attachment H3.

TABLE 6.8-2
SUMMARY OF ESTIMATED HEALTH RISKS FOR MAXIMUM EXPOSURE AREAS

	Average Exposure		Reasonable Maximum Exposure	
Receptor/Exposure Pathway	**Carcinogenic Risk**	**Hazard Index**	**Carcinogenic Risk**	**Hazard Index**
Hypothetical Resident (10 Acres)				
-Ingestion of Surface Soil Child/Adult (Carcinogenic)	1.0E-05		1.4E-04	
-Ingestion of Surface Soil Child (Noncarcinogenic)		1.5E-04		5.4E-04
-Ingestion of Surface Soil Adult (Noncarcinogenic)		1.2E-05		5.8E-05
-Inhalation of Particulates	***3.5E-06***		***3.7E-05***	
-Dermal Contact with Surface Soils	2.2E-11	6.0E-07	2.2E-09	1.9E-05
-Ingestion of Groundwater	4.3E-04	2.3E+01	1.0E-02	1.6E+02
-Inhalation of VOCs from Infiltration of Soil Gas	1.3E-10	1.2E-09	1.1E-09	2.8E-09
-Inhalation of VOCs from Groundwater Use	5.7E-04	2.1E-02	4.5E-03	5.0E-02
-Ingestion of Garden Produce (Root Uptake)	9.2E-07	6.8E-04	1.0E-05	2.4E-03
-Ingestion of Garden Produce (Deposition)	5.5E-08	8.9E-08	1.3E-06	6.4E-07
-Ingestion of Surface Water/Sediment	3.1E-10	2.3E-06	1.9E-08	4.2E-05
-Dermal Contact with Surface Water/Sediment	8.9E-09	1.1E-04	2.1E-07	7.9E-04
-External Irradiation from Surface Soil	9.5E-07		1.0E-05	
Total	1.1E-03	2.3E+01	1.5E-02	1.6E+02
Future Industrial/Office Worker (30 Acres)				
-Ingestion of Surface Soil	1.7E-06	1.0E-03	1.4E-04	1.3E-02
-Inhalation of Particulates	***3.4E-06***		***3.5E-05***	
-Dermal Contact with Surface Soil	9.0E-08	1.0E-02	3.6E-06	6.5E-02
-Inhalation of VOCs from Infiltration of Soil Gas	5.7E-11	1.1E-09	5.9E-10	1.8E-09
-External Irradiation from Surface Soil	1.4E-07		1.5E-06	
Total	***5.3E-06***	1.1E-02	***1.8E-04***	7.8E-02
Future Ecological Worker (50 Acres)				
-Ingestion of Surface Soil	1.5E-06	1.7E-03	5.2E-06	6.1E-03
-Inhalation of Particulates	***6.0E-07***		***1.1E-06***	
-Dermal Contact with Surface Soil	3.2E-08	5.8E-03	1.8E-07	3.2E-02
-Ingestion of Surface Water/Sediment	1.2E-10	3.3E-06	1.0E-09	2.8E-05
-Dermal Contact with Surface Water/Sediment	3.4E-09	1.4E-04	5.9E-09	2.6E-04
-External Irradiation from Surface Soil	3.4E-08		4.2E-08	
Total	***2.1E-06***	7.6E-03	***6.5E-06***	3.9E-02

Notes:

Changes from draft final to final are shown in italics/bold
Chemical- and pathway specific results are detailed in Attachment H3.

TABLE 6.8-3
SUMMARY OF ESTIMATED HEALTH RISKS FOR AOC NO. 2

Receptor/Exposure Pathway	Average Exposure		Reasonable Maximum Exposure	
	Carcinogenic Risk	Hazard Index	Carcinogenic Risk	Hazard Index
Current Industrial Worker				
-Ingestion of Surface Soil	3.7E-09	2.4E-07	1.5E-07	1.6E-06
-Inhalation of Particulates	***5.8E-09***		***4.6E-08***	
-Dermal Contact with Surface Soil	7.9E-13	4.9E-08	3.1E-11	3.1E-07
-External Irradiation from Surface Soil	4.6E-10		5.2E-09	
Total	***9.9E-09***	2.9E-07	***2.0E-07***	1.9E-06
Future Industrial/Office Worker				
-Ingestion of Surface Soil	1.1E-08	7.2E-07	8.5E-07	9.1E-06
-Inhalation of Particulates	***2.6E-08***		***2.7E-07***	
-Dermal Contact with Surface Soil	2.9E-12	1.8E-07	1.1E-10	1.1E-06
-Inhalation of Basement Vapors	1.1E-14	8.5E-12	1.1E-13	1.4E-11
-External Irradiation from Surface Soil	2.7E-09		3.1E-08	
Total	***3.9E-08***	9.0E-07	***1.2E-06***	1.0E-05
Future Ecological Worker				
-Ingestion of Surface Soil	1.3E-08	1.4E-06	4.7E-08	5.0E-06
-Inhalation of Particulates	***6.3E-09***		***1.2E-08***	
-Dermal Contact with Surface Soil	1.2E-12	1.2E-07	6.6E-12	6.6E-07
-Ingestion of Surface Water/Sediment	1.2E-10	3.3E-06	1.0E-09	2.8E-05
-Dermal Contact with Surface Water/Sediment	3.5E-09	1.6E-04	6.0E-09	2.7E-04
-External Irradiation from Surface Soil	8.2E-10		1.0E-09	
Total	***2.4E-08***	1.6E-04	***6.7E-08***	3.0E-04
Open Space Use				
-Ingestion of Surface Soil Child/Adult (Carcinogenic)	2.3E-09		1.2E-07	
-Ingestion of Surface Soil Child (Noncarcinogenic)		5.1E-07		8.5E-06
-Ingestion of Surface Soil Adult (Noncarcinogenic)		5.8E-08		9.1E-07
-Dermal Contact with Surface Soil	4.7E-14	1.3E-09	1.7E-11	1.4E-07
-Inhalation of Particulates	***7.3E-10***		***3.4E-08***	
-Ingestion of Surface Water/Sediment	3.9E-10	2.9E-06	1.6E-08	3.5E-05
-Dermal Contact with Surface Water/Sediment	2.2E-09	2.7E-05	8.9E-08	3.3E-04
-External Irradiation from Surface Soil	1.5E-10		3.0E-09	
Total	***5.8E-09***	3.1E-05	2.6E-07	3.8E-04
Future Construction Worker				
-Ingestion of Subsurface Soil	2.5E-08	3.2E-03	1.4E-07	1.8E-02
-Inhalation of Particulates	***1.8E-09***		***2.2E-09***	
-External Irradiation from Subsurface Soil	1.5E-09		1.9E-09	
Total	2.8E-08	3.2E-03	1.4E-07	1.8E-02

TABLE 6.8-3
SUMMARY OF ESTIMATED HEALTH RISKS FOR AOC NO. 2

Receptor/Exposure Pathway	Average Exposure		Reasonable Maximum Exposure	
	Carcinogenic Risk	Hazard Index	Carcinogenic Risk	Hazard Index
Hypothetical Resident				
-Ingestion of Surface Soil Child/Adult (Carcinogenic)	2.5E-07		3.4E-06	
-Ingestion of Surface Soil Child (Noncarcinogenic)		6.5E-05		2.4E-04
-Ingestion of Surface Soil Adult (Noncarcinogenic)		5.5E-06		2.6E-05
-Inhalation of Particulates	***1.3E-07***		***1.4E-06***	
-Dermal Contact with Surface Soils	4.6E-12	1.3E-07	4.8E-10	4.0E-06
-Ingestion of Groundwater	3.1E-07	6.0E-04	7.4E-06	4.3E-03
-Inhalation of VOCs from Infiltration of Soil Gas	5.6E-14	1.9E-11	4.5E-13	4.5E-11
-Inhalation of VOCs from Groundwater Use	3.1E-08	2.0E-05	2.5E-07	4.9E-05
-Ingestion of Garden Produce (Root Uptake)	2.0E-08	1.5E-04	2.0E-07	5.4E-04
-Ingestion of Garden Produce (Deposition)	2.0E-09	6.0E-08	4.9E-08	4.3E-07
-Ingestion of Surface Water/Sediment	3.1E-10	2.3E-06	1.9E-08	4.2E-05
-Dermal Contact with Surface Water/Sediment	8.9E-09	1.1E-04	2.1E-07	7.9E-04
-External Irradiation from Surface Soil	1.6E-08		1.7E-07	
Total	***7.6E-07***	9.6E-04	***1.3E-05***	6.0E-03

Notes:

Changes from draft final to final are shown in italics/bold
Chemical- and pathway specific results are detailed in Attachment H3.

TABLE 6.8-4
SUMMARY OF ESTIMATED HEALTH RISKS FOR OFFSITE RESIDENTS

Receptor/Exposure Pathway	Average Exposure		Reasonable Maximum Exposure	
	Carcinogenic Risk	Hazard Index	Carcinogenic Risk	Hazard Index
AOC No. 1, Current Resident, Southeast				
-Ingestion of Surface Soil Child/Adult (Carcinogenic)	0 [1]		0	
-Ingestion of Surface Soil Child (Noncarcinogenic)		0		0
-Ingestion of Surface Soil Adult (Noncarcinogenic)		0		0
-Inhalation of Particulates	*1.4E-09*	0	*1.5E-08*	0
-Dermal Contact with Surface Soil	0	0	0	0
-Ingestion of Garden Produce (Deposition)	0	0	0	0
Total	*1.4E-09*	0	*1.5E-08*	0
AOC No. 1, Current Resident, Indiana South				
-Ingestion of Surface Soil Child/Adult (Carcinogenic)	0		0	
-Ingestion of Surface Soil Child (Noncarcinogenic)		0		0
-Ingestion of Surface Soil Adult (Noncarcinogenic)		0		0
-Inhalation of Particulates	0	0	0	0
-Dermal Contact with Surface Soils	0	0	0	0
-Ingestion of Garden Produce (Deposition)	0	0	0	0
Total	0	0	0	0
AOC No. 1, Future Resident, Walnut				
-Ingestion of Surface Soil Child/Adult (Carcinogenic)	0		0	
-Ingestion of Surface Soil Child (Noncarcinogenic)		0		0
-Ingestion of Surface Soil Adult (Noncarcinogenic)		0		0
-Inhalation of Particulates	0	0	0	0
-Dermal Contact with Surface Soil	0	0	0	0
-Ingestion of Garden Produce (Deposition)	0	0	0	0
-Ingestion of Surface Water/Sediment	4.8E-11	1.5E-06	2.9E-9	2.8E-05
-Dermal Contact with Surface Water/Sediment	7.7E-09	8.4E-05	1.8E-07	5.9E-04
Total	7.7E-09	8.5E-05	1.8E-07	6.2E-04
AOC No. 1, Future Resident, Woman				
-Ingestion of Surface Soil Child/Adult (Carcinogenic)	0		0	
-Ingestion of Surface Soil Child (Noncarcinogenic)		0		0
-Ingestion of Surface Soil Adult (Noncarcinogenic)		0		0
-Inhalation of Particulates	*8.3E-10*	0	*8.7E-09*	0
-Dermal Contact with Surface Soil	0	0	0	0
-Ingestion of Garden Produce (Deposition)	0	0	0	0
-Ingestion of Surface Water/Sediment	2.7E-10	8.0E-07	1.6E-08	1.5E-05
-Dermal Contact with Surface Water/Sediment	1.3E-09	2.8E-05	3.1E-08	2.0E-04
Total	*2.4E-09*	2.9E-05	*5.5E-08*	2.1E-04

[1] Hazard/risk estimates reported as 0 indicate that no air or depositional impacts were predicted by air modeling (see Section H5.5.2).

TABLE 6.8-4
SUMMARY OF ESTIMATED HEALTH RISKS FOR OFFSITE RESIDENTS

Receptor/Exposure Pathway	Average Exposure Carcinogenic Risk	Average Exposure Hazard Index	Reasonable Maximum Exposure Carcinogenic Risk	Reasonable Maximum Exposure Hazard Index
AOC No. 2, Current Resident, Southeast				
-Ingestion of Surface Soil Child/Adult (Carcinogenic)	1.2E-13		1.7E-12	
-Ingestion of Surface Soil Child (Noncarcinogenic)		3.3E-11		1.2E-10
-Ingestion of Surface Soil Adult (Noncarcinogenic)		2.8E-12		1.3E-11
-Inhalation of Particulates	***5.7E-11***	0	***6.0E-10***	0
-Dermal Contact with Surface Soil	2.4E-18	6.5E-14	2.4E-16	2.0E-12
-Ingestion of Garden Produce (Deposition)	2.6E-12	7.9E-11	6.3E-11	5.7E-10
Total	***6.0E-11***	1.1E-10	***6.7E-10***	7.0E-10
AOC No. 2, Current Resident, Indiana South				
-Ingestion of Surface Soil Child/Adult (Carcinogenic)	0		0	
-Ingestion of Surface Soil Child (Noncarcinogenic)		0		0
-Ingestion of Surface Soil Adult (Noncarcinogenic)		0		0
-Inhalation of Particulates	***8.6E-13***	0	***9.1E-12***	0
-Dermal Contact with Surface Soils	0	0	0	0
-Ingestion of Garden Produce (Deposition)	0	0	0	0
Total	***8.6E-13***	0	***9.1E-12***	0
AOC No. 2, Future Resident, Walnut				
-Ingestion of Surface Soil Child/Adult (Carcinogenic)	0		0.0E+00	
-Ingestion of Surface Soil Child (Noncarcinogenic)		0		0
-Ingestion of Surface Soil Adult (Noncarcinogenic)		0		0
-Inhalation of Particulates	***2.6E-12***	0	***2.7E-11***	0
-Dermal Contact with Surface Soil	0	0	0	0
-Ingestion of Garden Produce (Deposition)	0	0	0	0
-Ingestion of Surface Water/Sediment	4.8E-11	1.5E-06	2.9E-09	2.8E-05
-Dermal Contact with Surface Water/Sediment	7.6E-09	8.4E-05	1.8E-07	6.0E-04
Total	7.7E-09	8.5E-05	1.8E-07	6.2E-04
AOC No. 2, Future Resident, Woman				
-Ingestion of Surface Soil Child/Adult (Carcinogenic)	1.2E-13		1.7E-12	
-Ingestion of Surface Soil Child (Noncarcinogenic)		3.3E-11		1.2E-10
-Ingestion of Surface Soil Adult (Noncarcinogenic)		2.8E-12		1.3E-11
-Inhalation of Particulates	***3.2E-11***	0	***3.4E-10***	0
-Dermal Contact with Surface Soil	2.4E-18	6.5E-14	2.4E-16	2.0E-12
-Ingestion of Garden Produce (Deposition)	2.6E-12	7.9E-11	6.3E-11	5.7E-10
-Ingestion of Surface Water/Sediment	2.7E-10	8.0E-07	1.6E-08	1.5E-05
-Dermal Contact with Surface Water/Sediment	1.3E-09	2.8E-05	3.1E-08	2.0E-04
Total	1.6E-09	2.9E-05	4.7E-08	2.1E-04

Notes:

Changes from draft final to final are shown in italics/bold
Chemical- and pathway-specific results are detailed in Attachment H3.

TABLE 6.9-2
SUMMARY OF ESTIMATED ANNUAL RADIATION DOSE FOR ONSITE RECEPTORS

Receptor/Exposure Pathway	Average Exposure (mrem/year)	Reasonable Maximum Exposure (mrem/year)
Current Worker		
-AOC No. 1	***1.0E+00***	***1.7E+00***
-AOC No. 2	***2.1E-02***	***4.0E-02***
Future Industrial/Office Worker		
-AOC No. 1	***4.8E+00***	***9.8E+00***
-30-Acre Maximum Exposure Area in AOC No. 1	***9.6E+00***	***2.0E+01***
-AOC No. 2	***1.0E-01***	***2.4E-01***
Future Ecological Worker		
-AOC No. 1	***2.2E+00***	***4.3E+00***
-50-Acre Maximum Exposure Area in AOC No. 1	***3.4E+00***	***6.8E+00***
-AOC No. 2	***5.2E-02***	***1.1E-01***
Future Open Space Use		
-AOC No. 1	***8.5E-02***	***1.0E+00***
-AOC No. 2	***2.3E-03***	***2.5E-02***
Future Construction Worker		
-AOC No. 1	***1.0E+00***	***1.3E+00***
-AOC No. 2	***3.1E-02***	***7.5E-02***
Future Resident		
-AOC No. 1	***1.3E+01***	***4.2E+01***
-10-Acre Maximum Exposure Area in AOC No. 1	***1.7E+01***	***6.7E+01***
-AOC No. 2	***3.9E-01***	1.6E+00

Notes:

Changes from draft final to final are shown in italics/bold
Dose calculations are detailed in Attachment H4

TABLE 6.9-3
SUMMARY OF ESTIMATED ANNUAL RADIATION DOSE FOR OFFSITE RECEPTORS

Receptor/Exposure Pathway	Average Exposure (mrem/year)	Reasonable Maximum Exposure (mrem/year)
Current Resident, Southeast		
-AOC No. 1	***1.3E-03***	***4.0E-03***
-AOC No. 2	***5.6E-05***	***1.8E-04***
Current Resident, Indiana South		
-AOC No. 1	0 [1]	0
-AOC No. 2	***8.4E-07***	***2.6E-06***
Future Resident, Walnut Cr./Indiana		
-AOC No. 1	9.7E-07	1.8E-05
-AOC No. 2	***3.5E-06***	***2.6E-05***
Future Resident, Woman Cr./Indiana		
-AOC No. 1	***7.8E-04***	***2.7E-03***
-AOC No. 2	***4.9E-05***	***4.2E-04***

Notes:

Changes from draft final to final are shown in italics/bold
Dose calculations are detailed in Attachment H4

[1] Radiation dose estimates reported as 0 indicate that no air or depositional impacts were predicted by air modeling. (See Section H5.5.2 in Appendix H.)

TABLE ES-1*
SUMMARY OF ESTIMATED HEALTH RISKS

	Average Exposure (CT)		Reasonable Maximum Exposure (RME)	
	Carcinogenic Risk	Hazard Index	Carcinogenic Risk	Hazard Index
AOC No. 1**				
Current Worker	***7E-07***	2E-03	1E-05	1E-02
Future Industrial/Officer Worker	***3E-06***	6E-03	8E-05	4E-02
Future Ecological Worker	1E-06	5E-03	4E-06	2E-02
Future Open Space Use	2E-07	5E-04	1E-05	1E-02
Future Construction Worker	***2E-07***	4E-03	3E-07	2E-02
Hypothetical Resident	4E-04	2E+01	8E-03	1E+02
Maximum Exposure Areas				
Hypothetical Resident (10 Acres)	1E-03	2E+01	2E-02	2E+02
Future Industrial/Officer Worker (30 Acres)	5E-06	1E-02	2E-04	8E-02
Future Ecological Worker (50 Acres)	2E-06	8E-03	***7E-06***	4E-02
AOC No. 2**				
Current Worker	***1E-08***	3E-07	2E-07	2E-06
Future Industrial/Officer Worker	4E-08	9E-07	1E-06	1E-05
Future Ecological Worker	2E-08	2E-04	7E-08	3E-04
Future Open Space Use	6E-09	3E-05	3E-07	4E-04
Future Construction Worker	3E-08	3E-03	1E-07	2E-02
Hypothetical Resident	8E-07	1E-03	1E-05	6E-03
Offsite Receptors***				
Current Resident, Southeast	1E-09	0	***2E-08***	0
Current Resident, Indiana South	***9E-13***	0	***9E-12***	0
Future Resident, Walnut Cr./Indiana	8E-09	9E-05	2E-07	6E-04
Future Resident, Woman Cr./Indiana	2E-09	3E-05	***6E-08***	2E-04

Note: Changes from draft final to final are shown in italics/bold

* Same as Table H11-1.

** Area of concern boundaries are illustrated in Figure H2-1.

*** Results shown correspond to the higher of estimated air impacts from AOC No. 1 and AOC No. 2.

CT = Central Tendency

RME = Reasonable Maximum Exposure

TABLE H8-1
SUMMARY OF ESTIMATED HEALTH RISKS FOR AOC No. 1

Receptor/Exposure Pathway	Average Exposure		Reasonable Maximum Exposure	
	Carcinogenic Risk	Hazard Index	Carcinogenic Risk	Hazard Index
Current Industrial Worker				
-Ingestion of Surface Soil	2.6E-07	1.8E-04	1.0E-05	1.1E-03
-Inhalation of Particulates	***3.9E-07***		***3.1E-06***	
-Dermal Contact with Surface Soil	1.3E-08	1.4E-03	5.0E-07	9.0E-03
-External Irradiation from Surface Soil	9.8E-09		1.1E-07	
Total	***6.8E-07***	1.6E-03	1.4E-05	1.0E-02
Future Industrial/Office Worker				
-Ingestion of Surface Soil	7.7E-07	5.1E-04	6.1E-05	6.5E-03
-Inhalation of Particulates	***1.8E-06***		***1.8E-05***	
-Dermal Contact with Surface Soil	4.6E-08	5.2E-03	1.8E-06	3.3E-02
-Inhalation of VOCs from Infiltration of Soil Gas	1.6E-08	3.9E-12	1.7E-07	6.5E-12
-External Irradiation from Surface Soil	5.8E-08		6.5E-07	
Total	***2.6E-06***	5.7E-03	***8.2E-05***	3.9E-02
Future Ecological Worker				
-Ingestion of Surface Soil	9.4E-07	1.0E-03	3.4E-06	3.6E-03
-Inhalation of Particulates	***4.3E-07***		***8.1E-07***	
-Dermal Contact with Surface Soil	1.9E-08	3.4E-03	1.1E-07	1.9E-02
-Ingestion of Surface Water/Sediment	1.2E-10	3.3E-06	1.0E-09	2.8E-05
-Dermal Contact with Surface Water/Sediment	3.5E-09	1.6E-04	6.0E-09	2.7E-04
-External Irradiation from Surface Soil	1.7E-08		2.1E-08	
Total	***1.4E-06***	4.6E-03	***4.3E-06***	2.3E-02
Open Space Use				
-Ingestion of Surface Soil Child/Adult (Carcinogenic)	1.7E-07		8.8E-06	
-Ingestion of Surface Soil Child (Noncarcinogenic)		3.7E-04		6.1E-03
-Ingestion of Surface Soil Adult (Noncarcinogenic)		4.2E-05		6.5E-04
-Inhalation of Particulates	***5.0E-08***		***2.3E-06***	
-Dermal Contact with Surface Soil	7.4E-10	3.8E-05	2.7E-07	4.1E-03
-Ingestion of Surface Water/Sediment	3.9E-10	2.9E-06	1.6E-08	3.5E-05
-Dermal Contact with Surface Water/Sediment	2.2E-09	2.7E-05	8.9E-08	3.3E-04
-External Irradiation from Surface Soil	3.2E-09		6.5E-08	
Total	***2.3E-07***	4.7E-04	***1.2E-05***	1.1E-02
Future Construction Worker				
-Ingestion of Subsurface Soil	2.5E-08	3.1E-03	1.4E-07	1.7E-02
-Inhalation of Particulates	***1.2E-07***	***1.2E-10***	***1.5E-07***	***1.5E-10***
-Dermal Contact with Subsurface Soil	5.6E-09	7.5E-04	3.1E-08	4.2E-03
-External Irradiation from Subsurface Soil	1.2E-09		1.6E-09	
Total	***1.5E-07***	3.8E-03	***3.2E-07***	2.2E-02

TABLE H8-1
SUMMARY OF ESTIMATED HEALTH RISKS FOR AOC No. 1

Receptor/Exposure Pathway	Average Exposure		Reasonable Maximum Exposure	
	Carcinogenic Risk	Hazard Index	Carcinogenic Risk	Hazard Index
Hypothetical Resident				
-Ingestion of Surface Soil Child/Adult (Carcinogenic)	1.8E-05		2.5E-04	
-Ingestion of Surface Soil Child (Noncarcinogenic)		4.7E-02		1.7E-01
-Ingestion of Surface Soil Adult (Noncarcinogenic)		3.9E-03		1.8E-02
-Inhalation of Particulates	***8.8E-06***		***9.3E-05***	
-Dermal Contact with Surface Soils	7.4E-08	3.7E-03	7.7E-06	1.2E-01
-Ingestion of Groundwater	2.6E-04	2.0E+01	6.2E-03	1.4E+02
-Inhalation of VOCs from Infiltration of Soil Gas	8.1E-08	8.6E-12	6.4E-07	2.1E-11
-Inhalation of VOCs from Groundwater Use	1.5E-04	8.5E-05	1.2E-03	2.0E-04
-Ingestion of Garden Produce (Root Uptake)	1.1E-06	1.6E-02	1.3E-05	5.5E-02
-Ingestion of Garden Produce (Deposition)	1.4E-07	4.0E-05	3.3E-06	2.9E-04
-Ingestion of Surface Water/Sediment	3.1E-10	2.3E-06	1.9E-08	4.2E-05
-Dermal Contact with Surface Water/Sediment	8.9E-09	1.1E-04	2.1E-07	7.9E-04
-External Irradiation from Surface Soil	3.5E-07		3.7E-06	
Total	4.4E-04	2.0E+01	7.7E-03	1.4E+02

Notes:

Changes from draft final to final are shown in italics/bold
Chemical- and pathway specific results are detailed in Attachment H3.

TABLE H8-2
SUMMARY OF ESTIMATED HEALTH RISKS FOR MAXIMUM EXPOSURE AREAS

	Average Exposure		Reasonable Maximum Exposure	
Receptor/Exposure Pathway	**Carcinogenic Risk**	**Hazard Index**	**Carcinogenic Risk**	**Hazard Index**
Hypothetical Resident (10 Acres)				
-Ingestion of Surface Soil Child/Adult (Carcinogenic)	1.0E-05		1.4E-04	
-Ingestion of Surface Soil Child (Noncarcinogenic)		1.5E-04		5.4E-04
-Ingestion of Surface Soil Adult (Noncarcinogenic)		1.2E-05		5.8E-05
-Inhalation of Particulates	***3.5E-06***		***3.7E-05***	
-Dermal Contact with Surface Soils	2.2E-11	6.0E-07	2.2E-09	1.9E-05
-Ingestion of Groundwater	4.3E-04	2.3E+01	1.0E-02	1.6E+02
-Inhalation of VOCs from Infiltration of Soil Gas	1.3E-10	1.2E-09	1.1E-09	2.8E-09
-Inhalation of VOCs from Groundwater Use	5.7E-04	2.1E-02	4.5E-03	5.0E-02
-Ingestion of Garden Produce (Root Uptake)	9.2E-07	6.8E-04	1.0E-05	2.4E-03
-Ingestion of Garden Produce (Deposition)	5.5E-08	8.9E-08	1.3E-06	6.4E-07
-Ingestion of Surface Water/Sediment	3.1E-10	2.3E-06	1.9E-08	4.2E-05
-Dermal Contact with Surface Water/Sediment	8.9E-09	1.1E-04	2.1E-07	7.9E-04
-External Irradiation from Surface Soil	9.5E-07		1.0E-05	
Total	1.1E-03	2.3E+01	1.5E-02	1.6E+02
Future Industrial/Office Worker (30 Acres)				
-Ingestion of Surface Soil	1.7E-06	1.0E-03	1.4E-04	1.3E-02
-Inhalation of Particulates	***3.4E-06***		***3.5E-05***	
-Dermal Contact with Surface Soil	9.0E-08	1.0E-02	3.6E-06	6.5E-02
-Inhalation of VOCs from Infiltration of Soil Gas	5.7E-11	1.1E-09	5.9E-10	1.8E-09
-External Irradiation from Surface Soil	1.4E-07		1.5E-06	
Total	***5.3E-06***	1.1E-02	***1.8E-04***	7.8E-02
Future Ecological Worker (50 Acres)				
-Ingestion of Surface Soil	1.5E-06	1.7E-03	5.2E-06	6.1E-03
-Inhalation of Particulates	***6.0E-07***		***1.1E-06***	
-Dermal Contact with Surface Soil	3.2E-08	5.8E-03	1.8E-07	3.2E-02
-Ingestion of Surface Water/Sediment	1.2E-10	3.3E-06	1.0E-09	2.8E-05
-Dermal Contact with Surface Water/Sediment	3.4E-09	1.4E-04	5.9E-09	2.6E-04
-External Irradiation from Surface Soil	3.4E-08		4.2E-08	
Total	***2.1E-06***	7.6E-03	***6.5E-06***	3.9E-02

Notes:

Changes from draft final to final are shown in italics/bold
Chemical- and pathway specific results are detailed in Attachment H3.

TABLE H8-3
SUMMARY OF ESTIMATED HEALTH RISKS FOR AOC NO. 2

Receptor/Exposure Pathway	Average Exposure		Reasonable Maximum Exposure	
	Carcinogenic Risk	Hazard Index	Carcinogenic Risk	Hazard Index
Current Industrial Worker				
-Ingestion of Surface Soil	3.7E-09	2.4E-07	1.5E-07	1.6E-06
-Inhalation of Particulates	***5.8E-09***		***4.6E-08***	
-Dermal Contact with Surface Soil	7.9E-13	4.9E-08	3.1E-11	3.1E-07
-External Irradiation from Surface Soil	4.6E-10		5.2E-09	
Total	***9.9E-09***	2.9E-07	***2.0E-07***	1.9E-06
Future Industrial/Office Worker				
-Ingestion of Surface Soil	1.1E-08	7.2E-07	8.5E-07	9.1E-06
-Inhalation of Particulates	***2.6E-08***		***2.7E-07***	
-Dermal Contact with Surface Soil	2.9E-12	1.8E-07	1.1E-10	1.1E-06
-Inhalation of Basement Vapors	1.1E-14	8.5E-12	1.1E-13	1.4E-11
-External Irradiation from Surface Soil	2.7E-09		3.1E-08	
Total	***3.9E-08***	9.0E-07	***1.2E-06***	1.0E-05
Future Ecological Worker				
-Ingestion of Surface Soil	1.3E-08	1.4E-06	4.7E-08	5.0E-06
-Inhalation of Particulates	***6.3E-09***		***1.2E-08***	
-Dermal Contact with Surface Soil	1.2E-12	1.2E-07	6.6E-12	6.6E-07
-Ingestion of Surface Water/Sediment	1.2E-10	3.3E-06	1.0E-09	2.8E-05
-Dermal Contact with Surface Water/Sediment	3.5E-09	1.6E-04	6.0E-09	2.7E-04
-External Irradiation from Surface Soil	8.2E-10		1.0E-09	
Total	***2.4E-08***	1.6E-04	***6.7E-08***	3.0E-04
Open Space Use				
-Ingestion of Surface Soil Child/Adult (Carcinogenic)	2.3E-09		1.2E-07	
-Ingestion of Surface Soil Child (Noncarcinogenic)		5.1E-07		8.5E-06
-Ingestion of Surface Soil Adult (Noncarcinogenic)		5.8E-08		9.1E-07
-Dermal Contact with Surface Soil	4.7E-14	1.3E-09	1.7E-11	1.4E-07
-Inhalation of Particulates	***7.3E-10***		***3.4E-08***	
-Ingestion of Surface Water/Sediment	3.9E-10	2.9E-06	1.6E-08	3.5E-05
-Dermal Contact with Surface Water/Sediment	2.2E-09	2.7E-05	8.9E-08	3.3E-04
-External Irradiation from Surface Soil	1.5E-10		3.0E-09	
Total	***5.8E-09***	3.1E-05	2.6E-07	3.8E-04
Future Construction Worker				
-Ingestion of Subsurface Soil	2.5E-08	3.2E-03	1.4E-07	1.8E-02
-Inhalation of Particulates	***1.8E-09***		***2.2E-09***	
-External Irradiation from Subsurface Soil	1.5E-09		1.9E-09	
Total	2.8E-08	3.2E-03	1.4E-07	1.8E-02

TABLE H8-3
SUMMARY OF ESTIMATED HEALTH RISKS FOR AOC NO. 2

Receptor/Exposure Pathway	Average Exposure		Reasonable Maximum Exposure	
	Carcinogenic Risk	Hazard Index	Carcinogenic Risk	Hazard Index
Hypothetical Resident				
-Ingestion of Surface Soil Child/Adult (Carcinogenic)	2.5E-07		3.4E-06	
-Ingestion of Surface Soil Child (Noncarcinogenic)		6.5E-05		2.4E-04
-Ingestion of Surface Soil Adult (Noncarcinogenic)		5.5E-06		2.6E-05
-Inhalation of Particulates	***1.3E-07***		***1.4E-06***	
-Dermal Contact with Surface Soils	4.6E-12	1.3E-07	4.8E-10	4.0E-06
-Ingestion of Groundwater	3.1E-07	6.0E-04	7.4E-06	4.3E-03
-Inhalation of VOCs from Infiltration of Soil Gas	5.6E-14	1.9E-11	4.5E-13	4.5E-11
-Inhalation of VOCs from Groundwater Use	3.1E-08	2.0E-05	2.5E-07	4.9E-05
-Ingestion of Garden Produce (Root Uptake)	2.0E-08	1.5E-04	2.0E-07	5.4E-04
-Ingestion of Garden Produce (Deposition)	2.0E-09	6.0E-08	4.9E-08	4.3E-07
-Ingestion of Surface Water/Sediment	3.1E-10	2.3E-06	1.9E-08	4.2E-05
-Dermal Contact with Surface Water/Sediment	8.9E-09	1.1E-04	2.1E-07	7.9E-04
-External Irradiation from Surface Soil	1.6E-08		1.7E-07	
Total	***7.6E-07***	9.6E-04	***1.3E-05***	6.0E-03

Notes:

Changes from draft final to final are shown in italics/bold
Chemical- and pathway specific results are detailed in Attachment H3.

TABLE H8-4
SUMMARY OF ESTIMATED HEALTH RISKS FOR OFFSITE RESIDENTS

Receptor/Exposure Pathway	Average Exposure		Reasonable Maximum Exposure	
	Carcinogenic Risk	Hazard Index	Carcinogenic Risk	Hazard Index
AOC No. 1, Current Resident, Southeast				
-Ingestion of Surface Soil Child/Adult (Carcinogenic)	0 [1]		0	
-Ingestion of Surface Soil Child (Noncarcinogenic)		0		0
-Ingestion of Surface Soil Adult (Noncarcinogenic)		0		0
-Inhalation of Particulates	*1.4E-09*	0	*1.5E-08*	0
-Dermal Contact with Surface Soil	0	0	0	0
-Ingestion of Garden Produce (Deposition)	0	0	0	0
Total	*1.4E-09*	0	*1.5E-08*	0
AOC No. 1, Current Resident, Indiana South				
-Ingestion of Surface Soil Child/Adult (Carcinogenic)	0		0	
-Ingestion of Surface Soil Child (Noncarcinogenic)		0		0
-Ingestion of Surface Soil Adult (Noncarcinogenic)		0		0
-Inhalation of Particulates	0	0	0	0
-Dermal Contact with Surface Soils	0	0	0	0
-Ingestion of Garden Produce (Deposition)	0	0	0	0
Total	0	0	0	0
AOC No. 1, Future Resident, Walnut				
-Ingestion of Surface Soil Child/Adult (Carcinogenic)	0		0	
-Ingestion of Surface Soil Child (Noncarcinogenic)		0		0
-Ingestion of Surface Soil Adult (Noncarcinogenic)		0		0
-Inhalation of Particulates	0	0	0	0
-Dermal Contact with Surface Soil	0	0	0	0
-Ingestion of Garden Produce (Deposition)	0	0	0	0
-Ingestion of Surface Water/Sediment	4.8E-11	1.5E-06	2.9E-9	2.8E-05
-Dermal Contact with Surface Water/Sediment	7.7E-09	8.4E-05	1.8E-07	5.9E-04
Total	7.7E-09	8.5E-05	1.8E-07	6.2E-04
AOC No. 1, Future Resident, Woman				
-Ingestion of Surface Soil Child/Adult (Carcinogenic)	0		0	
-Ingestion of Surface Soil Child (Noncarcinogenic)		0		0
-Ingestion of Surface Soil Adult (Noncarcinogenic)		0		0
-Inhalation of Particulates	*8.3E-10*	0	*8.7E-09*	0
-Dermal Contact with Surface Soil	0	0	0	0
-Ingestion of Garden Produce (Deposition)	0	0	0	0
-Ingestion of Surface Water/Sediment	2.7E-10	8.0E-07	1.6E-08	1.5E-05
-Dermal Contact with Surface Water/Sediment	1.3E-09	2.8E-05	3.1E-08	2.0E-04
Total	*2.4E-09*	2.9E-05	*5.5E-08*	2.1E-04

[1] Hazard/risk estimates reported as 0 indicate that no air or depositional impacts were predicted by air modeling (see Section H5.5.2).

TABLE H8-4
SUMMARY OF ESTIMATED HEALTH RISKS FOR OFFSITE RESIDENTS

Receptor/Exposure Pathway	Average Exposure		Reasonable Maximum Exposure	
	Carcinogenic Risk	Hazard Index	Carcinogenic Risk	Hazard Index
AOC No. 2, Current Resident, Southeast				
-Ingestion of Surface Soil Child/Adult (Carcinogenic)	1.2E-13		1.7E-12	
-Ingestion of Surface Soil Child (Noncarcinogenic)		3.3E-11		1.2E-10
-Ingestion of Surface Soil Adult (Noncarcinogenic)		2.8E-12		1.3E-11
-Inhalation of Particulates	***5.7E-11***	0	***6.0E-10***	0
-Dermal Contact with Surface Soil	2.4E-18	6.5E-14	2.4E-16	2.0E-12
-Ingestion of Garden Produce (Deposition)	2.6E-12	7.9E-11	6.3E-11	5.7E-10
Total	***6.0E-11***	1.1E-10	***6.7E-10***	7.0E-10
AOC No. 2, Current Resident, Indiana South				
-Ingestion of Surface Soil Child/Adult (Carcinogenic)	0		0	
-Ingestion of Surface Soil Child (Noncarcinogenic)		0		0
-Ingestion of Surface Soil Adult (Noncarcinogenic)		0		0
-Inhalation of Particulates	***8.6E-13***	0	***9.1E-12***	0
-Dermal Contact with Surface Soils	0	0	0	0
-Ingestion of Garden Produce (Deposition)	0	0	0	0
Total	***8.6E-13***	0	***9.1E-12***	0
AOC No. 2, Future Resident, Walnut				
-Ingestion of Surface Soil Child/Adult (Carcinogenic)	0		0.0E+00	
-Ingestion of Surface Soil Child (Noncarcinogenic)		0		0
-Ingestion of Surface Soil Adult (Noncarcinogenic)		0		0
-Inhalation of Particulates	***2.6E-12***	0	***2.7E-11***	0
-Dermal Contact with Surface Soil	0	0	0	0
-Ingestion of Garden Produce (Deposition)	0	0	0	0
-Ingestion of Surface Water/Sediment	4.8E-11	1.5E-06	2.9E-09	2.8E-05
-Dermal Contact with Surface Water/Sediment	7.6E-09	8.4E-05	1.8E-07	6.0E-04
Total	7.7E-09	8.5E-05	1.8E-07	6.2E-04
AOC No. 2, Future Resident, Woman				
-Ingestion of Surface Soil Child/Adult (Carcinogenic)	1.2E-13		1.7E-12	
-Ingestion of Surface Soil Child (Noncarcinogenic)		3.3E-11		1.2E-10
-Ingestion of Surface Soil Adult (Noncarcinogenic)		2.8E-12		1.3E-11
-Inhalation of Particulates	***3.2E-11***	0	***3.4E-10***	0
-Dermal Contact with Surface Soil	2.4E-18	6.5E-14	2.4E-16	2.0E-12
-Ingestion of Garden Produce (Deposition)	2.6E-12	7.9E-11	6.3E-11	5.7E-10
-Ingestion of Surface Water/Sediment	2.7E-10	8.0E-07	1.6E-08	1.5E-05
-Dermal Contact with Surface Water/Sediment	1.3E-09	2.8E-05	3.1E-08	2.0E-04
Total	1.6E-09	2.9E-05	4.7E-08	2.1E-04

Notes:

Changes from draft final to final are shown in italics/bold
Chemical- and pathway-specific results are detailed in Attachment H3.

TABLE H9-2
SUMMARY OF ESTIMATED ANNUAL RADIATION DOSE FOR AOC NO. 1

Receptor/Exposure Pathway	Average Exposure (mrem/year)	Reasonable Maximum Exposure (mrem/year)
Current Worker		
-Ingestion of Surface Soil	5.0E-02	3.2E-01
-Inhalation of Particulates	***8.2E-01***	***1.0E+00***
-External Irradiation from Surface Soil	1.7E-01	3.1E-01
Total	***1.0E+00***	***1.7E+00***
Future Industrial/Office Worker		
-Ingestion of Surface Soil	1.5E-01	1.9E+00
-Inhalation of Particulates	***3.6E+00***	***6.1E+00***
-External Irradiation from Surface Soil	1.0E+00	1.8E+00
Total	***4.8E+00***	***9.8E+00***
Future Ecological Worker		
-Ingestion of Surface Soil	2.9E-01	1.0E+00
-Inhalation of Particulates	***1.4E+00***	***2.7E+00***
-Ingestion of Surface Water/Sediment	2.6E-05	2.2E-04
-External Irradiation from Surface Soil	4.8E-01	6.0E-01
Total	***2.2E+00***	***4.3E+00***
Future Open Space Use		
-Ingestion of Surface Soil	***1.4E-02***	***2.2E-01***
-Inhalation of Particulates	***4.6E-02***	***6.4E-01***
-Ingestion of Surface Water/Sediment	2.3E-05	2.8E-04
-External Irradiation from Surface Soil	2.5E-02	1.5E-01
Total	***8.5E-02***	***1.0E+00***
Hypothetical Construction Worker		
-Ingestion of Subsurface Soil	3.7E-03	2.1E-02
-Inhalation of Particulates	***9.9E-01***	***1.2E+00***
-External Irradiation from Surface Soil	4.9E-03	5.6E-03
Total	***1.0E+00***	***1.3E+00***
Hypothetical Resident		
-Ingestion of Surface Soil	1.5E+00	6.3E+00
-Inhalation of Particulates	***8.1E+00***	***2.6E+01***
-Ingestion of Groundwater	8.0E-02	5.7E-01
-Ingestion of Garden Produce (Root Uptake)	3.2E-01	1.2E+00
-Ingestion of Garden Produce (Deposition)	1.1E-02	8.2E-02
-Ingestion of Surface Water/Sediment	1.9E-05	3.4E-04
-External Irradiation from Surface Soil	2.7E+00	8.6E+00
Total	***1.3E+01***	***4.2E+01***

Notes:

Changes from draft final to final are shown in italics/bold
Dose calculations are detailed in Attachment H4.
AOC = Area of Concern
mrem = millirem

TABLE H9-3
SUMMARY OF ESTIMATED ANNUAL RADIATION DOSE FOR MAXIMUM EXPOSURE AREAS

Receptor/Exposure Pathway	Average Exposure (mrem/year)	Reasonable Maximum Exposure (mrem/year)
Hypothetical Resident (10 Acres)		
-Ingestion of Surface Soil	3.3E+00	1.4E+01
-Inhalation of Particulates	***3.5E+00***	***1.1E+01***
-Ingestion of Groundwater	2.6E+00	1.9E+01
-Ingestion of Garden Produce (Root Uptake)	9.1E-01	3.3E+00
-Ingestion of Garden Produce (Deposition)	1.8E-02	1.3E-01
-Ingestion of Surface Water/Sediment	1.9E-05	3.4E-04
-External Irradiation from Surface Soil	6.3E+00	2.0E+01
Total	***1.7E+01***	***6.7E+01***
Future Industrial/Office Worker (30 Acres)		
-Ingestion of Surface Soil	3.4E-01	4.3E+00
-Inhalation of Particulates	***6.9E+00***	***1.2E+01***
-External Irradiation from Surface Soil	2.3E+00	4.3E+00
Total	***9.6E+00***	***2.0E+01***
Future Ecological Worker (50 Acres)		
-Ingestion of Surface Soil	5.4E-01	1.9E+00
-Inhalation of Particulates	***2.0E+00***	***3.7E+00***
-Ingestion of Surface Water/Sediment	2.6E-05	2.2E-04
-External Irradiation from Surface Soil	8.9E-01	1.1E+00
Total	***3.4E+00***	***6.8E+00***

Notes:

Changes from draft final to final are shown in italics/bold
Dose calculations are detailed in Attachment H4.
mrem = millirem

TABLE H9-4
SUMMARY OF ESTIMATED ANNUAL RADIATION DOSE FOR AOC NO. 2

Receptor/Exposure Pathway	Average Exposure (mrem/year)	Reasonable Maximum Exposure (mrem/year)
Current Industrial Worker		
-Ingestion of Surface Soil	1.9E-03	1.2E-02
-Inhalation of Particulates	***1.3E-02***	***1.6E-02***
-External Irradiation from Surface Soil	6.8E-03	1.2E-02
Total	***2.1E-02***	***4.0E-02***
Future Industrial/Office Worker		
-Ingestion of Surface Soil	5.7E-03	7.3E-02
-Inhalation of Particulates	***5.7E-02***	***9.4E-02***
-External Irradiation from Surface Soil	4.0E-02	7.3E-02
Total	***1.0E-01***	***2.4E-01***
Future Ecological Worker		
-Ingestion of Surface Soil	1.1E-02	4.0E-02
-Inhalation of Particulates	***2.2E-02***	***4.1E-02***
-Ingestion of Surface Water/Sediment	2.6E-05	2.2E-04
-External Irradiation from Surface Soil	1.9E-02	2.4E-02
Total	***5.2E-02***	***1.1E-01***
Future Open Space Use		
-Ingestion of Surface Soil	***5.6E-04***	***8.7E-03***
-Inhalation of Particulates	***7.0E-04***	***9.9E-03***
-Ingestion of Surface Water/Sediment	2.3E-05	2.8E-04
-External Irradiation from Surface Soil	9.7E-04	6.1E-03
Total	***2.3E-03***	***2.5E-02***
Future Construction Worker		
-Ingestion of Subsurface Soil	8.4E-03	4.7E-02
-Inhalation of Particulates	***1.5E-02***	***1.9E-02***
-External Irradiation from Surface Soil	7.6E-03	9.2E-03
Total	***3.1E-02***	***7.5E-02***
Hypothetical Resident		
-Ingestion of Surface Soil	5.7E-02	2.4E-01
-Inhalation of Particulates	***1.3E-01***	***3.9E-01***
-Ingestion of Groundwater	8.5E-02	6.0E-01
-Ingestion of Garden Produce (Root Uptake)	1.5E-02	5.5E-02
-Ingestion of Garden Produce (Deposition)	4.8E-04	3.4E-03
-Ingestion of Surface Water/Sediment	1.9E-05	3.4E-04
-External Irradiation from Surface Soil	1.1E-01	3.4E-01
Total	***3.9E-01***	1.6E+00

Notes:

Changes from draft final to final are shown in italics/bold
Dose calculations are detailed in Attachment H4.
AOC = Area of Concern
mrem = millirem

TABLE H9-5
SUMMARY OF ESTIMATED ANNUAL RADIATION DOSE FOR OFFSITE RESIDENTS

Receptor/Exposure Pathway	Average Exposure (mrem/year)	Reasonable Maximum Exposure (mrem/year)
AOC No. 1		
Current Resident, Southeast		
-Ingestion of Surface Soil	0 [1]	0
-Inhalation of Particulates	*1.3E-03*	*4.0E-03*
-Ingestion of Garden Produce (Deposition)	0	0
Total	*1.3E-03*	*4.0E-03*
Current Resident, Indiana South		
-Ingestion of Surface Soil	0	0
-Inhalation of Particulates	0	0
-Ingestion of Garden Produce (Deposition)	0	0
Total	0	0
Future Resident, Walnut Cr./Indiana		
-Ingestion of Surface Soil	0	0
-Inhalation of Particulates	0	0
-Ingestion of Surface Water/Sediment	9.7E-07	1.8E-05
-Ingestion of Garden Produce (Deposition)	0	0
Total	9.7E-07	1.8E-05
Future Resident, Woman Cr./Indiana		
-Ingestion of Surface Soil	0	0
-Inhalation of Particulates	*7.6E-04*	*2.4E-03*
-Ingestion of Surface Water/Sediment	1.8E-05	3.2E-04
-Ingestion of Soil Deposited on Vegetables	0	0
-Ingestion of Soil Deposited on Fruit	0	0
-Ingestion of Garden Produce (Deposition)	0	0
Total	*7.8E-04*	*2.7E-03*

[1] Cancer risk estimates reported as 0 indicate that no air or depositional impacts were predicted by air modeling (Section H5.5.2).
AOC = Area of Concern
mrem = millirem

TABLE H9-5
SUMMARY OF ESTIMATED ANNUAL RADIATION DOSE FOR OFFSITE RESIDENTS

Receptor/Exposure Pathway	Average Exposure (mrem/year)	Reasonable Maximum Exposure (mrem/year)
AOC No. 2		
Current Resident, Southeast		
-Ingestion of Surface Soil	2.9E-08	1.2E-07
-Inhalation of Particulates	***5.5E-05***	***1.8E-04***
-Ingestion of Garden Produce (Deposition)	6.3E-07	4.5E-06
Total	***5.6E-05***	***1.8E-04***
Current Resident, Indiana South		
-Ingestion of Surface Soil	0	0
-Inhalation of Particulates	***8.4E-07***	***2.6E-06***
-Ingestion of Garden Produce (Deposition)	0	0
Total	***8.4E-07***	***2.6E-06***
Future Resident, Walnut Cr./Indiana		
-Ingestion of Surface Soil	0	0
-Inhalation of Particulates	***2.5E-06***	***7.9E-06***
-Ingestion of Surface Water/Sediment Walnut Ck.	9.7E-07	1.8E-05
-Ingestion of Garden Produce (Deposition)	0	0
Total	***3.5E-06***	***2.6E-05***
Future Resident, Woman Cr./Indiana		
-Ingestion of Surface Soil	2.9E-08	1.2E-07
-Inhalation of Particulates	***3.1E-05***	***9.8E-05***
-Ingestion of Surface Water/Sediment	1.8E-05	3.2E-04
-Ingestion of Garden Produce (Deposition)	6.3E-07	4.5E-06
Total	***4.9E-05***	***4.2E-04***

Notes:

Changes from draft final to final are shown in italics/bold
Dose calculations are detailed in Attachment H4.
AOC = Area of Concern
mrem = millirem

TABLE H11-1*
SUMMARY OF ESTIMATED HEALTH RISKS

	Average Exposure (CT)		Reasonable Maximum Exposure (RME)	
	Carcinogenic Risk	Hazard Index	Carcinogenic Risk	Hazard Index
AOC No. 1**				
Current Worker	***7E-07***	2E-03	1E-05	1E-02
Future Industrial/Officer Worker	***3E-06***	6E-03	8E-05	4E-02
Future Ecological Worker	1E-06	5E-03	4E-06	2E-02
Future Open Space Use	2E-07	5E-04	1E-05	1E-02
Future Construction Worker	***2E-07***	4E-03	3E-07	2E-02
Hypothetical Resident	4E-04	2E+01	8E-03	1E+02
Maximum Exposure Areas				
Hypothetical Resident (10 Acres)	1E-03	2E+01	2E-02	2E+02
Future Industrial/Officer Worker (30 Acres)	5E-06	1E-02	2E-04	8E-02
Future Ecological Worker (50 Acres)	2E-06	8E-03	***7E-06***	4E-02
AOC No. 2**				
Current Worker	***1E-08***	3E-07	2E-07	2E-06
Future Industrial/Officer Worker	4E-08	9E-07	1E-06	1E-05
Future Ecological Worker	2E-08	2E-04	7E-08	3E-04
Future Open Space Use	6E-09	3E-05	3E-07	4E-04
Future Construction Worker	3E-08	3E-03	1E-07	2E-02
Hypothetical Resident	8E-07	1E-03	1E-05	6E-03
Offsite Receptors***				
Current Resident, Southeast	1E-09	0	***2E-08***	0
Current Resident, Indiana South	***9E-13***	0	***9E-12***	0
Future Resident, Walnut Cr./Indiana	8E-09	9E-05	2E-07	6E-04
Future Resident, Woman Cr./Indiana	2E-09	3E-05	***6E-08***	2E-04

Note: Changes from draft final to final are shown in italics/bold

* Same as Table H.ES-1.

** Area of concern boundaries are illustrated in Figure H2-1.

*** Results shown correspond to the higher of estimated air impacts from AOC No. 1 and AOC No. 2.

CT = Central Tendency

RME = Reasonable Maximum Exposure

ATTACHMENT H4-2
ANNUAL RADIATION DOSE FROM INHALATION OF SURFACE SOIL PARTICULATES
CURRENT ONSITE INDUSTRIAL WORKERS

Exposure Assumptions	Americium-241		Plutonium-239/240		Total Dose[a]	
	CT	RME	CT	RME	CT	RME
AOC No. 1						
CC = Contaminant Concentration (pCi/m^3)	4.09E-04	4.09E-04	1.13E-02	1.13E-02		
IR = Inhalation Rate (m^3/hr)	0.83	0.83	0.83	0.83		
EF = Exposure Frequency (days/year)	219	250	219	250		
W = Weighting Factor	0.17	0.17	0.17	0.17		
RD = Respiratory Deposition Factor	*1*	*1*	*1*	*1*		
ET = Exposure Time (hrs/day)	7.2	8.0	7.2	8.0		
Annual Radionuclide Intake (pCi/year)[b]	***9.10E-02***	***1.15E-01***	***2.51E+00***	***3.19E+00***		
Effective Dose Coefficient (mrem/pCi)	4.44E-01	4.44E-01	3.08E-01	3.08E-01		
Committed Effective Dose Equivalent (mrem/year)[c]	***4.04E-02***	***5.12E-02***	***7.74E-01***	***9.82E-01***	***8.15E-01***	***1.03E+00***
AOC No. 2						
CC = Contaminant Concentration (pCi/m^3)	2.13E-05	2.13E-05	1.53E-04	1.53E-04		
IR = Inhalation Rate (m^3/hr)	0.83	0.83	0.83	0.83		
EF = Exposure Frequency (days/year)	219	250	219	250		
W = Weighting Factor	0.17	0.17	0.17	0.17		
RD = Respiratory Deposition Factor	*1*	*1*	*1*	*1*		
ET = Exposure Time (hrs/day)	7.2	8.0	7.2	8.0		
Annual Radionuclide Intake (pCi/year)[b]	***4.74E-03***	***6.01E-03***	***3.40E-02***	***4.32E-02***		
Effective Dose Coefficient (mrem/pCi)	4.44E-01	4.44E-01	3.08E-01	3.08E-01		
Committed Effective Dose Equivalent (mrem/year)[c]	***2.10E-03***	***2.67E-03***	***1.05E-02***	***1.33E-02***	***1.26E-02***	***1.60E-02***

Note: Changes from draft final to final are shown in italics/bold

CT - Central Tendency

RME - Reasonable Maximum Exposure

[a] Total Dose is the sum of the Committed Effective Dose Equivalents for Am-241 and Pu-239/240

[b] Annual Radionuclide Intake = CC x IR x EF x WF x RD x ET

[c] Committed Effective Dose Equivalent = Annual Radionuclide Intake x Effective Dose Coefficient

ATTACHMENT H4-5
ANNUAL RADIATION DOSE FROM INHALATION OF SURFACE SOIL PARTICULATES FUTURE ONSITE INDUSTRIAL/OFFICE WORKER

Exposure Assumptions	Americium-241		Plutonium-239/240		Total Dose[a]	
	CT	RME	CT	RME	CT	RME
AOC No. 1						
CC = Contaminant Concentration (pCi/m^3)	4.09E-04	4.09E-04	1.13E-02	1.13E-02		
IR = Inhalation Rate (m^3/hr)	0.63	0.83	0.63	0.83		
EF = Exposure Frequency (days/year)	219	250	219	250		
RD = Respiration Deposition Factor	*1*	*1*	*1*	*1*		
ET = Exposure Time (hrs/day)	7.2	8	7.2	8		
Annual Radionuclide Intake (pCi/year)[b]	***4.06E-01***	***6.79E-01***	***1.12E+01***	***1.88E+01***		
Effective Dose Coefficient (mrem/pCi)	4.44E-01	4.44E-01	3.08E-01	3.08E-01		
Committed Effective Dose Equivalent (mrem/year)[c]	***1.80E-01***	***3.01E-01***	***3.46E+00***	***5.78E+00***	***3.64E+00***	***6.08E+00***
AOC No. 2						
CC = Contaminant Concentration (pCi/m^3)	2.13E-05	2.13E-05	1.54E-04	1.54E-04		
IR = Inhalation Rate (m^3/hr)	0.63	0.83	0.63	0.83		
EF = Exposure Frequency (days/year)	219	250	219	250		
RD = Respiration Deposition Factor	*1*	*1*	*1*	*1*		
ET = Exposure Time (hrs/day)	7.2	8	7.2	8		
Annual Radionuclide Intake (pCi/year)[b]	***2.12E-02***	***3.54E-02***	***1.53E-01***	***2.56E-01***		
Effective Dose Coefficient (mrem/pCi)	4.44E-01	4.44E-01	3.08E-01	3.08E-01		
Committed Effective Dose Equivalent (mrem/year)[c]	***9.39E-03***	***1.57E-02***	***4.71E-02***	***7.87E-02***	***5.65E-02***	***9.44E-02***
30-Acre Maximum Exposure Area						
CC = Contaminant Concentration (pCi/m^3)	8.11E-04	8.11E-04	2.15E-02	2.15E-02		
IR = Inhalation Rate (m^3/hr)	0.63	0.83	0.63	0.83		
EF = Exposure Frequency (days/year)	219	250	219	250		
RD = Respiration Deposition Factor	*1*	*1*	*1*	*1*		
ET = Exposure Time (hrs/day)	7.2	8	7.2	8		
Annual Radionuclide Intake (pCi/year)[b]	***8.06E-01***	***1.35E+00***	***2.14E+01***	***3.57E+01***		
Effective Dose Coefficient (mrem/pCi)	4.44E-01	4.44E-01	3.08E-01	3.08E-01		
Committed Effective Dose Equivalent (mrem/year)[c]	***3.58E-01***	***5.98E-01***	***6.58E+00***	***1.10E+01***	***6.94E+00***	***1.16E+01***

Note: Changes from draft final to final are shown in italics/bold

CT - Central Tendency

RME - Reasonable Maximum Exposure

[a] Total Dose is the sum of the Committed Effective Dose Equivalents for Am-241 and Pu-239/240

[b] Annual Radionuclide Intake = CC x IR x EF x RD x ET

[c] Committed Effective Dose Equivalent = Annual Radionuclide Intake x Effective Dose Coefficient

ATTACHMENT H4-8
ANNUAL RADIATION DOSE FROM INHALATION OF SURFACE SOIL PARTICULATES
FUTURE ONSITE ECOLOGICAL WORKER

Exposure Assumptions	Americium-241		Plutonium-239/240		Total Dose[a]	
	CT	RME	CT	RME	CT	RME
AOC No. 1						
CC = Contaminant Concentration (pCi/m^3)	4.09E-04	4.09E-04	1.13E-02	1.13E-02		
IR = Inhalation Rate (m^3/hr)	0.83	1.40	0.83	1.40		
EF = Exposure Frequency (days/year)	65	65	65	65		
RD = Repiratory Deposition Factor	*1*	*1*	*1*	*1*		
ET = Exposure Time (hrs/day)	7.2	8	7.2	8		
Annual Radionuclide Intake (pCi/year)[b]	***1.59E-01***	***2.98E-01***	***4.39E+00***	***8.23E+00***		
Effective Dose Coefficient (mrem/pCi)	4.44E-01	4.44E-01	3.08E-01	3.08E-01		
Committed Effective Dose Equivalent (mrem/year)[c]	***7E-02***	***1.32E-01***	***1.35E+00***	***2.53E+00***	***1.42E+00***	***2.67E+00***
AOC No. 2						
CC = Contaminant Concentration (pCi/m^3)	2.13E-05	2.13E-05	1.53E-04	1.53E-04		
IR = Inhalation Rate (m^3/hr)	0.83	1.40	0.83	1.40		
EF = Exposure Frequency (days/year)	65	65	65	65		
RD = Repiratory Deposition Factor	*1*	*1*	*1*	*1*		
ET = Exposure Time (hrs/day)	7.2	8	7.2	8		
Annual Radionuclide Intake (pCi/year)[b]	***8.27E-03***	***1.55E-02***	***5.94E-02***	***1.11E-01***		
Effective Dose Coefficient (mrem/pCi)	4.44E-01	4.44E-01	3.08E-01	3.08E-01		
Committed Effective Dose Equivalent (mrem/year)[c]	***3.67E-03***	***6.88E-03***	***1.83E-02***	***3.43E-02***	***2.20E-02***	***4.12E-02***
50-Acre Maximum Exposure Area						
CC = Contaminant Concentration (pCi/m^3)	7.28E-04	7.28E-04	1.55E-02	1.55E-02		
IR = Inhalation Rate (m^3/hr)	0.83	1.40	0.83	1.40		
EF = Exposure Frequency (days/year)	65	65	65	65		
RD = Repiratory Deposition Factor	*1*	*1*	*1*	*1*		
ET = Exposure Time (hrs/day)	7.2	8	7.2	8		
Annual Radionuclide Intake (pCi/year)[b]	***2.83E-01***	***5.30E-01***	***6.02E+00***	***1.13E+01***		
Effective Dose Coefficient (mrem/pCi)	4.44E-01	4.44E-01	3.08E-01	3.08E-01		
Committed Effective Dose Equivalent (mrem/year)[c]	***1.26E-01***	***2.35E-01***	***1.85E+00***	***3.48E+00***	***1.98E+00***	***3.71E+00***

Note: Changes from draft final to final are shown in italics/bold

CT - Central Tendency

RME - Reasonable Maximum Exposure

[a] Total Dose is the sum of the Committed Effective Dose Equivalents for Am-241 and Pu-239/240

[b] Annual Radionuclide Intake = CC x IR x RD x EF x ET

[c] Committed Effective Dose Equivalent = Annual Radionuclide Intake x Effective Dose Coefficient

ATTACHMENT H4-11
ANNUAL RADIATION DOSE FROM INGESTION OF SURFACE SOIL
FUTURE ONSITE OPEN SPACE USE

Exposure Assumptions	Americium-241		Plutonium-239/240		Total Dose[a]	
	CT	RME	CT	RME	CT	RME
AOC No. 1						
CC = Contaminant Concentration (pCi/kg)	2.95E+04	2.95E+04	8.13E+05	8.13E+05		
IR = Ingestion Rate (mg/visit)[b]	***9.6***	***60.0***	***9.6***	***60.0***		
EF = Exposure Frequency (visits/year)	10	25	10	25		
CF = Conversion Factor (kg/mg)	1E-06	1E-06	1E-06	1E-06		
Annual Radionuclide Intake (pCi/year)[c]	***2.83E+00***	***4.43E+01***	***7.80E+01***	***1.22E+03***		
Effective Dose Coefficient (mrem/pCi)	3.64E-03	3.64E-03	5.18E-05	5.18E-05		
Committed Effective Dose Equivalent (mrem/year)[d]	***1.03E-02***	***1.61E-01***	***4.04E-03***	***6.32E-02***	***1.44E-02***	***2.24E-01***
AOC No. 2						
CC = Contaminant Concentration (pCi/kg)	1.45E+03	1.45E+03	1.03E+04	1.03E+04		
IR = Ingestion Rate (mg/visit)[b]	***9.6***	***60.0***	***9.6***	***60.0***		
EF = Exposure Frequency (visits/year)	10	25	10	25		
CF = Conversion Factor (kg/mg)	1E-06	1E-06	1E-06	1E-06		
Annual Radionuclide Intake (pCi/year)[c]	***1.39E-01***	***2.18E+00***	***9.92E-01***	***1.55E+01***		
Effective Dose Coefficient (mrem/pCi)	3.64E-03	3.64E-03	5.18E-05	5.18E-05		
Committed Effective Dose Equivalent (mrem/year)[d]	***5.07E-04***	***7.92E-03***	***5.14E-05***	***8.03E-04***	***5.58E-04***	***8.72E-03***

Note: Changes from draft final to final are shown in italics/bold

CT - Central Tendency

RME - Reasonable Maximum Exposure

[a] Total Dose is the sum of the Committed Effective Dose Equivalents for Am-241 and Pu-239/240

[b] Child/Adult Weighted

[c] Annual Radionuclide Intake = CC x IR x EF x CF

[d] Committed Effective Dose Equivalent = Annual Radionuclide Intake x Effective Dose Coefficient

ATTACHMENT H4-12
ANNUAL RADIATION DOSE FROM INHALATION OF SURFACE SOIL PARTICULATES
FUTURE ONSITE OPEN SPACE USE

Exposure Assumptions	Americium-241		Plutonium-239/240		Total Dose[a]	
	CT	RME	CT	RME	CT	RME
AOC No. 1						
CC = Contaminant Concentration (pCi/m^3)	4.09E-04	4.09E-04	1.13E-02	1.13E-02		
IR = Inhalation Rate (m^3/hr)	0.83	1.40	0.83	1.40		
EF = Exposure Frequency (visits/year)	10	25	10	25		
RD = Respiratory Deposition Factor	*1*	*1*	*1*	*1*		
ET = Exposure Time (hrs/visit)	1.5	5.0	1.5	5.0		
Annual Radionuclide Intake (pCi/year)[b]	***5.09E-03***	***7.16E-02***	***1.41E-01***	***1.98E+00***		
Effective Dose Coefficient (mrem/pCi)	4.44E-01	4.44E-01	3.08E-01	3.08E-01		
Committed Effective Dose Equivalent (mrem/year)[c]	***2.26E-03***	***3.18E-02***	***4.33E-02***	***6.09E-01***	***4.56E-02***	***6.41E-01***
AOC No. 2						
CC = Contaminant Concentration (pCi/m^3)	2.13E-05	2.13E-05	1.53E-04	1.53E-04		
IR = Inhalation Rate (m^3/hr)	0.83	1.40	0.83	1.40		
EF = Exposure Frequency (visits/year)	10	25	10	25		
RD = Respiratory Deposition Factor	*1*	*1*	*1*	*1*		
ET = Exposure Time (hrs/visit)	1.5	5.0	1.5	5.0		
Annual Radionuclide Intake (pCi/year)[b]	***2.65E-04***	***3.73E-03***	***1.90E-03***	***2.68E-02***		
Effective Dose Coefficient (mrem/pCi)	4.44E-01	4.44E-01	3.08E-01	3.08E-01		
Committed Effective Dose Equivalent (mrem/year)[c]	***1E-04***	***1.66E-03***	***5.87E-04***	***8.25E-03***	***7.04E-04***	***9.90E-03***

Note: Changes from draft final to final are shown in italics/bold

CT - Central Tendency

RME - Reasonable Maximum Exposure

[a] Total Dose is the sum of the Committed Effective Dose Equivalents for Am-241 and Pu-239/240

[b] Annual Radionuclide Intake = CC x IR x EF x RD x ET

[c] Committed Effective Dose Equivalent = Annual Radionuclide Intake x Effective Dose Coefficient

ATTACHMENT H4-16
ANNUAL EXPOSURE FROM INHALATION OF SUBSURFACE SOIL PARTICULATES
FUTURE ONSITE CONSTRUCTION WORKER

	Americium-241		Plutonium-239/240		Uranium-233,234		Uranium-235		Uranium-238		Total Exposure[a]	
Exposure Assumptions	CT	RME	CT	RME	CT	RME	CT	RME	CT	RME	CT	RME
AOC No. 1												
CC = Contaminant Concentration (pCi/m^3)	4.09E-04	4.09E-04	1.13E-02	1.13E-02	9.29E-09	9.29E-09	7.92E-10	7.92E-10	9.82E-09	9.82E-09		
IR = Inhalation Rate (m^3/hr)	1.25	1.40	1.25	1.40	1.25	1.40	1.25	1.40	1.25	1.40		
EF = Exposure Frequency (days/year)	30	30	30	30	30	30	30	30	30	30		
RD = Respiratory Deposition Factor	***1***	***1***	***1***	***1***	***1***	***1***	***1***	***1***	***1***	***1***		
ET = Exposure Time (hrs/day)	7.2	8	7.2	8	7.2	8	7.2	8	7.2	8		
Annual Radionuclide Intake (pCi/year)[b]	***1.10E-01***	***1.37E-01***	***3.05E+00***	***3.80E+00***	***2.51E-06***	***3.12E-06***	***2.14E-07***	***2.66E-07***	***2.65E-06***	***3.30E-06***		
Effective Dose Coefficient (mrem/pCi)	4.44E-01	4.44E-01	3.08E-01	3.08E-01	1.32E-01	1.32E-01	1.23E-01	1.23E-01	1.18E-01	1.18E-01		
Committed Effective Dose Equivalent (mrem/year)[c]	***4.90E-02***	***6.10E-02***	***9.40E-01***	***1.17E+00***	***3.31E-07***	***4.12E-07***	***2.63E-08***	***3.27E-08***	***3.13E-07***	***3.89E-07***	***9.89E-01***	***1.23E+00***
AOC No. 2												
CC = Contaminant Concentration (pCi/m^3)	2.13E-05	2.13E-05	1.53E-04	1.53E-04	1.36E-08	1.36E-08	7.92E-10	7.92E-10	1.25E-08	1.25E-08		
IR = Inhalation Rate (m^3/hr)	1.25	1.40	1.25	1.40	1.25	1.40	1.25	1.40	1.25	1.40		
EF = Exposure Frequency (days/year)	30	30	30	30	30	30	30	30	30	30		
RD = Respiratory Deposition Factor	***1***	***1***	***1***	***1***	***1***	***1***	***1***	***1***	***1***	***1***		
ET = Exposure Time (hrs/day)	7.2	8	7.2	8	7.2	8	7.2	8	7.2	8		
Annual Radionuclide Intake (pCi/year)[b]	***5.75E-03***	***7.16E-03***	***4.13E-02***	***5.14E-02***	***3.67E-06***	***4.57E-06***	***2.14E-07***	***2.66E-07***	***3.38E-06***	***4.20E-06***		
Effective Dose Coefficient (mrem/pCi)	4.44E-01	4.44E-01	3.08E-01	3.08E-01	1.32E-01	1.32E-01	1.23E-01	1.23E-01	1.18E-01	1.18E-01		
Committed Effective Dose Equivalent (mrem/year)[c]	***2.55E-03***	***3.18E-03***	***1.27E-02***	***1.58E-02***	***4.85E-07***	***6.03E-07***	***2.63E-08***	***3.27E-08***	***3.98E-07***	***4.96E-07***	***1.53E-02***	***1.90E-02***

Note: Changes from draft final to final are shown in italics/bold

CT - Central Tendency

RME - Reasonable Maximum Exposure

[a] Total Dose is the sum of the Committed Effective Dose Equivalents for Am-241, Pu-239/240, U-233,234, U-235, and U-238

[b] Annual Radionuclide Intake = CC x IR x EF x RD x ET

[c] Committed Effective Dose Equivalent = Annual Radionuclide Intake x Effective Dose Coefficient

ATTACHMENT H4-19
ANNUAL RADIATION DOSE FROM INHALATION OF SURFACE SOIL PARTICULATES HYPOTHETICAL FUTURE ONSITE RESIDENTS

	Americium-241		Plutonium-239/240		Total Dose[a]	
Exposure Assumptions	**CT**	**RME**	**CT**	**RME**	**CT**	**RME**
AOC No. 1						
CC = Contaminant Concentration (pCi/m^3)	4.09E-04	4.09E-04	1.13E-02	1.13E-02		
IR = Inhalation Rate (m^3/hr)	0.63	0.83	0.63	0.83		
EF = Exposure Frequency (days/year)	234	350	234	350		
RD = Respiratory Deposition Factor	*1*	*1*	*1*	*1*		
ET = Exposure Time (hrs/day)	15	24	15	24		
Annual Radionuclide Intake (pCi/year)[b]	***9.04E-01***	***2.85E+00***	***2.50E+01***	***7.88E+01***		
Effective Dose Coefficient (mrem/pCi)	4.44E-01	4.44E-01	3.08E-01	3.08E-01		
Committed Effective Dose Equivalent (mrem/year)[c]	***4.02E-01***	***1.27E+00***	***7.70E+00***	***2.43E+01***	***8.10E+00***	***2.55E+01***
AOC No. 2						
CC = Contaminant Concentration (pCi/m^3)	2.13E-05	2.13E-05	1.53E-04	1.53E-04		
IR = Inhalation Rate (m^3/hr)	0.63	0.83	0.63	0.83		
EF = Exposure Frequency (days/year)	234	350	234	350		
RD = Respiratory Deposition Factor	*1*	*1*	*1*	*1*		
ET = Exposure Time (hrs/day)	15	24	15	24		
Annual Radionuclide Intake (pCi/year)[b]	***5E-02***	***1.49E-01***	***3.38E-01***	***1.07E+00***		
Effective Dose Coefficient (mrem/pCi)	4.44E-01	4.44E-01	3.08E-01	3.08E-01		
Committed Effective Dose Equivalent (mrem/year)[c]	***2.09E-02***	***6.59E-02***	***1.04E-01***	***3.29E-01***	***1.25E-01***	***3.94E-01***
10-Acre Maximum Exposure Area						
CC = Contaminant Concentration (pCi/m^3)	8.45E-04	8.45E-04	3.90E-03	3.90E-03		
IR = Inhalation Rate (m^3/hr)	0.63	0.83	0.63	0.83		
EF = Exposure Frequency (days/year)	234	350	234	350		
RD = Respiratory Deposition Factor	*1*	*1*	*1*	*1*		
ET = Exposure Time (hrs/day)	15	24	15	24		
Annual Radionuclide Intake (pCi/year)[b]	***1.87E+00***	***5.89E+00***	***8.62E+00***	***2.72E+01***		
Effective Dose Coefficient (mrem/pCi)	4.44E-01	4.44E-01	3.08E-01	3.08E-01		
Committed Effective Dose Equivalent (mrem/year)[c]	***8.30E-01***	***2.62E+00***	***2.66E+00***	***8.37E+00***	***3.49E+00***	***1.10E+01***

Note: Changes from draft final to final are shown in italics/bold
CT - Central Tendency
RME - Reasonable Maximum Exposure
[a] Total Dose is the sum of the Committed Effective Dose Equivalents for Am-241 and Pu-239/240
[b] Annual Radionuclide Intake = CC x IR x EF x RD x ET
[c] Committed Effective Dose Equivalent = Annual Radionuclide Intake x Effective Dose Coefficient

ATTACHMENT H4-28
ANNUAL RADIATION DOSE FROM INHALATION OF SURFACE SOIL PARTICULATES[a]
CURRENT AND FUTURE OFFSITE RESIDENTS

Exposure Assumptions	Americium-241 CT	Americium-241 RME	Plutonium-239/240 CT	Plutonium-239/240 RME	Total Dose[b] CT	Total Dose[b] RME
Current Offsite Resident, Southeast						
AOC No. 1						
CC = Contaminant Concentration (pCi/m^3)	6.49E-08	6.49E-08	1.79E-06	1.79E-06		
IR = Inhalation Rate (m^3/hr)	0.63	0.83	0.63	0.83		
EF = Exposure Frequency (days/year)	234	350	234	350		
RD = Respiratory Deposition Factor	*1*	*1*	*1*	*1*		
ET = Exposure Time (hrs/day)	15	24	15	24		
Annual Radionuclide Intake (pCi/year)[c]	*1.44E-04*	*4.52E-04*	*3.96E-03*	*1.25E-02*		
Effective Dose Coefficient (mrem/pCi)	4.44E-01	4.44E-01	3.08E-01	3.08E-01		
Committed Effective Dose Equivalent (mrem/year)[d]	*6.37E-05*	*2.01E-04*	*1.22E-03*	*3.84E-03*	*1.28E-03*	*4.04E-03*
AOC No. 2						
CC = Contaminant Concentration (pCi/m^3)	9.51E-09	9.51E-09	6.76E-08	6.76E-08		
IR = Inhalation Rate (m^3/hr)	0.63	0.83	0.63	0.83		
EF = Exposure Frequency (days/year)	234	350	234	350		
RD = Respiratory Deposition Factor	*1*	*1*	*1*	*1*		
ET = Exposure Time (hrs/day)	15	24	15	24		
Annual Radionuclide Intake (pCi/year)[c]	*2.10E-05*	*6.63E-05*	*1.49E-04*	*4.71E-04*		
Effective Dose Coefficient (mrem/pCi)	4.44E-01	4.44E-01	3.08E-01	3.08E-01		
Committed Effective Dose Equivalent (mrem/year)[d]	*9.34E-06*	*2.94E-05*	*4.60E-05*	*1.45E-04*	*5.54E-05*	*1.75E-04*
Current Offsite Resident, Indiana South						
AOC No. 2						
CC = Contaminant Concentration (pCi/m^3)	1.44E-10	1.44E-10	1.02E-09	1.02E-09		
IR = Inhalation Rate (m^3/hr)	0.63	0.83	0.63	0.83		
EF = Exposure Frequency (days/year)	234	350	234	350		
RD = Respiratory Deposition Factor	*1*	*1*	*1*	*1*		
ET = Exposure Time (hrs/day)	15	24	15	24		
Annual Radionuclide Intake (pCi/year)[c]	*3.18E-07*	*1.00E-06*	*2.26E-06*	*7.11E-06*		
Effective Dose Coefficient (mrem/pCi)	4.44E-01	4.44E-01	3.08E-01	3.08E-01		
Committed Effective Dose Equivalent (mrem/year)[d]	*1.41E-07*	*4.46E-07*	*6.95E-07*	*2.19E-06*	*8.36E-07*	*2.64E-06*
Future Offsite Resident, Walnut Creek/Indiana						
AOC No. 2						
CC = Contaminant Concentration (pCi/m^3)	4.33E-10	4.33E-10	3.07E-09	3.07E-09		
IR = Inhalation Rate (m^3/hr)	0.63	0.83	0.63	0.83		
EF = Exposure Frequency (days/year)	234	350	234	350		
RD = Respiratory Deposition Factor	*1*	*1*	*1*	*1*		
ET = Exposure Time (hrs/day)	15	24	15	24		
Annual Radionuclide Intake (pCi/year)[c]	*9.57E-07*	*3.02E-06*	*6.79E-06*	*2.14E-05*		
Effective Dose Coefficient (mrem/pCi)	4.44E-01	4.44E-01	3.08E-01	3.08E-01		
Committed Effective Dose Equivalent (mrem/year)[d]	*4.25E-07*	*1.34E-06*	*2.09E-06*	*6.59E-06*	*2.52E-06*	*7.93E-06*

ATTACHMENT H4-28
ANNUAL RADIATION DOSE FROM INHALATION OF SURFACE SOIL PARTICULATES[a]
CURRENT AND FUTURE OFFSITE RESIDENTS

Exposure Assumptions	Americium-241		Plutonium-239/240		Total Dose[b]	
	CT	RME	CT	RME	CT	RME
Future Offsite Resident, Woman Creek/Indiana						
AOC No. 1						
CC = Contaminant Concentration (pCi/m^3)	3.85E-08	3.85E-08	1.06E-06	1.06E-06		
IR = Inhalation Rate (m^3/hr)	0.63	0.83	0.63	0.83		
EF = Exposure Frequency (days/year)	234	350	234	350		
RD = Respiratory Deposition Factor	***1***	***1***	***1***	***1***		
ET = Exposure Time (hrs/day)	15	24	15	24		
Annual Radionuclide Intake (pCi/year)[c]	***8.51E-05***	***2.68E-04***	***2.34E-03***	***7.39E-03***		
Effective Dose Coefficient (mrem/pCi)	4.44E-01	4.44E-01	3.08E-01	3.08E-01		
Committed Effective Dose Equivalent (mrem/year)[d]	***3.78E-05***	***1.19E-04***	***7.22E-04***	***2.28E-03***	***7.60E-04***	***2.40E-03***
AOC No. 2						
CC = Contaminant Concentration (pCi/m^3)	5.32E-09	5.32E-09	3.79E-08	3.79E-08		
IR = Inhalation Rate (m^3/hr)	0.63	0.83	0.63	0.83		
EF = Exposure Frequency (days/year)	234	350	234	350		
RD = Respiratory Deposition Factor	***1***	***1***	***1***	***1***		
ET = Exposure Time (hrs/day)	15	24	15	24		
Annual Radionuclide Intake (pCi/year)[c]	***1E-05***	***3.71E-05***	***8.38E-05***	***2.64E-04***		
Effective Dose Coefficient (mrem/pCi)	4.44E-01	4.44E-01	3.08E-01	3.08E-01		
Committed Effective Dose Equivalent (mrem/year)[d]	***5.22E-06***	***1.65E-05***	***2.58E-05***	***8.14E-05***	***3.10E-05***	***9.79E-05***

Note: Changes from draft final to final are shown in italics/bold

CT - Central Tendency

RME - Reasonable Maximum Exposure

[a] Modeling of Am-241 and Pu-239/240 concentrations indicated none were current or future contaminants of concern in the following areas: AOC No. 1 - Indiana South and Walnut/Indiana

[b] Total Dose is the sum of the Committed Effective Dose Equivalents for Am-241 and Pu-239/240

[c] Annual Radionuclide Intake = CC x IR x EF x RD x ET

[d] Committed Effective Dose Equivalent = Annual Radionuclide Intake x Effective Dose Coefficient

SUMMARY OF RISKS
CURRENT ONSITE WORKER
AREA OF CONCERN NO. 1

	Central Tendency		Reasonable Maximum	
Pathway	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Ingestion of surface soil	1.75E-04	2.62E-07	1.11E-03	1.04E-05
Inhalation of particulates from surface soil	-	***3.94E-07***	-	***3.12E-06***
Dermal contact with surface soil*	1.43E-03	1.26E-08	9.04E-03	4.97E-07
External Radiation	-	9.78E-09	-	1.11E-07
Total	1.60E-03	***6.78E-07***	1.02E-02	***1.41E-05***

* Dermal contact with metals (except mercury) and radionuclides is considered insignificant.

Note: Changes from draft final to final are shown in italics/bold

CURRENT C...ITE WORKER
AREA OF CONCERN NO. 1

CT Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF x WF
CR = IF x C x SF

	C	IR	ET	EF	ED	DF	WF	IF	SF	CR
Radionuclides	Air Concentration (pCi/m^3)	Inhalation Rate (m^3/hr)	Exposure Time (hr/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Deposition Factor	Weighting Factor	Intake Factor (m^3)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	4.09E-04	0.83	7.2	219	4	***1.00***	0.17	***8.90E+02***	3.20E-08	***1.1648E-08***
Plutonium-239\240	1.13E-02	0.83	7.2	219	4	***1.00***	0.17	***8.90E+02***	3.80E-08	***3.8214E-07***
							Total Radionuclide Risk			***3.94E-07***

RME Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF x WF
CR = IF x C x SF

	C	IR	ET	EF	ED	DF	WF	IF	SF	CR
Radionuclides	Air Concentration (pCi/m^3)	Inhalation Rate (m^3/hr)	Exposure Time (hr/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Deposition Factor	Weighting Factor	Intake Factor (m^3)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	4.09E-04	0.83	8	250	25	***1.00***	0.17	***7.06E+03***	3.20E-08	***9.2336E-08***
Plutonium-239/240	1.13E-02	0.83	8	250	25	***1.00***	0.17	***7.06E+03***	3.80E-08	***3.0294E-06***
							Total Radionuclide Risk			***3.12E-06***

Total Cancer Risk ***3.12E-06***

Note: Changes from draft final to final are shown in italics/bold

SUMMARY OF RISKS
FUTURE INDUSTRIAL/OFFICE WORKER
AREA OF CONCERN NO. 1

	Central Tendency		Reasonable Maximum	
Pathway	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Ingestion of surface soil	5.15E-04	7.70E-07	6.53E-03	6.10E-05
Inhalation of particulates from surface soil	-	***1.76E-06***	-	***1.84E-05***
Dermal contact with surface soil*	5.18E-03	4.56E-08	3.29E-02	1.81E-06
Inhalation of Indoor VOCs	3.86E-12	1.61E-08	6.45E-12	1.68E-07
External Radiation	-	5.75E-08	-	6.52E-07
Total	5.70E-03	***2.65E-06***	3.94E-02	***8.20E-05***

* Dermal contact with metals (except mercury) and radionuclides is considered insignificant.

Note: Changes from draft final to final are shown in italics/bold

FUTURE INDUSTR[illegible]/OFFICE WORKER
AREA OF CONCERN NO. 1

CT Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	4.09E-04	0.63	7.2	219	4	***1***	***3.97E+03***	3.20E-08	***5.20E-08***
Plutonium-239/240	1.13E-02	0.63	7.2	219	4	***1***	***3.97E+03***	3.80E-08	***1.71E-06***
								Total Radionuclide Cancer Risk	***1.76E-06***
								Total Cancer Risk	***1.76E-06***

RME Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	4.09E-04	0.83	8	250	25	***1***	***4.15E+04***	3.20E-08	***5.43E-07***
Plutonium-239/240	1.13E-02	0.83	8	250	25	***1***	***4.15E+04***	3.80E-08	***1.78E-05***
								Total Radionuclide Cancer Risk	***1.84E-05***
								Total Cancer Risk	***1.84E-05***

Note: Changes from draft final to final are shown in italics/bold

SUMMARY OF RISK
FUTURE ONSITE ECOLOGICAL RESEARCHER
AREA OF CONCERN NO. 1

	Central Tendency		Reasonable Maximum	
Pathway	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Ingestion of surface soil	1.01E-03	9.42E-07	3.59E-03	3.36E-06
Inhalation of particulates from surface soil	-	***4.30E-07***	-	***8.05E-07***
Dermal contact with surface soil*	3.43E-03	1.89E-08	1.91E-02	1.05E-07
Ingestion of surface water - Walnut Creek	2.13E-06	1.86E-11	1.82E-05	1.59E-10
Ingestion of surface water - Woman Creek	1.12E-06	1.03E-10	9.59E-06	8.85E-10
Dermal contact with surface water - Walnut Creek	1.17E-04	2.97E-09	2.00E-04	5.09E-09
Dermal contact with surface water - Woman Creek	3.89E-05	5.00E-10	6.66E-05	8.58E-10
External Radiation	-	1.73E-08	-	2.16E-08
Total	4.60E-03	***1.41E-06***	2.30E-02	***4.30E-06***

* Dermal contact with metals (except mercury) and radionuclides is considered insignificant.

Note: Changes from draft final to final are shown in italics/bold

FUTURE ONSITE ECOLOGICAL RESEARCHER
AREA OF CONCERN NO. 1

CT Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	4.09E-04	0.83	7.2	65	2.5	***1***	***9.71E+02***	3.20E-08	***1.27E-08***
Plutonium-239/240	1.13E-02	0.83	7.2	65	2.5	***1***	***9.71E+02***	3.80E-08	***4.17E-07***
								Total Radionuclide Cancer Risk	***4.30E-07***
								Total Cancer Risk	***4.30E-07***

RME - Inhalation of particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	4.09E-04	1.4	8	65	2.5	1	***1.82E+03***	3.20E-08	***2.38E-08***
Plutonium-239/240	1.13E-02	1.4	8	65	2.5	1	***1.82E+03***	3.80E-08	***7.82E-07***
								Total Radionuclide Cancer Risk	***8.05E-07***
								Total Cancer Risk	***8.05E-07***

Note: Changes from draft final to final are shown in italics/bold

SUMMARY OF RISK
FUTURE ONSITE CONSTRUCTION WORKER
AREA OF CONCERN NO. 1

	Central Tendency		Reasonable Maximum	
Pathway	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Ingestion of subsurface soil	3.11E-03	2.46E-08	1.74E-02	1.38E-07
Inhalation of particulates from subsurface soil	***1.20E-10***	***1.19E-07***	***1.49E-10***	***1.49E-07***
Dermal contact with subsurface soil*	7.47E-04	5.55E-09	4.15E-03	3.08E-08
External Radiation	-	1.24E-09	-	1.55E-09
Total	3.85E-03	***1.51E-07***	2.16E-02	***3.19E-07***

*Dermal absorption of metals and radionuclides is considered insignificant.

Note: Changes from draft final to final are shown in italics/bold

FUTURE ONSITE CO. ..TRUCTION WORKER
AREA OF CONCERN NO. 1

CT - Inhalation of particulates from subsurface soil

Noncarcinogens

$$IF = (IR \times ET \times EF \times ED \times DF)/(BW \times AT)$$
$$HQ = (IF \times C)/RfD$$

	C	IR	ET	EF	ED	DF	BW	AT	IF	RfD	HQ
Chemical	Air Concentration (mg/m^3)	Inhalation Rate (m^3/hr)	Exposure Time (hr/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Deposition Factor	Body Weight (kg)	Averaging Time (days)	Intake Factor ($m^3/kg\text{-}day$)	Reference Dose (mg/kg-day)	Hazard Quotient
Mercury	1.02E-12	1.25	7.2	30	1	*1*	70	365	***1.06E-02***	9.00E-05	***1.20E-10***
										Total Hazard Index	***1.1977E-10***

Nonradionuclide Carcinogens

$$IF = (IR \times ET \times EF \times ED \times DF)/(BW \times AT)$$
$$CR = IF \times C \times SF$$

	C	IR	ET	EF	ED	DF	BW	AT	IF	SF	CR
Chemical	Air Concentration (mg/m^3)	Inhalation Rate (m^3/hr)	Exposure Time (hr/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Deposition Factor	Body Weight (kg)	Averaging Time (days)	Intake Factor ($m^3/kg\text{-}day$)	Slope Factor 1/(mg/kg-day)	Cancer Risk
Arsenic	7.24E-11	1.25	7.2	30	1	*1*	70	25550	***1.51E-04***	1.50E+01	***1.64E-13***
Cadmium (food)	1.35E-11	1.25	7.2	30	1	*1*	70	25550	***1.51E-04***	6.30E+00	***1.28E-14***
										Total Chemical Cancer Risk	***1.77E-13***

Radionuclides

$$IF = IR \times ET \times EF \times ED \times DF$$
$$CR = IF \times C \times SF$$

	C	IR	ET	EF	ED	DF	IF	SF	CR
Radionuclides	Air Concentration (pCi/m^3)	Inhalation Rate (m^3/hr)	Exposure Time (hr/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Deposition Factor	Intake Factor (m^3)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	4.09E-04	1.25	7.2	30	1	*1*	***2.70E+02***	3.20E-08	***3.53E-09***
Plutonium-239/240	1.13E-02	1.25	7.2	30	1	*1*	***2.70E+02***	3.80E-08	***1.16E-07***
Uranium-233/234	9.29E-09	1.25	7.2	30	1	*1*	***2.70E+02***	2.60E-08	***6.52E-14***
Uranium-235	7.92E-10	1.25	7.2	30	1	*1*	***2.70E+02***	2.50E-08	***5.35E-15***
Uranium-238	9.82E-09	1.25	7.2	30	1	*1*	***2.70E+02***	2.40E-08	***6.36E-14***
								Total Radionuclide Cancer Risk	***1.19E-07***

Total Cancer Risk ***1.19E-07***

FUTURE ONSITE CO. .TRUCTION WORKER
AREA OF CONCERN NO. 1

RME - Inhalation of particulates from subsurface soil

Noncarcinogens

IF = (IR x ET x EF x ED x DF)/(BW x AT)
HQ = (IF x C)/RfD

	C	IR	ET	EF	ED	DF	BW	AT	IF	RfD	HQ
Chemical	Air Concentration (mg/m^3)	Inhalation Rate (m^3/hr)	Exposure Time (hr/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Deposition Factor	Body Weight (kg)	Averaging Time (days)	Intake Factor ($m^3/kg\text{-}day$)	Reference Dose (mg/kg-day)	Hazard Quotient
Mercury	1.02E-12	1.4	8	30	1	*1*	70	365	***1.32E-02***	9.00E-05	***1.49E-10***
										Total Hazard Index	***1.49E-10***

Nonradionuclide Carcinogens

IF = (IR x ET x EF x ED x DF)/(BW x AT)
CR = IF x C x SF

	C	IR	ET	EF	ED	DF	BW	AT	IF	SF	CR
Chemical	Air Concentration (mg/m^3)	Inhalation Rate (m^3/hr)	Exposure Time (hr/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Deposition Factor	Body Weight (kg)	Averaging Time (days)	Intake Factor ($m^3/kg\text{-}day$)	Slope Factor 1/(mg/kg-day)	Cancer Risk
Arsenic	7.24E-11	1.4	8	30	1	*1*	70	25550	***1.88E-04***	1.50E+01	***2.04E-13***
Cadmium (food)	1.35E-11	1.4	8	30	1	*1*	70	25550	***1.88E-04***	6.30E+00	***1.60E-14***
										Total Chemical Cancer Risk	***2.20E-13***

Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

	C	IR	ET	EF	ED	DF	IF	SF	CR
Radionuclides	Air Concentration (pCi/m^3)	Inhalation Rate (m^3/hr)	Exposure Time (hr/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Deposition Factor	Intake Factor (m^3)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	4.09E-04	1.4	8	30	1	*1*	***3.36E+02***	3.20E-08	***4.40E-09***
Plutonium-239/240	1.13E-02	1.4	8	30	1	*1*	***3.36E+02***	3.80E-08	***1.44E-07***
Uranium-233/234	9.29E-09	1.4	8	30	1	*1*	***3.36E+02***	2.60E-08	***8.12E-14***
Uranium-235	7.92E-10	1.4	8	30	1	*1*	***3.36E+02***	2.50E-08	***6.65E-15***
Uranium-238	9.82E-09	1.4	8	30	1	*1*	***3.36E+02***	2.40E-08	***7.92E-14***
								Total Radionuclide Cancer Risk	***1.49E-07***

Total Cancer Risk ***1.49E-07***

Note: Changes from draft final to final are shown in italics/bold

SUMMARY OF RISK
OPEN SPACE USER
AREA OF CONCERN NO. 1

	Central Tendency		Reasonable Maximum	
Pathway	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Ingestion of surface soil by an adult	4.18E-05	-	6.53E-04	-
Ingestion of surface soil by a child	3.66E-04	-	6.10E-03	-
Carcinogenic effects of soil ingestion	-	1.69E-07	-	8.85E-06
Inhalation of particulates from surface soil	-	***4.96E-08***	-	***2.32E-06***
Dermal contact with surface soil*	3.76E-05	7.44E-10	4.15E-03	2.74E-07
Ingestion of surface water - Walnut Creek	1.90E-06	5.96E-11	2.28E-05	2.39E-09
Ingestion of surface water - Woman Creek	1.00E-06	3.32E-10	1.20E-05	1.33E-08
Dermal contact with surface water - Walnut Creek	2.05E-05	1.87E-09	2.51E-04	7.64E-08
Dermal contact with surface water - Woman Creek	6.83E-06	3.16E-10	8.35E-05	1.29E-08
External Radiation	-	3.22E-09	-	6.52E-08
Total	4.75E-04	***2.25E-07***	1.13E-02	***1.16E-05***

* Dermal contact with metals (except mercury) and radionuclides is considered insignificant.

Note: Changes from draft final to final are shown in italics/bold

OPEN SPACE USER
AREA OF CONCERN NO. 1

CT Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/visit)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	4.09E-04	0.83	1.5	10	9	*1*	*1.12E+02*	3.20E-08	*1.47E-09*
Plutonium-239/240	1.13E-02	0.83	1.5	10	9	*1*	*1.12E+02*	3.80E-08	*4.81E-08*
								Total Radionuclide Cancer Risk	*4.96E-08*
								Total Cancer Risk	*4.96E-08*

RME - Inhalation of particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/visit)	EF Exposure Frequency (visits/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	4.09E-04	1.4	5	25	30	*1*	*5.25E+03*	3.20E-08	*6.87E-08*
Plutonium-239/240	1.13E-02	1.4	5	25	30	*1*	*5.25E+03*	3.80E-08	*2.25E-06*
								Total Radionuclide Cancer Risk	*2.32E-06*
								Total Cancer Risk	*2.32E-06*

Note: Changes from draft final to final are shown in italics/bold

SUMMARY OF RISK
HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 1

	Central Tendency		Reasonable Maximum	
Pathway	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Ingestion of surface soil by an adult	3.91E-03	-	1.83E-02	-
Ingestion of surface soil by a child	4.68E-02	-	1.71E-01	
Carcinogenic effects of soil ingestion	-	1.79E-05	-	2.48E-04
Inhalation of particulates from surface soil	-	***8.81E-06***	-	***9.26E-05***
Dermal contact with surface soil*	3.75E-03	7.42E-08	1.16E-01	7.66E-06
Ingestion of vegetables with soil deposition	1.75E-05	5.90E-08	1.31E-04	1.47E-06
Ingestion of fruit with soil deposition	2.29E-05	7.71E-08	1.60E-04	1.80E-06
Ingestion of leafy vegetables with root uptake	1.16E-03	3.87E-07	4.32E-03	4.81E-06
Ingestion of other produce with root uptake	1.45E-02	6.69E-07	5.08E-02	7.80E-06
Ingestion of groundwater	1.96E+01	2.62E-04	1.40E+02	6.22E-03
Ingestion of surface water - Walnut Creek	1.52E-06	4.77E-11	2.77E-05	2.89E-09
Ingestion of surface water - Woman Creek	8.01E-07	2.66E-10	1.46E-05	1.61E-08
Dermal contact with surface water - Walnut Creek	8.36E-05	7.64E-09	5.95E-04	1.81E-07
Dermal contact with surface water - Woman Creek	2.78E-05	1.29E-09	1.98E-04	3.06E-08
Inhalation of VOCs from infiltration	8.60E-12	8.07E-08	2.06E-11	6.44E-07
Inhalation of VOCs from groundwater use	8.50E-05	1.47E-04	2.03E-04	1.17E-03
External Radiation	-	3.45E-07	-	3.68E-06
Total	1.97E+01	***4.37E-04***	1.40E+02	***7.75E-03***

* Dermal contact with metals (except mercury) and radionuclides is considered insignificant.

Note: Changes from draft final to final are shown in italics/bold

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 1

CT Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	4.09E-04	0.63	15	234	9	*1*	***1.99E+04***	3.20E-08	***2.60E-07***
Plutonium-239/240	1.13E-02	0.63	15	234	9	*1*	***1.99E+04***	3.80E-08	***8.55E-06***
								Total Radionuclide Cancer Risk	***8.81E-06***

Total Cancer Risk ***8.81E-06***

RME Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	4.09E-04	0.83	24	350	30	*1*	***2.09E+05***	3.20E-08	***2.74E-06***
Plutonium-239/240	1.13E-02	0.83	24	350	30	*1*	***2.09E+05***	3.80E-08	***8.98E-05***
								Total Radionuclide Cancer Risk	***9.26E-05***

Total Cancer Risk ***9.26E-05***

Note: Changes from draft final to final are shown in italics/bold

SUMMARY OF RISK
HYPOTHETICAL ONSITE RESIDENT
10-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

	Central Tendency		Reasonable Maximum	
Pathway	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Ingestion of surface soil by an adult	1.24E-05	-	5.78E-05	-
Ingestion of surface soil by a child	1.48E-04	-	5.40E-04	
Carcinogenic effects of soil ingestion	-	1.03E-05	-	1.43E-04
Inhalation of particulates from surface soil	-	***3.49E-06***	-	***3.67E-05***
Dermal contact with surface soil*	5.98E-07	2.15E-11	1.85E-05	2.22E-09
Ingestion of vegetables with soil deposition	3.85E-08	2.39E-08	2.88E-07	5.95E-07
Ingestion of fruit with soil deposition	5.03E-08	3.12E-08	3.52E-07	7.28E-07
Ingestion of leafy vegetables with root uptake	5.06E-05	4.65E-07	1.89E-04	5.79E-06
Ingestion of other produce with root uptake	6.26E-04	4.86E-05	2.19E-03	4.32E-06
Ingestion of groundwater	2.26E+01	4.25E-04	1.61E+02	1.01E-02
Ingestion of surface water - Walnut Creek	1.52E-06	4.77E-11	2.77E-05	2.89E-09
Ingestion of surface water - Woman Creek	8.01E-07	2.66E-10	1.46E-05	1.61E-08
Dermal contact with surface water - Walnut Creek	8.36E-05	7.64E-09	5.95E-04	1.81E-07
Dermal contact with surface water - Woman Creek	2.78E-05	1.29E-09	1.98E-04	3.06E-08
Inhalation of VOCs from infiltration	1.16E-09	1.34E-10	2.78E-09	1.07E-09
Inhalation of VOCs from groundwater use	2.09E-02	5.69E-04	4.99E-02	4.54E-03
External Radiation	-	9.45E-07	-	1.01E-05
Total	2.26E+01	1.06E-03	1.61E+02	1.48E-02

* Dermal contact with metals (except mercury) and radionuclides is considered insignificant.

Note: Changes from draft final to final are shown in italics/bold

HYPOTHETICA. NSITE RESIDENT
10-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

CT Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	8.45E-04	0.63	15	234	9	*1*	***1.99E+04***	3.20E-08	***5.38E-07***
Plutonium-239/240	3.90E-03	0.63	15	234	9	*1*	***1.99E+04***	3.80E-08	***2.95E-06***
								Total Radionuclide Cancer Risk	***3.49E-06***

Total Cancer Risk ***3.49E-06***

RME Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	8.45E-04	0.83	24	350	30	*1*	***2.09E+05***	3.20E-08	***5.66E-06***
Plutonium-239/240	3.90E-03	0.83	24	350	30	*1*	***2.09E+05***	3.80E-08	***3.10E-05***
								Total Radionuclide Cancer Risk	***3.67E-05***

Total Cancer Risk ***3.67E-05***

Note: Changes from draft final to final are shown in italics/bold

HYPOTHETIC. NSITE RESIDENT
10-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

CT - Dermal contact with surface water - Walnut Creek

Noncarcinogens

IF = (SA x DP x ET x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

Chemical	C Surface Water Concentration (mg/l)	SA Skin Surface Area (cm^2)	DP Dermal Permeability (cm/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (day/yr)	ED Exposure Duration (years)	CF Conversion Factor (l/cm^3)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (l/kg-day)	RfD Reference Dose (mg/kg-day)	HQ Hazard Quotient
1,1-Dichloroethene	5.00E-06	*9275*	0.016	1	5	9	*0.001*	70	3285	***2.90E-05***	9.00E-03	***1.61E-08***
Carbon Tetrachloride	4.81E-04	*9275*	0.022	1	5	9	*0.001*	70	3285	***3.99E-05***	7.00E-04	***2.74E-05***
Chloroform	9.30E-05	*9275*	0.13	1	5	9	*0.001*	70	3285	***2.36E-04***	1.00E-02	***2.19E-06***
Methylene Chloride	3.80E-05	*9275*	0.0045	1	5	9	*0.001*	70	3285	***8.17E-06***	6.00E-02	***5.17E-09***
Tetrachloroethene	8.03E-04	*9275*	0.37	1	5	9	*0.001*	70	3285	***6.72E-04***	1.00E-02	***5.39E-05***
											Total Hazard Index	***8.36E-05***

Nonradionuclide carcinogens

IF = (SA x DP x ET x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

Chemical	C Surface Water Concentration (mg/l)	SA Skin Surface Area (cm^2)	DP Dermal Permeability (cm/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (day/yr)	ED Exposure Duration (years)	CF Conversion Factor (l/cm^3)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (l/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
1,1-Dichloroethene	5.00E-06	*9275*	0.016	1	5	9	*0.001*	70	25550	***3.73E-06***	6.00E-01	***1.12E-11***
Carbon Tetrachloride	4.81E-04	*9275*	0.022	1	5	9	*0.001*	70	25550	***5.13E-06***	1.30E-01	***3.21E-10***
Chloroform	9.30E-05	*9275*	0.13	1	5	9	*0.001*	70	25550	***3.03E-05***	6.10E-03	***1.72E-11***
Methylene Chloride	3.80E-05	*9275*	0.0045	1	5	9	*0.001*	70	25550	***1.05E-06***	7.50E-03	***2.99E-13***
Tetrachloroethene	8.03E-04	*9275*	0.37	1	5	9	*0.001*	70	25550	***8.63E-05***	5.20E-02	***3.61E-09***
Trichloroethene	6.24E-03	*9275*	0.23	1	5	9	*0.001*	70	25550	***5.37E-05***	1.10E-02	***3.68E-09***
											Total Cancer Risk	***7.64E-09***

HYPOTHETIC[illegible]NSITE RESIDENT
10-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

RME - Dermal contact with surface water - Walnut Creek

Noncarcinogens

IF = (SA x DP x ET x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

Chemical	C Surface Water Concentration (mg/l)	SA Skin Surface Area (cm^2)	DP Dermal Permeability (cm/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (day/yr)	ED Exposure Duration (years)	CF Conversion Factor (l/cm^3)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (l/kg-day)	RfD Reference Dose (mg/kg-day)	HQ Hazard Quotient
1,1-Dichloroethene	5.00E-06	***18150***	0.016	2.6	7	30	***0.001***	70	10950	***2.07E-04***	9.00E-03	***1.15E-07***
Carbon Tetrachloride	4.81E-04	***18150***	0.022	2.6	7	30	***0.001***	70	10950	***2.84E-04***	7.00E-04	***1.95E-04***
Chloroform	9.30E-05	***18150***	0.13	2.6	7	30	***0.001***	70	10950	***1.68E-03***	1.00E-02	***1.56E-05***
Methylene Chloride	3.80E-05	***18150***	0.0045	2.6	7	30	***0.001***	70	10950	***5.82E-05***	6.00E-02	***3.68E-08***
Tetrachloroethene	8.03E-04	***18150***	0.37	2.6	7	30	***0.001***	70	10950	***4.78E-03***	1.00E-02	***3.84E-04***
											Total Hazard Index	***5.95E-04***

Nonradionuclide carcinogens

IF = (SA x DP x ET x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

Chemical	C Surface Water Concentration (mg/l)	SA Skin Surface Area (cm^2)	DP Dermal Permeability (cm/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (day/yr)	ED Exposure Duration (years)	CF Conversion Factor (l/cm^3)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (l/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
1,1-Dichloroethene	5.00E-06	***18150***	0.016	2.6	7	30	***0.001***	70	25550	***8.87E-05***	6.00E-01	***2.66E-10***
Carbon Tetrachloride	4.81E-04	***18150***	0.022	2.6	7	30	***0.001***	70	25550	***1.22E-04***	1.30E-01	***7.62E-09***
Chloroform	9.30E-05	***18150***	0.13	2.6	7	30	***0.001***	70	25550	***7.20E-04***	6.10E-03	***4.09E-10***
Methylene Chloride	3.80E-05	***18150***	0.0045	2.6	7	30	***0.001***	70	25550	***2.49E-05***	7.50E-03	***7.11E-12***
Tetrachloroethene	8.03E-04	***18150***	0.37	2.6	7	30	***0.001***	70	25550	***2.05E-03***	5.20E-02	***8.56E-08***
Trichloroethene	6.24E-03	***18150***	0.23	2.6	7	30	***0.001***	70	25550	***1.27E-03***	1.10E-02	***8.75E-08***
											Total Cancer Risk	***1.81E-07***

Note: Changes from draft final to final are shown in italics/bold

HYPOTHETICA. .NSITE RESIDENT
10 ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

CT - Dermal contact with surface water - Woman Creek

Noncarcinogens

IF = (SA x DP x ET x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

Chemical	C Surface Water Concentration (mg/l)	SA Skin Surface Area (cm^2)	DP Dermal Permeability (cm/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (day/yr)	ED Exposure Duration (years)	CF Conversion Factor (l/cm^3)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (l/kg-day)	RfD Reference Dose (mg/kg-day)	HQ Hazard Quotient
1,1-Dichloroethene	2.00E-06	*9275*	0.016	1	5	9	*0.001*	70	3285	***2.90E-05***	9.00E-03	***6.45E-09***
Carbon Tetrachloride	2.62E-04	*9275*	0.022	1	5	9	*0.001*	70	3285	***3.99E-05***	7.00E-04	***1.49E-05***
Chloroform	2.15E-04	*9275*	0.13	1	5	9	*0.001*	70	3285	***2.36E-04***	1.00E-02	***5.07E-06***
Methylene Chloride	1.06E-04	*9275*	0.0045	1	5	9	*0.001*	70	3285	***8.17E-06***	6.00E-02	***1.44E-08***
Tetrachloroethene	1.16E-04	*9275*	0.37	1	5	9	*0.001*	70	3285	***6.72E-04***	1.00E-02	***7.79E-06***
											Total Hazard Index	***2.78E-05***

Nonradionuclide carcinogens

IF = (SA x DP x ET x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

Chemical	C Surface Water Concentration (mg/l)	SA Skin Surface Area (cm^2)	DP Dermal Permeability (cm/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (day/yr)	ED Exposure Duration (years)	CF Conversion Factor (l/cm^3)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (l/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
1,1-Dichloroethene	2.00E-06	*9275*	0.016	1	5	9	*0.001*	70	25550	***3.73E-06***	6.00E-01	***4.48E-12***
Carbon Tetrachloride	2.62E-04	*9275*	0.022	1	5	9	*0.001*	70	25550	***5.13E-06***	1.30E-01	***1.75E-10***
Chloroform	2.15E-04	*9275*	0.13	1	5	9	*0.001*	70	25550	***3.03E-05***	6.10E-03	***3.98E-11***
Methylene Chloride	1.06E-04	*9275*	0.0045	1	5	9	*0.001*	70	25550	***1.05E-06***	7.50E-03	***8.35E-13***
Tetrachloroethene	1.16E-04	*9275*	0.37	1	5	9	*0.001*	70	25550	***8.63E-05***	5.20E-02	***5.21E-10***
Trichloroethene	9.25E-04	*9275*	0.23	1	5	9	*0.001*	70	25550	***5.37E-05***	1.10E-02	***5.46E-10***
											Total Cancer Risk	***1.29E-09***

HYPOTHETICA. ONSITE RESIDENT
10 ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

RME - Dermal contact with surface water - Woman Creek

Noncarcinogens

IF = (SA x DP x ET x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

Chemical	C Surface Water Concentration (mg/l)	SA Skin Surface Area (cm^2)	DP Dermal Permeability (cm/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (day/yr)	ED Exposure Duration (years)	CF Conversion Factor (l/cm^3)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (l/kg-day)	RfD Reference Dose (mg/kg-day)	HQ Hazard Quotient
1,1-Dichloroethene	2.00E-06	***18150***	0.016	2.6	7	30	***0.001***	70	10950	***2.07E-04***	9.00E-03	***4.60E-08***
Carbon Tetrachloride	2.62E-04	***18150***	0.022	2.6	7	30	***0.001***	70	10950	***2.84E-04***	7.00E-04	***1.06E-04***
Chloroform	2.15E-04	***18150***	0.13	2.6	7	30	***0.001***	70	10950	***1.68E-03***	1.00E-02	***3.61E-05***
Methylene Chloride	1.06E-04	***18150***	0.0045	2.6	7	30	***0.001***	70	10950	***5.82E-05***	6.00E-02	***1.03E-07***
Tetrachloroethene	1.16E-04	***18150***	0.37	2.6	7	30	***0.001***	70	10950	***4.78E-03***	1.00E-02	***5.55E-05***
											Total Hazard Index	***1.98E-04***

Nonradionuclide carcinogens

IF = (SA x DP x ET x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

Chemical	C Surface Water Concentration (mg/l)	SA Skin Surface Area (cm^2)	DP Dermal Permeability (cm/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (day/yr)	ED Exposure Duration (years)	CF Conversion Factor (l/cm^3)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (l/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
1,1-Dichloroethene	2.00E-06	***18150***	0.016	2.6	7	30	***0.001***	70	25550	***8.87E-05***	6.00E-01	***1.06E-10***
Carbon Tetrachloride	2.62E-04	***18150***	0.022	2.6	7	30	***0.001***	70	25550	***1.22E-04***	1.30E-01	***4.15E-09***
Chloroform	2.15E-04	***18150***	0.13	2.6	7	30	***0.001***	70	25550	***7.20E-04***	6.10E-03	***9.45E-10***
Methylene Chloride	1.06E-04	***18150***	0.0045	2.6	7	30	***0.001***	70	25550	***2.49E-05***	7.50E-03	***1.98E-11***
Tetrachloroethene	1.16E-04	***18150***	0.37	2.6	7	30	***0.001***	70	25550	***2.05E-03***	5.20E-02	***1.24E-08***
Trichloroethene	9.25E-04	***18150***	0.23	2.6	7	30	***0.001***	70	25550	***1.27E-03***	1.10E-02	***1.30E-08***
											Total Cancer Risk	***3.06E-08***

Note: Changes from draft final to final are shown in italics/bold

SUMMARY OF RISKS
FUTURE INDUSTRIAL/OFFICE WORKER
30-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

	Central Tendency		Reasonable Maximum	
Pathway	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Ingestion of surface soil	1.02E-03	1.73E-06	1.30E-02	1.37E-04
Inhalation of particulates from surface soil	-	***3.35E-06***	-	***3.50E-05***
Dermal contact with surface soil*	1.03E-02	9.05E-08	6.52E-02	3.59E-06
Inhalation of Indoor VOCs	1.09E-09	5.67E-11	1.83E-09	5.92E-10
External Radiation	-	1.35E-07	-	1.53E-06
Total	1.13E-02	***5.31E-06***	7.82E-02	***1.77E-04***

* Dermal contact with metals (except mercury) and radionuclides is considered insignificant.

Note: Changes from draft final to final are shown in italics/bold

FUTURE INDUSTRIAL/OFFICE WORKER
30-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

CT Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

	C	IR	ET	EF	ED	DF	IF	SF	CR
Radionuclides	Air Concentration (pCi/m^3)	Inhalation Rate (m^3/hr)	Exposure Time (hr/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Deposition Factor	Intake Factor (m^3)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	8.11E-04	0.63	7.2	219	4	*1*	***3.97E+03***	3.20E-08	***1.03E-07***
Plutonium-239/240	2.15E-02	0.63	7.2	219	4	*1*	***3.97E+03***	3.80E-08	***3.25E-06***
								Total Radionuclide Cancer Risk	***3.35E-06***
								Total Cancer Risk	***3.35E-06***

RME Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

	C	IR	ET	EF	ED	DF	IF	SF	CR
Radionuclides	Air Concentration (pCi/m^3)	Inhalation Rate (m^3/hr)	Exposure Time (hr/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Deposition Factor	Intake Factor (m^3)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	8.11E-04	0.83	8	250	25	*1*	***4.15E+04***	3.20E-08	***1.08E-06***
Plutonium-239/240	2.15E-02	0.83	8	250	25	*1*	***4.15E+04***	3.80E-08	***3.39E-05***
								Total Radionuclide Cancer Risk	***3.50E-05***
								Total Cancer Risk	***3.50E-05***

Note: Changes from draft final to final are shown in italics/bold

SUMMARY OF RISK
FUTURE ONSITE ECOLOGICAL RESEARCHER
50-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

	Central Tendency		Reasonable Maximum	
Pathway	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Ingestion of surface soil	1.70E-03	1.46E-06	6.05E-03	5.20E-06
Inhalation of particulates from surface soil	-	***5.95E-07***	-	***1.11E-06***
Dermal contact with surface soil*	5.79E-03	3.19E-08	3.22E-02	1.77E-07
Ingestion of surface water - Walnut Creek	2.13E-06	1.86E-11	1.82E-05	1.59E-10
Ingestion of surface water - Woman Creek	1.12E-06	1.03E-10	9.59E-06	8.85E-10
Dermal contact with surface water - Walnut Creek	1.17E-04	2.97E-09	2.00E-04	5.09E-09
Dermal contact with surface water - Woman Creek	3.89E-05	5.00E-10	6.66E-05	8.58E-10
External Radiation	-	3.36E-08	-	4.21E-08
Total	7.64E-03	***2.12E-06***	3.85E-02	***6.55E-06***

* Dermal contact with metals (except mercury) and radionuclides is considered insignificant.

Note: Changes from draft final to final are shown in italics/bold

FUTURE ONSITE E. .OGICAL RESEARCHER
50-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

CT Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	7.28E-04	0.83	7.2	65	2.5	***1***	***9.71E+02***	3.20E-08	***2.26E-08***
Plutonium-239/240	1.55E-02	0.83	7.2	65	2.5	***1***	***9.71E+02***	3.80E-08	***5.72E-07***
							Total Radionuclide Cancer Risk		***5.95E-07***

Total Cancer Risk ***5.95E-07***

RME Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	7.28E-04	1.4	8	65	2.5	***1***	***1.82E+03***	3.20E-08	***4.24E-08***
Plutonium-239/240	1.55E-02	1.4	8	65	2.5	***1***	***1.82E+03***	3.80E-08	***1.07E-06***
							Total Radionuclide Cancer Risk		***1.11E-06***

Total Cancer Risk ***1.11E-06***

Note: Changes from draft final to final are shown in italics/bold

SUMMARY OF RISKS
CURRENT ONSITE WORKER
AREA OF CONCERN NO. 2

	Central Tendency		Reasonable Maximum	
Pathway	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Ingestion of surface soil	2.44E-07	3.66E-09	1.55E-06	1.45E-07
Inhalation of particulates from surface soil	-	***5.78E-09***	-	***4.58E-08***
Dermal contact with surface soil*	4.90E-08	7.85E-13	3.11E-07	3.11E-11
External Radiation	-	4.62E-10	-	5.23E-09
Total	2.93E-07	***9.90E-09***	1.86E-06	***1.96E-07***

* Dermal contact with metals (except mercury) and radionuclides is considered insignificant.

Note: Changes from draft final to final are shown in italics/bold

CURREN1 ,ITE WORKER
AREA OF CONCERN NO. 2

CT Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF x WF
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m³)	IR Inhalation Rate (m³/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	WF Weighting Factor	IF Intake Factor (m³)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	2.13E-05	0.83	7.2	219	4	***1***	0.17	***8.90E+02***	3.20E-08	***6.07E-10***
Plutonium-239/240	1.53E-04	0.83	7.2	219	4	***1***	0.17	***8.90E+02***	3.80E-08	***5.17E-09***
								Total Radionuclide Risk		***5.78E-09***

RME Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF x WF
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m³)	IR Inhalation Rate (m³/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	WF Weighting Factor	IF Intake Factor (m³)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	2.13E-05	0.83	8	250	25	***1***	0.17	***7.06E+03***	3.20E-08	***4.81E-09***
Plutonium-239/240	1.53E-04	0.83	8	250	25	***1***	0.17	***7.06E+03***	3.80E-08	***4.10E-08***
								Total Radionuclide Risk		***4.58E-08***

Total Cancer Risk ***4.58E-08***

Note: Changes from draft final to final are shown in italics/bold

SUMMARY OF RISKS
FUTURE INDUSTRIAL/OFFICE WORKER
AREA OF CONCERN NO. 2

	Central Tendency		Reasonable Maximum	
Pathway	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Ingestion of surface soil	7.17E-07	1.08E-08	9.10E-06	8.53E-07
Inhalation of particulates from surface soil	-	***2.58E-08***	-	***2.70E-07***
Dermal contact with surface soil*	1.78E-07	2.85E-12	1.13E-06	1.13E-10
Inhalation of indoor VOCs	8.51E-12	1.13E-14	1.42E-11	1.18E-13
External Radiation	-	2.72E-09	-	3.08E-08
Total	8.96E-07	***3.93E-08***	1.02E-05	***1.15E-06***

* Dermal contact with metals (except mercury) and radionuclides is considered insignificant.

Note: Changes from draft final to final are shown in italics/bold

FUTURE INDUS' .L/OFFICE WORKER
AREA OF CONCERN NO. 2

CT Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF x DF

	C	IR	ET	EF	ED	DF	IF	SF	CR
Radionuclides	Air Concentration (pCi/m^3)	Inhalation Rate (m^3/hr)	Exposure Time (hr/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Deposition Factor	Intake Factor (m^3)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	2.13E-05	0.63	7.2	219	4	*1*	***3.97E+03***	3.20E-08	***2.71E-09***
Plutonium-239/240	1.53E-04	0.63	7.2	219	4	*1*	***3.97E+03***	3.80E-08	***2.31E-08***
								Total Radionuclide Cancer Risk	***2.58E-08***

Total Cancer Risk ***2.58E-08***

RME Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

	C	IR	ET	EF	ED	DF	IF	SF	CR
Radionuclides	Air Concentration (pCi/m^3)	Inhalation Rate (m^3/hr)	Exposure Time (hr/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Deposition Factor	Intake Factor (m^3)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	2.13E-05	0.83	8	250	25	*1*	***4.15E+04***	3.20E-08	***2.83E-08***
Plutonium-239/240	1.53E-04	0.83	8	250	25	*1*	***4.15E+04***	3.80E-08	***2.41E-07***
								Total Radionuclide Cancer Risk	***2.70E-07***

Total Cancer Risk ***2.70E-07***

Note: Changes from draft final to final are shown in italics/bold

SUMMARY OF RISK
FUTURE ONSITE ECOLOGICAL RESEARCHER
AREA OF CONCERN NO. 2

	Central Tendency		Reasonable Maximum	
Pathway	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Ingestion of surface soil	1.40E-06	1.32E-08	5.00E-06	4.70E-08
Inhalation of particulates from surface soil	-	***6.31E-09***	-	***1.18E-08***
Dermal contact with surface soil*	1.18E-07	1.18E-12	6.56E-07	6.58E-12
Ingestion of surface water - Walnut Creek	2.13E-06	1.86E-11	1.82E-05	1.59E-10
Ingestion of surface water - Woman Creek	1.12E-06	1.03E-10	9.59E-06	8.85E-10
Dermal contact with surface water- Walnut Creek	1.17E-04	2.97E-09	2.00E-04	5.09E-09
Dermal contact with surface water - Woman Creek	3.89E-05	5.00E-10	6.66E-05	8.58E-10
External Radiation	-	8.15E-10	-	1.02E-09
Total	1.60E-04	***2.39E-08***	3.00E-04	***6.69E-08***

* Dermal contact with metals (except mercury) and radionuclides is considered insignificant.

Note: Changes from draft final to final are shown in italics/bold

FUTURE ONSITE EC LOGICAL RESEARCHER
AREA OF CONCERN NO. 2

CT Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	2.13E-05	0.83	7.2	65	2.5	*1*	***9.71E+02***	3.20E-08	***6.62E-10***
Plutonium-239/240	1.53E-04	0.83	7.2	65	2.5	*1*	***9.71E+02***	3.80E-08	***5.65E-09***
								Total Radionuclide Cancer Risk	***6.31E-09***
								Total Cancer Risk	***6.31E-09***

RME Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	2.13E-05	1.4	8	65	2.5	*1*	***1.82E+03***	3.20E-08	***1.24E-09***
Plutonium-239/240	1.53E-04	1.4	8	65	2.5	*1*	***1.82E+03***	3.80E-08	***1.06E-08***
								Total Radionuclide Cancer Risk	***1.18E-08***
								Total Cancer Risk	***1.18E-08***

Note: Changes from draft final to final are shown in italics/bold

SUMMARY OF RISK
OPEN SPACE USER
AREA OF CONCERN NO. 2

	Central Tendency		Reasonable Maximum	
Pathway	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Ingestion of surface soil by an adult	5.82E-08	-	9.10E-07	-
Ingestion of surface soil by a child	5.10E-07	-	8.49E-06	-
Carcinogenic effects of soil ingestion	-	2.35E-09	-	1.23E-07
Inhalation of particulates from surface soil	-	***7.28E-10***	-	***3.41E-08***
Dermal contact with surface soil*	1.29E-09	4.65E-14	1.43E-07	1.71E-11
Ingestion of surface water - Walnut Creek	1.90E-06	5.96E-11	2.28E-05	2.39E-09
Ingestion of surface water - Woman Creek	1.00E-06	3.32E-10	1.20E-05	1.33E-08
Dermal contact with surface water - Walnut Creek	2.05E-05	1.87E-09	2.51E-04	7.64E-08
Dermal contact with surface water - Woman Creek	6.83E-06	3.16E-10	8.35E-05	1.29E-08
External Radiation	-	1.52E-10	-	3.08E-09
Total	3.08E-05	***5.81E-09***	3.79E-04	***2.65E-07***

* Dermal contact with metals (except mercury) and radionuclides is considered insignificant.

Note: Changes from draft final to final are shown in italics/bold

OPEN . .CE USER
AREA OF CONCERN NO. 2

CT Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	2.13E-05	0.83	1.5	10	9	***1***	***1.12E+02***	3.20E-08	***7.64E-11***
Plutonium-239/240	1.53E-04	0.83	1.5	10	9	***1***	***1.12E+02***	3.80E-08	***6.51E-10***
								Total Radionuclide Cancer Risk	***7.28E-10***
								Total Cancer Risk	***7.28E-10***

RME Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	2.13E-05	1.4	5	25	30	***1***	***5.25E+03***	3.20E-08	***3.58E-09***
Plutonium-239/240	1.53E-04	1.4	5	25	30	***1***	***5.25E+03***	3.80E-08	***3.05E-08***
								Total Radionuclide Cancer Risk	***3.41E-08***
								Total Cancer Risk	***3.41E-08***

Note: Changes from draft final to final are shown in italics/bold

SUMMARY OF RISK
FUTURE ONSITE CONSTRUCTION WORKER
AREA OF CONCERN NO. 2

	Central Tendency		Reasonable Maximum	
Pathway	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Ingestion of subsurface soil	3.23E-03	2.52E-08	1.82E-02	1.41E-07
Inhalation of particulates from surface and subsurface soil	-	***1.75E-09***	-	***2.18E-09***
Dermal contact with subsurface soil*	-	-	-	-
External Radiation	-	1.53E-09	-	1.91E-09
Total	3.23E-03	***2.85E-08***	1.82E-02	***1.46E-07***

*Dermal absorption of metals and radionuclides is considered insignificant.

Note: Changes from draft final to final are shown in italics/bold

FUTURE ONSITE C TRUCTION WORKER
AREA OF CONCERN NO. 2

CT Inhalation of Particulates - Nonradionuclide Carcinogens

IF = (IR x ET x EF x ED x DF)/(BW x AT)
CR = IF x C x SF

Chemical	C Air Concentration (mg/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (m^3/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Arsenic	1.34E-10	1.25	7.2	30	1	*1*	70	25550	***1.51E-04***	1.50E+01	***3.03E-13***
Cadmium (food)	5.54E-12	1.25	7.2	30	1	*1*	70	25550	***1.51E-04***	6.30E+00	***5.27E-15***
										Total Chemical Cancer Risk	***3.09E-13***

Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	2.13E-05	1.25	7.2	30	1	*1*	***2.70E+02***	3.20E-08	***1.84E-10***
Plutonium-239/240	1.53E-04	1.25	7.2	30	1	*1*	***2.70E+02***	3.80E-08	***1.57E-09***
Uranium-233/234	1.36E-08	1.25	7.2	30	1	*1*	***2.70E+02***	2.60E-08	***9.55E-14***
Uranium-235	7.92E-10	1.25	7.2	30	1	*1*	***2.70E+02***	2.50E-08	***5.35E-15***
Uranium-238	1.25E-08	1.25	7.2	30	1	*1*	***2.70E+02***	2.40E-08	***8.10E-14***
								Total Radionuclide Cancer Risk	***1.75E-09***

Total Cancer Risk ***1.75E-09***

FUTURE ONSITE C..STRUCTION WORKER
AREA OF CONCERN NO. 2

RME Inhalation of Particulates - Nonradionuclide Carcinogens

IF = (IR x ET x EF x ED x DF)/(BW x AT)
CR = IF x C x SF

Chemical	C Air Concentration (mg/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (m^3/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Arsenic	1.34E-10	1.4	8	30	1	*1*	70	25550	***1.88E-04***	1.50E+01	***3.78E-13***
Cadmium (food)	5.54E-12	1.4	8	30	1	*1*	70	25550	***1.88E-04***	6.30E+00	***6.56E-15***
										Total Chemical Cancer Risk	***3.84E-13***

Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	2.13E-05	1.4	8	30	1	*1*	***3.36E+02***	3.20E-08	***2.29E-10***
Plutonium-239/240	1.53E-04	1.4	8	30	1	*1*	***3.36E+02***	3.80E-08	***1.95E-09***
Uranium-233/234	1.36E-08	1.4	8	30	1	*1*	***3.36E+02***	2.60E-08	***1.19E-13***
Uranium-235	7.92E-10	1.4	8	30	1	*1*	***3.36E+02***	2.50E-08	***6.65E-15***
Uranium-238	1.25E-08	1.4	8	30	1	*1*	***3.36E+02***	2.40E-08	***1.01E-13***
								Total Radionuclide Cancer Risk	***2.18E-09***

Total Cancer Risk ***2.18E-09***

Note: Changes from draft final to final are shown in italics/bold

SUMMARY OF RISK
HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 2

	Central Tendency		Reasonable Maximum	
Pathway	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Ingestion of surface soil by an adult	5.45E-06	-	2.55E-05	-
Ingestion of surface soil by a child	6.52E-05	-	2.38E-04	
Carcinogenic effects of soil ingestion	-	2.48E-07	-	3.44E-06
Inhalation of particulates from surface soil	-	***1.29E-07***	-	***1.36E-06***
Dermal contact with surface soil*	1.29E-07	4.64E-12	3.99E-06	4.79E-10
Ingestion of vegetables with soil deposition	2.60E-08	8.75E-10	1.94E-07	2.18E-08
Ingestion of fruit with soil deposition	3.39E-08	1.14E-09	2.37E-07	2.67E-08
Ingestion of leafy vegetables with root uptake	1.18E-05	9.35E-09	4.42E-05	1.16E-07
Ingestion of other produce with root uptake	1.42E-04	1.20E-08	4.97E-04	8.47E-08
Ingestion of groundwater	6.04E-04	3.10E-07	4.30E-03	7.35E-06
Ingestion of surface water - Walnut Creek	1.52E-06	4.77E-11	2.77E-05	2.89E-09
Ingestion of surface water - Woman Creek	8.01E-07	2.66E-10	1.46E-05	1.61E-08
Dermal contact with surface water - Walnut Creek	8.36E-05	7.64E-09	5.95E-04	1.81E-07
Dermal contact with surface water - Woman Creek	2.78E-05	1.29E-09	1.98E-04	3.06E-08
Inhalation of VOCs from infiltration	1.89E-11	5.64E-14	4.53E-11	4.50E-13
Inhalation of VOCs from groundwater use	2.07E-05	3.09E-08	4.95E-05	2.47E-07
External Radiation	-	1.63E-08	-	1.74E-07
Total	9.63E-04	*7.67E-07*	6.00E-03	***1.31E-05***

* Dermal contact with metals (except mercury) and radionuclides is considered insignificant.

Note: Changes from draft final to final are shown in italics/bold

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 2

CT Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	2.13E-05	0.63	15	234	9	***1***	***1.99E+04***	3.20E-08	***1.36E-08***
Plutonium-239/240	1.53E-04	0.63	15	234	9	***1***	***1.99E+04***	3.80E-08	***1.16E-07***
								Total Radionuclide Cancer Risk	***1.29E-07***

Total Cancer Risk ***1.29E-07***

RME Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	2.13E-05	0.83	24	350	30	***1***	***2.09E+05***	3.20E-08	***1.43E-07***
Plutonium-239/240	1.53E-04	0.83	24	350	30	***1***	***2.09E+05***	3.80E-08	***1.22E-06***
								Total Radionuclide Cancer Risk	***1.36E-06***

Total Cancer Risk ***1.36E-06***

Note: Changes from draft final to final are shown in italics/bold

SUMMARY OF RISK
CURRENT OFFSITE RESIDENT
SOUTHEAST
AREA OF CONCERN NO. 1

	Central Tendency		Reasonable Maximum	
Pathway	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Ingestion of surface soil by a child*	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of surface soil by an adult*	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Carcinogenic effects of soil ingestion*	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of particulates from surface soil	0.00E+00	***1.40E-09***	0.00E+00	***1.47E-08***
Dermal contact with surface soil*	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of vegetables with soil deposition*	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of fruit with soil deposition*	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total	0.00E+00	***1.40E-09***	0.00E+00	***1.47E-08***

* Windborne contaminants from AOC No. 1 are not deposited in significant concentrations at this location.

Note: Changes from draft final to final are shown in italics/bold

CURRENT ‹ . SITE RESIDENT
SOUTHEAST
AREA OF CONCERN NO. 1

CT Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration[1] (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	6.49E-08	0.63	15	234	9	*1*	***1.99E+04***	3.20E-08	***4.13E-11***
Plutonium-239/240	1.79E-06	0.63	15	234	9	*1*	***1.99E+04***	3.80E-08	***1.35E-09***
							Total Radionuclide Cancer Risk		***1.40E-09***

Total Cancer Risk ***1.40E-09***

RME Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration[1] (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	6.49E-08	0.83	24	350	30	*1*	***2.09E+05***	3.20E-08	***4.34E-10***
Plutonium-239/240	1.79E-06	0.83	24	350	30	*1*	***2.09E+05***	3.80E-08	***1.42E-08***
							Total Radionuclide Cancer Risk		***1.47E-08***

Total Cancer Risk ***1.47E-08***

Note: Changes from draft final to final are shown in italics/bold

SUMMARY OF RISK
FUTURE OFFSITE RESIDENT
WOMAN CREEK
AREA OF CONCERN NO. 1

	Central Tendency		Reasonable Maximum	
Pathway	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Ingestion of surface soil by an adult*	0.00E+00	-	0.00E+00	-
Ingestion of surface soil by a child*	0.00E+00	-	0.00E+00	-
Carcinogenic effects of soil ingestion*	-	0.00E+00	-	0.00E+00
Inhalation of particulates from surface soil	0.00E+00	***8.26E-10***	0.00E+00	***8.68E-09***
Dermal contact with surface soil*	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of vegetables with soil deposition*	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of fruit with soil deposition*	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of surface water	8.01E-07	2.66E-10	1.46E-05	1.61E-08
Dermal contact with surface water	2.78E-05	1.29E-09	1.98E-04	3.06E-08
Total	2.86E-05	***2.38E-09***	2.13E-04	***5.54E-08***

* Windborne COCs from AOC No. 1 surface soil are not deposited in significant quantities at this receptor location.

FUTURE O[illegible]TE RESIDENT
WOMAN CREEK
AREA OF CONCERN NO. 1

CT Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

	C	IR	ET	EF	ED	DF	IF	SF	CR
Radionuclides	Air Concentration (pCi/m^3)	Inhalation Rate (m^3/hr)	Exposure Time (hr/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Deposition Factor	Intake Factor (m^3)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	3.85E-08	0.63	15	234	9	*1*	***1.99E+04***	3.20E-08	***2.45E-11***
Plutonium-239/240	1.06E-06	0.63	15	234	9	*1*	***1.99E+04***	3.80E-08	***8.02E-10***
								Total Radionuclide Cancer Risk	***8.26E-10***
								Total Cancer Risk	***8.26E-10***

RME Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

	C	IR	ET	EF	ED	DF	IF	SF	CR
Radionuclides	Air Concentration (pCi/m^3)	Inhalation Rate (m^3/hr)	Exposure Time (hr/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Deposition Factor	Intake Factor (m^3)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	3.85E-08	0.83	24	350	30	*1*	***2.09E+05***	3.20E-08	***2.58E-10***
Plutonium-239/240	1.06E-06	0.83	24	350	30	*1*	***2.09E+05***	3.80E-08	***8.42E-09***
								Total Radionuclide Cancer Risk	***8.68E-09***
								Total Cancer Risk	***8.68E-09***

Note: Changes from draft final to final are shown in italics/bold

SUMMARY OF RISK
CURRENT OFFSITE RESIDENT
INDIANA SOUTH
AREA OF CONCERN NO. 2

	Central Tendency		Reasonable Maximum	
Pathway	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Ingestion of surface soil by an adult*	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of surface soil by a child*	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Carcinogenic effects of soil ingestion*	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Inhalation of particulates from surface soil	0.00E+00	***8.63E-13***	0.00E+00	***9.07E-12***
Dermal contact with surface soil*	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of vegetables with soil deposition*	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of fruit with soil deposition*	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total	0.00E+00	***8.63E-13***	0.00E+00	***9.07E-12***

* Windborne contaminants from AOC No. 2 are not deposited in significant concentrations at this location.

Note: Changes from draft final to final are shown in italics/bold

CURRENT O_ SITE RESIDENT
INDIANA SOUTH
AREA OF CONCERN NO. 2

CT Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration[1] (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	1.44E-10	0.63	15	234	9	*1*	***1.99E+04***	3.20E-08	***9.17E-14***
Plutonium-239/240	1.02E-09	0.63	15	234	9	*1*	***1.99E+04***	3.80E-08	***7.71E-13***
								Total Radionuclide Cancer Risk	***8.63E-13***
								Total Cancer Risk	***8.63E-13***

RME Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration[1] (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	1.44E-10	0.83	24	350	30	*1*	***2.09E+05***	3.20E-08	***9.64E-13***
Plutonium-239/240	1.02E-09	0.83	24	350	30	*1*	***2.09E+05***	3.80E-08	***8.11E-12***
								Total Radionuclide Cancer Risk	***9.07E-12***
								Total Cancer Risk	***9.07E-12***

Note: Changes from draft final to final are shown in italics/bold

SUMMARY OF RISK
CURRENT OFFSITE RESIDENT
SOUTHEAST
AREA OF CONCERN NO. 2

	Central Tendency		Reasonable Maximum	
Pathway	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Ingestion of surface soil by an adult	2.76E-12	-	1.29E-11	-
Ingestion of surface soil by a child	3.30E-11	-	1.20E-10	-
Carcinogenic effects of soil ingestion	-	1.24E-13	-	1.73E-12
Inhalation of particulates from surface soil	0.00E+00	***5.72E-11***	0.00E+00	***6.01E-10***
Dermal contact with surface soil*	6.53E-14	2.35E-18	2.02E-12	2.43E-16
Ingestion of vegetables with soil deposition	3.41E-11	1.14E-12	2.55E-10	2.84E-11
Ingestion of fruit with soil deposition	4.46E-11	1.49E-12	3.12E-10	3.48E-11
Total	1.15E-10	***5.99E-11***	7.03E-10	***6.66E-10***

* Dermal contact with metals (except mercury) and radionuclides is considered insignificant.

Note: Changes from draft final to final are shown in italics/bold

CURRENT O. SITE RESIDENT
SOUTHEAST
AREA OF CONCERN NO. 2

CT Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

	C	IR	ET	EF	ED	DF	IF	SF	CR
Radionuclides	Air Concentration (pCi/m^3)	Inhalation Rate (m^3/hr)	Exposure Time (hr/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Deposition Factor	Intake Factor (m^3)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	9.51E-09	0.63	15	234	9	*1*	***1.99E+04***	3.20E-08	***6.06E-12***
Plutonium-239/240	6.76E-08	0.63	15	234	9	*1*	***1.99E+04***	3.80E-08	***5.11E-11***
								Total Radionuclide Cancer Risk	***5.72E-11***
								Total Cancer Risk	***5.72E-11***

RME Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

	C	IR	ET	EF	ED	DF	IF	SF	CR
Radionuclides	Air Concentration (pCi/m^3)	Inhalation Rate (m^3/hr)	Exposure Time (hr/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Deposition Factor	Intake Factor (m^3)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	9.51E-09	0.83	24	350	30	*1*	***2.09E+05***	3.20E-08	***6.37E-11***
Plutonium-239/240	6.76E-08	0.83	24	350	30	*1*	***2.09E+05***	3.80E-08	***5.37E-10***
								Total Radionuclide Cancer Risk	***6.01E-10***
								Total Cancer Risk	***6.01E-10***

Note: Changes from draft final to final are shown in italics/bold

SUMMARY OF RISK
FUTURE OFFSITE RESIDENT
WALNUT CREEK
AREA OF CONCERN NO. 2

	Central Tendency		Reasonable Maximum	
Pathway	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Ingestion of surface soil by an adult*	0.00E+00	-	0.00E+00	-
Ingestion of surface soil by a child*	0.00E+00	-	0.00E+00	-
Carcinogenic effects of soil ingestion*	-	0.00E+00	-	0.00E+00
Inhalation of particulates from surface soil	0.00E+00	***2.60E-12***	0.00E+00	***2.73E-11***
Dermal contact with surface soil*	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of vegetables with soil deposition*	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of fruit with soil deposition*	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ingestion of surface water	1.52E-06	4.77E-11	2.77E-05	2.89E-09
Dermal contact with surface water	8.36E-05	7.64E-09	5.95E-04	1.81E-07
Total	8.51E-05	7.69E-09	6.23E-04	1.84E-07

* Windborne contaminants from AOC No. 2 are not deposited in significant concentrations at this location.

Note: Changes from draft final to final are shown in italics/bold

FUTURE O[illegible] .TE RESIDENT
WALNUT CREEK
AREA OF CONCERN NO. 2

CT Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

	C	IR	ET	EF	ED	DF	IF	SF	CR
Radionuclides	Air Concentration (pCi/m^3)	Inhalation Rate (m^3/hr)	Exposure Time (hr/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Deposition Factor	Intake Factor (m^3)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	4.33E-10	0.63	15	234	9	*1*	***1.99E+04***	3.20E-08	***2.76E-13***
Plutonium-239/240	3.07E-09	0.63	15	234	9	*1*	***1.99E+04***	3.80E-08	***2.32E-12***
								Total Radionuclide Cancer Risk	***2.60E-12***
								Total Cancer Risk	***2.60E-12***

RME Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

	C	IR	ET	EF	ED	DF	IF	SF	CR
Radionuclides	Air Concentration (pCi/m^3)	Inhalation Rate (m^3/hr)	Exposure Time (hr/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Deposition Factor	Intake Factor (m^3)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	4.33E-10	0.83	24	350	30	*1*	***2.09E+05***	3.20E-08	***2.90E-12***
Plutonium-239/240	3.07E-09	0.83	24	350	30	*1*	***2.09E+05***	3.80E-08	***2.44E-11***
								Total Radionuclide Cancer Risk	***2.73E-11***
								Total Cancer Risk	***2.73E-11***

Note: Changes from draft final to final are shown in italics/bold

SUMMARY OF RISK
FUTURE OFFSITE RESIDENT
WOMAN CREEK
AREA OF CONCERN NO. 2

	Central Tendency		Reasonable Maximum	
Pathway	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Ingestion of surface soil by an adult	2.76E-12	-	1.29E-11	-
Ingestion of surface soil by a child	3.30E-11	-	1.20E-10	-
Carcinogenic effects of soil ingestion	-	1.24E-13	-	1.73E-12
Inhalation of particulates from surface soil	-	***3.21E-11***	-	***3.37E-10***
Dermal contact with surface soil*	6.53E-14	2.35E-18	2.02E-12	2.43E-16
Ingestion of vegetables with soil deposition	3.41E-11	1.14E-12	2.55E-10	2.84E-11
Ingestion of fruit with soil deposition	4.46E-11	1.49E-12	3.12E-10	3.48E-11
Ingestion of surface water	8.01E-07	2.66E-10	1.46E-05	1.61E-08
Dermal contact with surface water	2.78E-05	1.29E-09	1.98E-04	3.06E-08
Total	2.86E-05	***1.59E-09***	2.13E-04	***4.71E-08***

* Dermal contact with metals (except mercury) and radionuclides is considered insignificant.

Note: Changes from draft final to final are shown in italics/bold

FUTURE OI.. .ATE RESIDENT
WOMAN CREEK
AREA OF CONCERN NO. 2

CT Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

	C	IR	ET	EF	ED	DF	IF	SF	CR
Radionuclides	Air Concentration (pCi/m^3)	Inhalation Rate (m^3/hr)	Exposure Time (hr/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Deposition Factor	Intake Factor (m^3)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	5.32E-09	0.63	15	234	9	*1*	***1.99E+04***	3.20E-08	***3.39E-12***
Plutonium-239/240	3.79E-08	0.63	15	234	9	*1*	***1.99E+04***	3.80E-08	***2.87E-11***
								Total Radionuclide Cancer Risk	***3.21E-11***

Total Cancer Risk ***3.21E-11***

RME Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

	C	IR	ET	EF	ED	DF	IF	SF	CR
Radionuclides	Air Concentration (pCi/m^3)	Inhalation Rate (m^3/hr)	Exposure Time (hr/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Deposition Factor	Intake Factor (m^3)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	5.32E-09	0.83	24	350	30	*1*	***2.09E+05***	3.20E-08	***3.56E-11***
Plutonium-239/240	3.79E-08	0.83	24	350	30	*1*	***2.09E+05***	3.80E-08	***3.01E-10***
								Total Radionuclide Cancer Risk	***3.37E-10***

Total Cancer Risk 3.37E-10

HYPOTHETIC. ›NSITE RESIDENT
10-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

CT - Ingestion of leafy produces with root uptake

Noncarcinogens

$$IF = (IR \times FP \times FH \times FC \times ME \times EF \times ED \times CF)/(BW \times AT)$$
$$HQ = (C \times IF)/RfD$$

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	RfD	HQ
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient
Bis(2-ethylhexyl)phthalate	3.27E-02	340000	0.06	0.25	1	150	9	0.000001	70	3285	2.99E-05	2.00E-02	4.90E-05
Chromium	5.36E-02	340000	0.06	0.25	1	150	9	0.000001	70	3285	2.99E-05	1.00E+00	1.60E-06
												Total Hazard Index	5.06E-05

HYPOTHETICAL ONSITE RESIDENT
10-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

CT - Ingestion of leafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FC x FP x FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Bis(2-ethylhexyl)phthalate	3.27E-02	340000	0.06	0.25	1	150	9	0.000001	70	25550	3.85E-06	1.40E-02	1.76E-09
										Total Chemical Cancer Risk			1.76E-09

Radionuclides

IF = IR x FP x FH x FC x ME x EF x ED x CF
CR = C x IF x SF

Radionuclide	C Concentration in Produce (pCi/g)	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (g/mg)	IF Intake Factor (g)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	2.06E-01	340000	0.06	0.25	1	150	9	0.001	6.89E+03	2.40E-10	3.40E-07
Plutonium-239/240	7.76E-02	340000	0.06	0.25	1	150	9	0.001	6.89E+03	2.30E-10	1.23E-07
								Total Radionuclide Cancer Risk			4.63E-07
									Total Cancer Risk		4.65E-07

HYPOTHETIC.. ONSITE RESIDENT
10-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

RME - Ingestion of leafy produces with root uptake

Noncarcinogens

IF = (IR x FC x FP x FH x ME x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	RfD	HQ
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient
Bis(2-ethylhexyl)phthalate	3.27E-02	340000	0.06	0.4	1	350	30	0.000001	70	10950	1.12E-04	2.00E-02	1.83E-04
Chromium	5.36E-02	340000	0.06	0.4	1	350	30	0.000001	70	10950	1.12E-04	1.00E+00	5.99E-06
												Total Hazard Index	1.89E-04

HYPOTHETIC. ONSITE RESIDENT
10-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

RME - Ingestion of leafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FPx FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Bis(2-ethylhexyl)phthalate	3.27E-02	340000	0.06	0.4	1	350	30	0.000001	70	25550	4.79E-05	1.40E-02	2.19E-08
											Total Chemical Cancer Risk		2.19E-08

Radionuclides

IF = IR x FC x FP xFH x ME x EF x ED x CF
CR = C x IF x SF

Radionuclide	C Concentration in Produce (pCi/g)	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (g/mg)	IF Intake Factor (g)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	2.06E-01	340000	0.06	0.4	1	350	30	0.001	8.57E+04	2.40E-10	4.24E-06
Plutonium-239/240	7.76E-02	340000	0.06	0.4	1	350	30	0.001	8.57E+04	2.30E-10	1.53E-06
							Total Radionuclide Cancer Risk				5.77E-06
								Total Cancer Risk			5.79E-06

Note: Changes from draft final to final are shown in italics/bold

(1) Fraction of ingested produce that is leafy; transfer coefficient (Bv) is used to estimate root uptake (Baes et al. 1984)

HYPOTHETICA ONSITE RESIDENT
10-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

CT - Ingestion of fruit and nonleafy produces with root uptake

Noncarcinogens

IF = (IR x FP x FH xFC x ME x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	RfD	HQ
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient
Bis(2-ethylhexyl)phthalate	3.27E-02	340000	0.94	0.2	1	150	9	0.000001	70	3285	3.75E-04	2.00E-02	6.14E-04
Chromium	3.22E-02	340000	0.94	0.2	1	150	9	0.000001	70	3285	3.75E-04	1.00E+00	1.21E-05
												Total Hazard Index	6.26E-04

HYPOTHETICA ONSITE RESIDENT
10-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

CT - Ingestion of fruit and nonleafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FC x FP x FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Bis(2-ethylhexyl)phthalate	3.27E-02	340000	0.94	0.2	1	150	9	0.000001	70	25550	4.82E-05	1.40E-02	2.21E-08
											Total Chemical Cancer Risk		4.82E-05

Radionuclides

IF = IR x FP x FH x FC x ME x EF x ED x CF
CR = C x IF x SF

Radionuclide	C Concentration in Produce (pCi/g)	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (g/mg)	IF Intake Factor (g)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	9.38E-03	340000	0.94	0.2	1	150	9	0.001	8.63E+04	2.40E-10	1.94E-07
Plutonium-239/240	7.76E-03	340000	0.94	0.2	1	150	9	0.001	8.63E+04	2.30E-10	1.54E-07
										Total Radionuclide Cancer Risk	3.48E-07
										Total Cancer Risk	4.86E-05

HYPOTHETICAL ONSITE RESIDENT
10-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

RME - Ingestion of fruit and nonleafy produces with root uptake

Noncarcinogens

IF = (IR x FC x FP x FH x ME x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	RfD	HQ
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient
Bis(2-ethylhexyl)phthalate	3.27E-02	340000	0.94	0.3	1	350	30	0.000001	70	10950	1.31E-03	2.00E-02	2.15E-03
Chromium	3.22E-02	340000	0.94	0.3	1	350	30	0.000001	70	10950	1.31E-03	1.00E+00	4.23E-05
								Total Hazard Index					2.19E-03

HYPOTHETICAL ONSITE RESIDENT
10-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

RME - Ingestion of fruit and nonleafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FPx FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Bis(2-ethylhexyl)phthalate	3.27E-02	340000	0.94	0.3	1	350	30	0.000001	70	25550	5.63E-04	1.40E-02	2.58E-07
												Total Chemical Cancer Risk	2.58E-07

Radionuclides

IF = IR x FC x FP xFH x ME x EF x ED x CF
CR = C x IF x SF

Radionuclide	C Concentration in Produce (pCi/g)	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (g/mg)	IF Intake Factor (g)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	9.38E-03	340000	0.94	0.3	1	350	30	0.001	1.01E+06	2.40E-10	2.27E-06
Plutonium-239/240	7.76E-03	340000	0.94	0.3	1	350	30	0.001	1.01E+06	2.30E-10	1.80E-06
										Total Radionuclide Cancer Risk	4.06E-06

Total Cancer Risk 4.32E-06

Note: Changes from draft final to final are shown in italics/bold

(1) Fraction of ingested produce that is fruit or nonleafy; transfer coefficient (Br) is used to estimate root uptake (Baes et al. 1984)

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 1

CT - Ingestion of fruit and nonleafy produces with root uptake

Noncarcinogens

IF = (IR x FP x FH xFC x ME x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	RfD	HQ
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient
Aroclor-1254	1.13E-03	340000	0.94	0.2	0.5	150	9	0.000001	70	3285	1.88E-04	2.00E-05	1.06E-02
Aroclor-1260	3.84E-04	340000	0.94	0.2	0.5	150	9	0.000001	70	3285	1.88E-04	2.00E-05	3.60E-03
Bis(2-ethylhexyl)phthalate	1.54E-02	340000	0.94	0.2	1	150	9	0.000001	70	3285	3.75E-04	2.00E-02	2.89E-04
Chromium	2.62E-02	340000	0.94	0.2	1	150	9	0.000001	70	3285	3.75E-04	1.00E+00	9.83E-06
												Total Hazard Index	1.45E-02

HYPOTHETICA. ONSITE RESIDENT
AREA OF CONCERN NO. 1

CT - Ingestion of fruit and nonleafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FC x FP x FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	SF	CR
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Slope Factor 1/(mg/kg-day)	Cancer Risk
Aroclor-1254	1.13E-03	340000	0.94	0.2	0.5	150	9	0.000001	70	25550	2.41E-05	7.70E+00	2.10E-07
Aroclor-1260	3.84E-04	340000	0.94	0.2	0.5	150	9	0.000001	70	25550	2.41E-05	7.70E+00	7.13E-08
Bis(2-ethylhexyl)phthalate	1.54E-02	340000	0.94	0.2	1	150	9	0.000001	70	25550	4.82E-05	1.40E-02	1.04E-08
											Total Chemical Cancer Risk		2.92E-07

Radionuclides

IF = IR x FP x FH x FC x ME x EF x ED x CF
CR = C x IF x SF

	C	IR	FP	FH	ME	EF	ED	CF	IF	SF	CR
Radionuclide	Concentration in Produce (pCi/g)	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (g/mg)	Intake Factor (g)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	3.16E-03	340000	0.94	0.2	1	150	9	0.001	8.63E+04	2.40E-10	6.54E-08
Plutonium-239/240	1.57E-02	340000	0.94	0.2	1	150	9	0.001	8.63E+04	2.30E-10	3.12E-07
										Total Radionuclide Cancer Risk	3.77E-07
										Total Cancer Risk	6.69E-07

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 1

RME - Ingestion of fruit and nonleafy produces with root uptake

Noncarcinogens

IF = (IR x FC x FP x FH x ME x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	RfD Reference Dose (mg/kg-day)	HQ Hazard Quotient
Aroclor-1254	1.13E-03	340000	0.94	0.3	0.5	350	30	0.000001	70	10950	6.57E-04	2.00E-05	3.71E-02
Aroclor-1260	3.84E-04	340000	0.94	0.3	0.5	350	30	0.000001	70	10950	6.57E-04	2.00E-05	1.26E-02
Bis(2-ethylhexyl)phthalate	1.54E-02	340000	0.94	0.3	1	350	30	0.000001	70	10950	1.31E-03	2.00E-02	1.01E-03
Chromium	2.62E-02	340000	0.94	0.3	1	350	30	0.000001	70	10950	1.31E-03	1.00E+00	3.44E-05
								Total Hazard Index					5.08E-02

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 1

RME - Ingestion of fruit and nonleafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FPx FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Aroclor-1254	1.13E-03	340000	0.94	0.3	0.5	350	30	0.000001	70	25550	2.81E-04	7.70E+00	2.45E-06
Aroclor-1260	3.84E-04	340000	0.94	0.3	0.5	350	30	0.000001	70	25550	2.81E-04	7.70E+00	8.32E-07
Bis(2-ethylhexyl)phthalate	1.54E-02	340000	0.94	0.3	1	350	30	0.000001	70	25550	5.63E-04	1.40E-02	1.21E-07
											Total Chemical Cancer Risk		3.40E-06

Radionuclides

IF = IR x FC x FP xFH x ME x EF x ED x CF
CR = C x IF x SF

Radionuclide	C Concentration in Produce (pCi/g)	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (g/mg)	IF Intake Factor (g)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	3.16E-03	340000	0.94	0.3	1	350	30	0.001	1.01E+06	2.40E-10	7.64E-07
Plutonium-239/240	1.57E-02	340000	0.94	0.3	1	350	30	0.001	1.01E+06	2.30E-10	3.64E-06
										Total Radionuclide Cancer Risk	7.80E-06
										Total Cancer Risk	4.40E-06

Note: Changes from draft final to final are shown in italics/bold

(1) Fraction of ingested produce that is fruit or nonleafy; transfer coefficient (Br) is used to estimate root uptake (Baes et al. 1984)

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 1

CT - Ingestion of leafy produces with root uptake

Noncarcinogens

IF = (IR x FP x FH x FC x ME x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	RfD Reference Dose (mg/kg-day)	HQ Hazard Quotient
Aroclor-1254	1.13E-03	340000	0.06	0.25	0.5	150	9	0.000001	70	3285	1.50E-05	2.00E-05	8.46E-04
Aroclor-1260	3.84E-04	340000	0.06	0.25	0.5	150	9	0.000001	70	3285	1.50E-05	2.00E-05	2.87E-04
Bis(2-ethylhexyl)phthalate	1.54E-02	340000	0.06	0.25	1	150	9	0.000001	70	3285	2.99E-05	2.00E-02	2.31E-05
Chromium	4.37E-02	340000	0.06	0.25	1	150	9	0.000001	70	3285	2.99E-05	1.00E+00	1.31E-06
												Total Hazard Index	1.16E-03

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 1

CT - Ingestion of leafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FC x FP x FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Aroclor-1254	1.13E-03	340000	0.06	0.25	0.5	150	9	0.000001	70	25550	1.92E-06	7.70E+00	1.67E-08
Aroclor-1260	3.84E-04	340000	0.06	0.25	0.5	150	9	0.000001	70	25550	1.92E-06	7.70E+00	5.69E-09
Bis(2-ethylhexyl)phthalate	1.54E-02	340000	0.06	0.25	1	150	9	0.000001	70	25550	3.85E-06	1.40E-02	8.30E-10
										Total Chemical Cancer Risk			2.33E-08

Radionuclides

IF = IR x FP x FH x FC x ME x EF x ED x CF
CR = C x IF x SF

Radionuclide	C Concentration in Produce (pCi/g)	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (g/mg)	IF Intake Factor (g)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	6.94E-02	340000	0.06	0.25	1	150	9	0.001	6.89E+03	2.40E-10	1.15E-07
Plutonium-239/240	1.57E-01	340000	0.06	0.25	1	150	9	0.001	6.89E+03	2.30E-10	2.49E-07
								Total Radionuclide Cancer Risk			3.63E-07
									Total Cancer Risk		3.87E-07

HYPOTHETIC ONSITE RESIDENT
AREA OF CONCERN NO. 1

RME - Ingestion of leafy produces with root uptake

Noncarcinogens

IF = (IR x FC x FP x FH x ME x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	RfD	HQ
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient
Aroclor-1254	1.13E-03	340000	0.06	0.4	0.5	350	30	0.000001	70	10950	5.59E-05	2.00E-05	3.16E-03
Aroclor-1260	3.84E-04	340000	0.06	0.4	0.5	350	30	0.000001	70	10950	5.59E-05	2.00E-05	1.07E-03
Bis(2-ethylhexyl)phthalate	1.54E-02	340000	0.06	0.4	1	350	30	0.000001	70	10950	1.12E-04	2.00E-02	8.61E-05
Chromium	4.37E-02	340000	0.06	0.4	1	350	30	0.000001	70	10950	1.12E-04	1.00E+00	4.88E-06
												Total Hazard Index	4.32E-03

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 1

RME - Ingestion of leafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FPx FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Aroclor-1254	1.13E-03	340000	0.06	0.4	0.5	350	30	0.000001	70	25550	2.40E-05	7.70E+00	2.08E-07
Aroclor-1260	3.84E-04	340000	0.06	0.4	0.5	350	30	0.000001	70	25550	2.40E-05	7.70E+00	7.08E-08
Bis(2-ethylhexyl)phthalate	1.54E-02	340000	0.06	0.4	1	350	30	0.000001	70	25550	4.79E-05	1.40E-02	1.03E-08
											Total Chemical Cancer Risk		2.90E-07

Radionuclides

IF = IR x FC x FP xFH x ME x EF x ED x CF
CR = C x IF x SF

Radionuclide	C Concentration in Produce (pCi/g)	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (g/mg)	IF Intake Factor (g)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	6.94E-02	340000	0.06	0.4	1	350	30	0.001	8.57E+04	2.40E-10	1.43E-06
Plutonium-239/240	1.57E-01	340000	0.06	0.4	1	350	30	0.001	8.57E+04	2.30E-10	3.09E-06
							Total Radionuclide Cancer Risk				4.52E-06
								Total Cancer Risk			4.81E-06

Note: Changes from draft final to final are shown in italics/bold

(1) Fraction of ingested produce that is leafy; transfer coefficient (Bv) is used to estimate root uptake (Baes et al. 1984)

HYPOTHETIC. ONSITE RESIDENT
AREA OF CONCERN NO. 2

CT - Ingestion of leafy produces with root uptake

Noncarcinogens

IF = (IR x FP x FH x FC x ME x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	RfD	HQ
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient
Bis(2-ethylhexyl)phthalate	7.06E-03	340000	0.06	0.25	1	150	9	0.000001	70	3285	2.99E-05	2.00E-02	1.06E-05
Chromium	4.21E-02	340000	0.06	0.25	1	150	9	0.000001	70	3285	2.99E-05	1.00E+00	1.26E-06
												Total Hazard Index	1.18E-05

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 2

CT - Ingestion of leafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FC x FP x FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Bis(2-ethylhexyl)phthalate	7.06E-03	340000	0.06	0.25	1	150	9	0.000001	70	25550	3.85E-06	1.40E-02	3.80E-10
										Total Chemical Cancer Risk			3.80E-10

Radionuclides

IF = IR x FP x FH x FC x ME x EF x ED x CF
CR = C x IF x SF

Radionuclide	C Concentration in Produce (pCi/g)	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (g/mg)	IF Intake Factor (g)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	3.53E-03	340000	0.06	0.25	1	150	9	0.001	6.89E+03	2.40E-10	5.83E-09
Plutonium-239/240	1.98E-03	340000	0.06	0.25	1	150	9	0.001	6.89E+03	2.30E-10	3.14E-09
								Total Radionuclide Cancer Risk			8.97E-09
									Total Cancer Risk		9.35E-09

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 2

RME - Ingestion of leafy produces with root uptake

Noncarcinogens

IF = (IR x FC x FP x FH x ME x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	RfD	HQ
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient
Bis(2-ethylhexyl)phthalate	7.06E-03	340000	0.06	0.4	1	350	30	0.000001	70	10950	1.12E-04	2.00E-02	3.95E-05
Chromium	4.21E-02	340000	0.06	0.4	1	350	30	0.000001	70	10950	1.12E-04	1.00E+00	4.71E-06
												Total Hazard Index	4.42E-05

HYPOTHETIC.. ONSITE RESIDENT
AREA OF CONCERN NO. 2

RME - Ingestion of leafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FPx FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Bis(2-ethylhexyl)phthalate	7.06E-03	340000	0.06	0.4	1	350	30	0.000001	70	25550	4.79E-05	1.40E-02	4.74E-09
											Total Chemical Cancer Risk		4.74E-09

Radionuclides

IF = IR x FC x FP xFH x ME x EF x ED x CF
CR = C x IF x SF

Radionuclide	C Concentration in Produce (pCi/g)	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (g/mg)	IF Intake Factor (g)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	3.53E-03	340000	0.06	0.4	1	350	30	0.001	8.57E+04	2.40E-10	7.26E-08
Plutonium-239/240	1.98E-03	340000	0.06	0.4	1	350	30	0.001	8.57E+04	2.30E-10	3.90E-08
							Total Radionuclide Cancer Risk				1.12E-07
								Total Cancer Risk			1.16E-07

Note: Changes from draft final to final are shown in italics/bold

(1) Fraction of ingested produce that is leafy; transfer coefficient (Bv) is used to estimate root uptake (Baes et al. 1984)

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 2

CT - Ingestion of fruit and nonleafy produces with root uptake

Noncarcinogens

IF = (IR x FP x FH xFC x ME x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	RfD	HQ
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient
Bis(2-ethylhexyl)phthalate	7.06E-03	340000	0.94	0.2	1	150	9	0.000001	70	3285	3.75E-04	2.00E-02	1.32E-04
Chromium	2.52E-02	340000	0.94	0.2	1	150	9	0.000001	70	3285	3.75E-04	1.00E+00	9.46E-06
												Total Hazard Index	1.42E-04

HYPOTHETIC. ONSITE RESIDENT
AREA OF CONCERN NO. 2

CT - Ingestion of fruit and nonleafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FC x FP x FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	SF	CR
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Slope Factor 1/(mg/kg-day)	Cancer Risk
Bis(2-ethylhexyl)phthalate	7.06E-03	340000	0.94	0.2	1	150	9	0.000001	70	25550	4.82E-05	1.40E-02	4.77E-09
											Total Chemical Cancer Risk		4.77E-09

Radionuclides

IF = IR x FP x FH x FC x ME x EF x ED x CF
CR = C x IF x SF

	C	IR	FP	FH	ME	EF	ED	CF	IF	SF	CR
Radionuclide	Concentration in Produce (pCi/g)	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (g/mg)	Intake Factor (g)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	1.61E-04	340000	0.94	0.2	1	150	9	0.001	8.63E+04	2.40E-10	3.33E-09
Plutonium-239/240	1.98E-04	340000	0.94	0.2	1	150	9	0.001	8.63E+04	2.30E-10	3.93E-09
										Total Radionuclide Cancer Risk	7.26E-09
										Total Cancer Risk	1.20E-08

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 2

RME - Ingestion of fruit and nonleafy produces with root uptake

Noncarcinogens

IF = (IR x FC x FP x FH x ME x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	RfD	HQ
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient
Bis(2-ethylhexyl)phthalate	7.06E-03	340000	0.94	0.3	1	350	30	0.000001	70	10950	1.31E-03	2.00E-02	4.64E-04
Chromium	2.52E-02	340000	0.94	0.3	1	350	30	0.000001	70	10950	1.31E-03	1.00E+00	3.31E-05
								Total Hazard Index					4.97E-04

FUTURE ONSITE E. .OGICAL RESEARCHER
50-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

CT Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	7.28E-04	0.83	7.2	65	2.5	***1***	***9.71E+02***	3.20E-08	***2.26E-08***
Plutonium-239/240	1.55E-02	0.83	7.2	65	2.5	***1***	***9.71E+02***	3.80E-08	***5.72E-07***
							Total Radionuclide Cancer Risk		***5.95E-07***

Total Cancer Risk ***5.95E-07***

RME Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	7.28E-04	1.4	8	65	2.5	***1***	***1.82E+03***	3.20E-08	***4.24E-08***
Plutonium-239/240	1.55E-02	1.4	8	65	2.5	***1***	***1.82E+03***	3.80E-08	***1.07E-06***
							Total Radionuclide Cancer Risk		***1.11E-06***

Total Cancer Risk ***1.11E-06***

Note: Changes from draft final to final are shown in italics/bold

CURREN1 ,ITE WORKER
AREA OF CONCERN NO. 2

CT Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF x WF
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m³)	IR Inhalation Rate (m³/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	WF Weighting Factor	IF Intake Factor (m³)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	2.13E-05	0.83	7.2	219	4	***1***	0.17	***8.90E+02***	3.20E-08	***6.07E-10***
Plutonium-239/240	1.53E-04	0.83	7.2	219	4	***1***	0.17	***8.90E+02***	3.80E-08	***5.17E-09***
								Total Radionuclide Risk		***5.78E-09***

RME Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF x WF
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m³)	IR Inhalation Rate (m³/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	WF Weighting Factor	IF Intake Factor (m³)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	2.13E-05	0.83	8	250	25	***1***	0.17	***7.06E+03***	3.20E-08	***4.81E-09***
Plutonium-239/240	1.53E-04	0.83	8	250	25	***1***	0.17	***7.06E+03***	3.80E-08	***4.10E-08***
								Total Radionuclide Risk		***4.58E-08***

Total Cancer Risk ***4.58E-08***

Note: Changes from draft final to final are shown in italics/bold

FUTURE INDUS' .L/OFFICE WORKER
AREA OF CONCERN NO. 2

CT Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF x DF

	C	IR	ET	EF	ED	DF	IF	SF	CR
Radionuclides	Air Concentration (pCi/m^3)	Inhalation Rate (m^3/hr)	Exposure Time (hr/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Deposition Factor	Intake Factor (m^3)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	2.13E-05	0.63	7.2	219	4	*1*	***3.97E+03***	3.20E-08	***2.71E-09***
Plutonium-239/240	1.53E-04	0.63	7.2	219	4	*1*	***3.97E+03***	3.80E-08	***2.31E-08***
								Total Radionuclide Cancer Risk	***2.58E-08***

Total Cancer Risk ***2.58E-08***

RME Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

	C	IR	ET	EF	ED	DF	IF	SF	CR
Radionuclides	Air Concentration (pCi/m^3)	Inhalation Rate (m^3/hr)	Exposure Time (hr/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Deposition Factor	Intake Factor (m^3)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	2.13E-05	0.83	8	250	25	*1*	***4.15E+04***	3.20E-08	***2.83E-08***
Plutonium-239/240	1.53E-04	0.83	8	250	25	*1*	***4.15E+04***	3.80E-08	***2.41E-07***
								Total Radionuclide Cancer Risk	***2.70E-07***

Total Cancer Risk ***2.70E-07***

Note: Changes from draft final to final are shown in italics/bold

FUTURE ONSITE EC LOGICAL RESEARCHER
AREA OF CONCERN NO. 2

CT Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	2.13E-05	0.83	7.2	65	2.5	*1*	***9.71E+02***	3.20E-08	***6.62E-10***
Plutonium-239/240	1.53E-04	0.83	7.2	65	2.5	*1*	***9.71E+02***	3.80E-08	***5.65E-09***
								Total Radionuclide Cancer Risk	***6.31E-09***
								Total Cancer Risk	***6.31E-09***

RME Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	2.13E-05	1.4	8	65	2.5	*1*	***1.82E+03***	3.20E-08	***1.24E-09***
Plutonium-239/240	1.53E-04	1.4	8	65	2.5	*1*	***1.82E+03***	3.80E-08	***1.06E-08***
								Total Radionuclide Cancer Risk	***1.18E-08***
								Total Cancer Risk	***1.18E-08***

Note: Changes from draft final to final are shown in italics/bold

OPEN . .CE USER
AREA OF CONCERN NO. 2

CT Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	2.13E-05	0.83	1.5	10	9	***1***	***1.12E+02***	3.20E-08	***7.64E-11***
Plutonium-239/240	1.53E-04	0.83	1.5	10	9	***1***	***1.12E+02***	3.80E-08	***6.51E-10***
								Total Radionuclide Cancer Risk	***7.28E-10***
								Total Cancer Risk	***7.28E-10***

RME Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	2.13E-05	1.4	5	25	30	***1***	***5.25E+03***	3.20E-08	***3.58E-09***
Plutonium-239/240	1.53E-04	1.4	5	25	30	***1***	***5.25E+03***	3.80E-08	***3.05E-08***
								Total Radionuclide Cancer Risk	***3.41E-08***
								Total Cancer Risk	***3.41E-08***

Note: Changes from draft final to final are shown in italics/bold

FUTURE ONSITE C TRUCTION WORKER
AREA OF CONCERN NO. 2

CT Inhalation of Particulates - Nonradionuclide Carcinogens

IF = (IR x ET x EF x ED x DF)/(BW x AT)
CR = IF x C x SF

Chemical	C Air Concentration (mg/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (m^3/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Arsenic	1.34E-10	1.25	7.2	30	1	*1*	70	25550	***1.51E-04***	1.50E+01	***3.03E-13***
Cadmium (food)	5.54E-12	1.25	7.2	30	1	*1*	70	25550	***1.51E-04***	6.30E+00	***5.27E-15***
										Total Chemical Cancer Risk	***3.09E-13***

Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	2.13E-05	1.25	7.2	30	1	*1*	***2.70E+02***	3.20E-08	***1.84E-10***
Plutonium-239/240	1.53E-04	1.25	7.2	30	1	*1*	***2.70E+02***	3.80E-08	***1.57E-09***
Uranium-233/234	1.36E-08	1.25	7.2	30	1	*1*	***2.70E+02***	2.60E-08	***9.55E-14***
Uranium-235	7.92E-10	1.25	7.2	30	1	*1*	***2.70E+02***	2.50E-08	***5.35E-15***
Uranium-238	1.25E-08	1.25	7.2	30	1	*1*	***2.70E+02***	2.40E-08	***8.10E-14***
								Total Radionuclide Cancer Risk	***1.75E-09***

Total Cancer Risk ***1.75E-09***

FUTURE ONSITE C..STRUCTION WORKER
AREA OF CONCERN NO. 2

RME Inhalation of Particulates - Nonradionuclide Carcinogens

IF = (IR x ET x EF x ED x DF)/(BW x AT)
CR = IF x C x SF

Chemical	C Air Concentration (mg/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (m^3/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Arsenic	1.34E-10	1.4	8	30	1	*1*	70	25550	***1.88E-04***	1.50E+01	***3.78E-13***
Cadmium (food)	5.54E-12	1.4	8	30	1	*1*	70	25550	***1.88E-04***	6.30E+00	***6.56E-15***
										Total Chemical Cancer Risk	***3.84E-13***

Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	2.13E-05	1.4	8	30	1	*1*	***3.36E+02***	3.20E-08	***2.29E-10***
Plutonium-239/240	1.53E-04	1.4	8	30	1	*1*	***3.36E+02***	3.80E-08	***1.95E-09***
Uranium-233/234	1.36E-08	1.4	8	30	1	*1*	***3.36E+02***	2.60E-08	***1.19E-13***
Uranium-235	7.92E-10	1.4	8	30	1	*1*	***3.36E+02***	2.50E-08	***6.65E-15***
Uranium-238	1.25E-08	1.4	8	30	1	*1*	***3.36E+02***	2.40E-08	***1.01E-13***
								Total Radionuclide Cancer Risk	***2.18E-09***

Total Cancer Risk ***2.18E-09***

Note: Changes from draft final to final are shown in italics/bold

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 2

CT Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

	C	IR	ET	EF	ED	DF	IF	SF	CR
Radionuclides	Air Concentration (pCi/m^3)	Inhalation Rate (m^3/hr)	Exposure Time (hr/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Deposition Factor	Intake Factor (m^3)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	2.13E-05	0.63	15	234	9	*1*	***1.99E+04***	3.20E-08	***1.36E-08***
Plutonium-239/240	1.53E-04	0.63	15	234	9	*1*	***1.99E+04***	3.80E-08	***1.16E-07***
								Total Radionuclide Cancer Risk	***1.29E-07***
								Total Cancer Risk	***1.29E-07***

RME Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

	C	IR	ET	EF	ED	DF	IF	SF	CR
Radionuclides	Air Concentration (pCi/m^3)	Inhalation Rate (m^3/hr)	Exposure Time (hr/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Deposition Factor	Intake Factor (m^3)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	2.13E-05	0.83	24	350	30	*1*	***2.09E+05***	3.20E-08	***1.43E-07***
Plutonium-239/240	1.53E-04	0.83	24	350	30	*1*	***2.09E+05***	3.80E-08	***1.22E-06***
								Total Radionuclide Cancer Risk	***1.36E-06***
								Total Cancer Risk	***1.36E-06***

Note: Changes from draft final to final are shown in italics/bold

CURRENT ‹ . SITE RESIDENT
SOUTHEAST
AREA OF CONCERN NO. 1

CT Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration[1] (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	6.49E-08	0.63	15	234	9	*1*	***1.99E+04***	3.20E-08	***4.13E-11***
Plutonium-239/240	1.79E-06	0.63	15	234	9	*1*	***1.99E+04***	3.80E-08	***1.35E-09***
							Total Radionuclide Cancer Risk		***1.40E-09***

Total Cancer Risk ***1.40E-09***

RME Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration[1] (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	6.49E-08	0.83	24	350	30	*1*	***2.09E+05***	3.20E-08	***4.34E-10***
Plutonium-239/240	1.79E-06	0.83	24	350	30	*1*	***2.09E+05***	3.80E-08	***1.42E-08***
							Total Radionuclide Cancer Risk		***1.47E-08***

Total Cancer Risk ***1.47E-08***

Note: Changes from draft final to final are shown in italics/bold

FUTURE O[illegible]TE RESIDENT
WOMAN CREEK
AREA OF CONCERN NO. 1

CT Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

	C	IR	ET	EF	ED	DF	IF	SF	CR
Radionuclides	Air Concentration (pCi/m^3)	Inhalation Rate (m^3/hr)	Exposure Time (hr/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Deposition Factor	Intake Factor (m^3)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	3.85E-08	0.63	15	234	9	*1*	***1.99E+04***	3.20E-08	***2.45E-11***
Plutonium-239/240	1.06E-06	0.63	15	234	9	*1*	***1.99E+04***	3.80E-08	***8.02E-10***
								Total Radionuclide Cancer Risk	***8.26E-10***
								Total Cancer Risk	***8.26E-10***

RME Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

	C	IR	ET	EF	ED	DF	IF	SF	CR
Radionuclides	Air Concentration (pCi/m^3)	Inhalation Rate (m^3/hr)	Exposure Time (hr/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Deposition Factor	Intake Factor (m^3)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	3.85E-08	0.83	24	350	30	*1*	***2.09E+05***	3.20E-08	***2.58E-10***
Plutonium-239/240	1.06E-06	0.83	24	350	30	*1*	***2.09E+05***	3.80E-08	***8.42E-09***
								Total Radionuclide Cancer Risk	***8.68E-09***
								Total Cancer Risk	***8.68E-09***

Note: Changes from draft final to final are shown in italics/bold

CURRENT O_ SITE RESIDENT
INDIANA SOUTH
AREA OF CONCERN NO. 2

CT Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration[1] (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	1.44E-10	0.63	15	234	9	*1*	***1.99E+04***	3.20E-08	***9.17E-14***
Plutonium-239/240	1.02E-09	0.63	15	234	9	*1*	***1.99E+04***	3.80E-08	***7.71E-13***
								Total Radionuclide Cancer Risk	***8.63E-13***
								Total Cancer Risk	***8.63E-13***

RME Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration[1] (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	1.44E-10	0.83	24	350	30	*1*	***2.09E+05***	3.20E-08	***9.64E-13***
Plutonium-239/240	1.02E-09	0.83	24	350	30	*1*	***2.09E+05***	3.80E-08	***8.11E-12***
								Total Radionuclide Cancer Risk	***9.07E-12***
								Total Cancer Risk	***9.07E-12***

Note: Changes from draft final to final are shown in italics/bold

CURRENT O. SITE RESIDENT
SOUTHEAST
AREA OF CONCERN NO. 2

CT Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

	C	IR	ET	EF	ED	DF	IF	SF	CR
Radionuclides	Air Concentration (pCi/m^3)	Inhalation Rate (m^3/hr)	Exposure Time (hr/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Deposition Factor	Intake Factor (m^3)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	9.51E-09	0.63	15	234	9	*1*	***1.99E+04***	3.20E-08	***6.06E-12***
Plutonium-239/240	6.76E-08	0.63	15	234	9	*1*	***1.99E+04***	3.80E-08	***5.11E-11***
								Total Radionuclide Cancer Risk	***5.72E-11***
								Total Cancer Risk	***5.72E-11***

RME Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

	C	IR	ET	EF	ED	DF	IF	SF	CR
Radionuclides	Air Concentration (pCi/m^3)	Inhalation Rate (m^3/hr)	Exposure Time (hr/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Deposition Factor	Intake Factor (m^3)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	9.51E-09	0.83	24	350	30	*1*	***2.09E+05***	3.20E-08	***6.37E-11***
Plutonium-239/240	6.76E-08	0.83	24	350	30	*1*	***2.09E+05***	3.80E-08	***5.37E-10***
								Total Radionuclide Cancer Risk	***6.01E-10***
								Total Cancer Risk	***6.01E-10***

Note: Changes from draft final to final are shown in italics/bold

FUTURE O[illegible]TE RESIDENT
WALNUT CREEK
AREA OF CONCERN NO. 2

CT Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	4.33E-10	0.63	15	234	9	*1*	***1.99E+04***	3.20E-08	***2.76E-13***
Plutonium-239/240	3.07E-09	0.63	15	234	9	*1*	***1.99E+04***	3.80E-08	***2.32E-12***
								Total Radionuclide Cancer Risk	***2.60E-12***
								Total Cancer Risk	***2.60E-12***

RME Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

Radionuclides	C Air Concentration (pCi/m^3)	IR Inhalation Rate (m^3/hr)	ET Exposure Time (hr/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	DF Deposition Factor	IF Intake Factor (m^3)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	4.33E-10	0.83	24	350	30	*1*	***2.09E+05***	3.20E-08	***2.90E-12***
Plutonium-239/240	3.07E-09	0.83	24	350	30	*1*	***2.09E+05***	3.80E-08	***2.44E-11***
								Total Radionuclide Cancer Risk	***2.73E-11***
								Total Cancer Risk	***2.73E-11***

Note: Changes from draft final to final are shown in italics/bold

FUTURE OI.. .ATE RESIDENT
WOMAN CREEK
AREA OF CONCERN NO. 2

CT Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

	C	IR	ET	EF	ED	DF	IF	SF	CR
Radionuclides	Air Concentration (pCi/m^3)	Inhalation Rate (m^3/hr)	Exposure Time (hr/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Deposition Factor	Intake Factor (m^3)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	5.32E-09	0.63	15	234	9	*1*	***1.99E+04***	3.20E-08	***3.39E-12***
Plutonium-239/240	3.79E-08	0.63	15	234	9	*1*	***1.99E+04***	3.80E-08	***2.87E-11***
								Total Radionuclide Cancer Risk	***3.21E-11***

Total Cancer Risk ***3.21E-11***

RME Inhalation of Particulates - Radionuclides

IF = IR x ET x EF x ED x DF
CR = IF x C x SF

	C	IR	ET	EF	ED	DF	IF	SF	CR
Radionuclides	Air Concentration (pCi/m^3)	Inhalation Rate (m^3/hr)	Exposure Time (hr/day)	Exposure Frequency (days/yr)	Exposure Duration (years)	Deposition Factor	Intake Factor (m^3)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	5.32E-09	0.83	24	350	30	*1*	***2.09E+05***	3.20E-08	***3.56E-11***
Plutonium-239/240	3.79E-08	0.83	24	350	30	*1*	***2.09E+05***	3.80E-08	***3.01E-10***
								Total Radionuclide Cancer Risk	***3.37E-10***

Total Cancer Risk 3.37E-10

HYPOTHETIC. ›NSITE RESIDENT
10-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

CT - Ingestion of leafy produces with root uptake

Noncarcinogens

$$IF = (IR \times FP \times FH \times FC \times ME \times EF \times ED \times CF)/(BW \times AT)$$
$$HQ = (C \times IF)/RfD$$

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	RfD	HQ
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient
Bis(2-ethylhexyl)phthalate	3.27E-02	340000	0.06	0.25	1	150	9	0.000001	70	3285	2.99E-05	2.00E-02	4.90E-05
Chromium	5.36E-02	340000	0.06	0.25	1	150	9	0.000001	70	3285	2.99E-05	1.00E+00	1.60E-06
												Total Hazard Index	5.06E-05

HYPOTHETICAL ONSITE RESIDENT
10-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

CT - Ingestion of leafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FC x FP x FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Bis(2-ethylhexyl)phthalate	3.27E-02	340000	0.06	0.25	1	150	9	0.000001	70	25550	3.85E-06	1.40E-02	1.76E-09
										Total Chemical Cancer Risk			1.76E-09

Radionuclides

IF = IR x FP x FH x FC x ME x EF x ED x CF
CR = C x IF x SF

Radionuclide	C Concentration in Produce (pCi/g)	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (g/mg)	IF Intake Factor (g)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	2.06E-01	340000	0.06	0.25	1	150	9	0.001	6.89E+03	2.40E-10	3.40E-07
Plutonium-239/240	7.76E-02	340000	0.06	0.25	1	150	9	0.001	6.89E+03	2.30E-10	1.23E-07
								Total Radionuclide Cancer Risk			4.63E-07
									Total Cancer Risk		4.65E-07

HYPOTHETIC.. ONSITE RESIDENT
10-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

RME - Ingestion of leafy produces with root uptake

Noncarcinogens

IF = (IR x FC x FP x FH x ME x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	RfD	HQ
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient
Bis(2-ethylhexyl)phthalate	3.27E-02	340000	0.06	0.4	1	350	30	0.000001	70	10950	1.12E-04	2.00E-02	1.83E-04
Chromium	5.36E-02	340000	0.06	0.4	1	350	30	0.000001	70	10950	1.12E-04	1.00E+00	5.99E-06
												Total Hazard Index	1.89E-04

HYPOTHETIC. ONSITE RESIDENT
10-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

RME - Ingestion of leafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FPx FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Bis(2-ethylhexyl)phthalate	3.27E-02	340000	0.06	0.4	1	350	30	0.000001	70	25550	4.79E-05	1.40E-02	2.19E-08
											Total Chemical Cancer Risk		2.19E-08

Radionuclides

IF = IR x FC x FP xFH x ME x EF x ED x CF
CR = C x IF x SF

Radionuclide	C Concentration in Produce (pCi/g)	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (g/mg)	IF Intake Factor (g)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	2.06E-01	340000	0.06	0.4	1	350	30	0.001	8.57E+04	2.40E-10	4.24E-06
Plutonium-239/240	7.76E-02	340000	0.06	0.4	1	350	30	0.001	8.57E+04	2.30E-10	1.53E-06
							Total Radionuclide Cancer Risk				5.77E-06
								Total Cancer Risk			5.79E-06

Note: Changes from draft final to final are shown in italics/bold

(1) Fraction of ingested produce that is leafy; transfer coefficient (Bv) is used to estimate root uptake (Baes et al. 1984)

HYPOTHETICA ONSITE RESIDENT
10-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

CT - Ingestion of fruit and nonleafy produces with root uptake

Noncarcinogens

IF = (IR x FP x FH xFC x ME x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	RfD	HQ
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient
Bis(2-ethylhexyl)phthalate	3.27E-02	340000	0.94	0.2	1	150	9	0.000001	70	3285	3.75E-04	2.00E-02	6.14E-04
Chromium	3.22E-02	340000	0.94	0.2	1	150	9	0.000001	70	3285	3.75E-04	1.00E+00	1.21E-05
												Total Hazard Index	6.26E-04

HYPOTHETICA ONSITE RESIDENT
10-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

CT - Ingestion of fruit and nonleafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FC x FP x FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Bis(2-ethylhexyl)phthalate	3.27E-02	340000	0.94	0.2	1	150	9	0.000001	70	25550	4.82E-05	1.40E-02	2.21E-08
											Total Chemical Cancer Risk		4.82E-05

Radionuclides

IF = IR x FP x FH x FC x ME x EF x ED x CF
CR = C x IF x SF

Radionuclide	C Concentration in Produce (pCi/g)	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (g/mg)	IF Intake Factor (g)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	9.38E-03	340000	0.94	0.2	1	150	9	0.001	8.63E+04	2.40E-10	1.94E-07
Plutonium-239/240	7.76E-03	340000	0.94	0.2	1	150	9	0.001	8.63E+04	2.30E-10	1.54E-07
										Total Radionuclide Cancer Risk	3.48E-07
										Total Cancer Risk	4.86E-05

HYPOTHETICAL ONSITE RESIDENT
10-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

RME - Ingestion of fruit and nonleafy produces with root uptake

Noncarcinogens

IF = (IR x FC x FP x FH x ME x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	RfD	HQ
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient
Bis(2-ethylhexyl)phthalate	3.27E-02	340000	0.94	0.3	1	350	30	0.000001	70	10950	1.31E-03	2.00E-02	2.15E-03
Chromium	3.22E-02	340000	0.94	0.3	1	350	30	0.000001	70	10950	1.31E-03	1.00E+00	4.23E-05
								Total Hazard Index					2.19E-03

HYPOTHETICAL ONSITE RESIDENT
10-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

RME - Ingestion of fruit and nonleafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FPx FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Bis(2-ethylhexyl)phthalate	3.27E-02	340000	0.94	0.3	1	350	30	0.000001	70	25550	5.63E-04	1.40E-02	2.58E-07
												Total Chemical Cancer Risk	2.58E-07

Radionuclides

IF = IR x FC x FP xFH x ME x EF x ED x CF
CR = C x IF x SF

Radionuclide	C Concentration in Produce (pCi/g)	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (g/mg)	IF Intake Factor (g)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	9.38E-03	340000	0.94	0.3	1	350	30	0.001	1.01E+06	2.40E-10	2.27E-06
Plutonium-239/240	7.76E-03	340000	0.94	0.3	1	350	30	0.001	1.01E+06	2.30E-10	1.80E-06
										Total Radionuclide Cancer Risk	4.06E-06

Total Cancer Risk 4.32E-06

Note: Changes from draft final to final are shown in italics/bold

(1) Fraction of ingested produce that is fruit or nonleafy; transfer coefficient (Br) is used to estimate root uptake (Baes et al. 1984)

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 1

CT - Ingestion of fruit and nonleafy produces with root uptake

Noncarcinogens

IF = (IR x FP x FH xFC x ME x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	RfD	HQ
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient
Aroclor-1254	1.13E-03	340000	0.94	0.2	0.5	150	9	0.000001	70	3285	1.88E-04	2.00E-05	1.06E-02
Aroclor-1260	3.84E-04	340000	0.94	0.2	0.5	150	9	0.000001	70	3285	1.88E-04	2.00E-05	3.60E-03
Bis(2-ethylhexyl)phthalate	1.54E-02	340000	0.94	0.2	1	150	9	0.000001	70	3285	3.75E-04	2.00E-02	2.89E-04
Chromium	2.62E-02	340000	0.94	0.2	1	150	9	0.000001	70	3285	3.75E-04	1.00E+00	9.83E-06
												Total Hazard Index	1.45E-02

HYPOTHETICA. ONSITE RESIDENT
AREA OF CONCERN NO. 1

CT - Ingestion of fruit and nonleafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FC x FP x FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	SF	CR
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Slope Factor 1/(mg/kg-day)	Cancer Risk
Aroclor-1254	1.13E-03	340000	0.94	0.2	0.5	150	9	0.000001	70	25550	2.41E-05	7.70E+00	2.10E-07
Aroclor-1260	3.84E-04	340000	0.94	0.2	0.5	150	9	0.000001	70	25550	2.41E-05	7.70E+00	7.13E-08
Bis(2-ethylhexyl)phthalate	1.54E-02	340000	0.94	0.2	1	150	9	0.000001	70	25550	4.82E-05	1.40E-02	1.04E-08
											Total Chemical Cancer Risk		2.92E-07

Radionuclides

IF = IR x FP x FH x FC x ME x EF x ED x CF
CR = C x IF x SF

	C	IR	FP	FH	ME	EF	ED	CF	IF	SF	CR
Radionuclide	Concentration in Produce (pCi/g)	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (g/mg)	Intake Factor (g)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	3.16E-03	340000	0.94	0.2	1	150	9	0.001	8.63E+04	2.40E-10	6.54E-08
Plutonium-239/240	1.57E-02	340000	0.94	0.2	1	150	9	0.001	8.63E+04	2.30E-10	3.12E-07
										Total Radionuclide Cancer Risk	3.77E-07
										Total Cancer Risk	6.69E-07

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 1

RME - Ingestion of fruit and nonleafy produces with root uptake

Noncarcinogens

IF = (IR x FC x FP x FH x ME x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	RfD Reference Dose (mg/kg-day)	HQ Hazard Quotient
Aroclor-1254	1.13E-03	340000	0.94	0.3	0.5	350	30	0.000001	70	10950	6.57E-04	2.00E-05	3.71E-02
Aroclor-1260	3.84E-04	340000	0.94	0.3	0.5	350	30	0.000001	70	10950	6.57E-04	2.00E-05	1.26E-02
Bis(2-ethylhexyl)phthalate	1.54E-02	340000	0.94	0.3	1	350	30	0.000001	70	10950	1.31E-03	2.00E-02	1.01E-03
Chromium	2.62E-02	340000	0.94	0.3	1	350	30	0.000001	70	10950	1.31E-03	1.00E+00	3.44E-05
								Total Hazard Index					5.08E-02

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 1

RME - Ingestion of fruit and nonleafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FPx FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Aroclor-1254	1.13E-03	340000	0.94	0.3	0.5	350	30	0.000001	70	25550	2.81E-04	7.70E+00	2.45E-06
Aroclor-1260	3.84E-04	340000	0.94	0.3	0.5	350	30	0.000001	70	25550	2.81E-04	7.70E+00	8.32E-07
Bis(2-ethylhexyl)phthalate	1.54E-02	340000	0.94	0.3	1	350	30	0.000001	70	25550	5.63E-04	1.40E-02	1.21E-07
											Total Chemical Cancer Risk		3.40E-06

Radionuclides

IF = IR x FC x FP xFH x ME x EF x ED x CF
CR = C x IF x SF

Radionuclide	C Concentration in Produce (pCi/g)	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (g/mg)	IF Intake Factor (g)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	3.16E-03	340000	0.94	0.3	1	350	30	0.001	1.01E+06	2.40E-10	7.64E-07
Plutonium-239/240	1.57E-02	340000	0.94	0.3	1	350	30	0.001	1.01E+06	2.30E-10	3.64E-06
										Total Radionuclide Cancer Risk	7.80E-06
										Total Cancer Risk	4.40E-06

Note: Changes from draft final to final are shown in italics/bold

(1) Fraction of ingested produce that is fruit or nonleafy; transfer coefficient (Br) is used to estimate root uptake (Baes et al. 1984)

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 1

CT - Ingestion of leafy produces with root uptake

Noncarcinogens

$$IF = (IR \times FP \times FH \times FC \times ME \times EF \times ED \times CF)/(BW \times AT)$$
$$HQ = (C \times IF)/RfD$$

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	RfD Reference Dose (mg/kg-day)	HQ Hazard Quotient
Aroclor-1254	1.13E-03	340000	0.06	0.25	0.5	150	9	0.000001	70	3285	1.50E-05	2.00E-05	8.46E-04
Aroclor-1260	3.84E-04	340000	0.06	0.25	0.5	150	9	0.000001	70	3285	1.50E-05	2.00E-05	2.87E-04
Bis(2-ethylhexyl)phthalate	1.54E-02	340000	0.06	0.25	1	150	9	0.000001	70	3285	2.99E-05	2.00E-02	2.31E-05
Chromium	4.37E-02	340000	0.06	0.25	1	150	9	0.000001	70	3285	2.99E-05	1.00E+00	1.31E-06
												Total Hazard Index	1.16E-03

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 1

CT - Ingestion of leafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FC x FP x FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Aroclor-1254	1.13E-03	340000	0.06	0.25	0.5	150	9	0.000001	70	25550	1.92E-06	7.70E+00	1.67E-08
Aroclor-1260	3.84E-04	340000	0.06	0.25	0.5	150	9	0.000001	70	25550	1.92E-06	7.70E+00	5.69E-09
Bis(2-ethylhexyl)phthalate	1.54E-02	340000	0.06	0.25	1	150	9	0.000001	70	25550	3.85E-06	1.40E-02	8.30E-10
										Total Chemical Cancer Risk			2.33E-08

Radionuclides

IF = IR x FP x FH x FC x ME x EF x ED x CF
CR = C x IF x SF

Radionuclide	C Concentration in Produce (pCi/g)	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (g/mg)	IF Intake Factor (g)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	6.94E-02	340000	0.06	0.25	1	150	9	0.001	6.89E+03	2.40E-10	1.15E-07
Plutonium-239/240	1.57E-01	340000	0.06	0.25	1	150	9	0.001	6.89E+03	2.30E-10	2.49E-07
								Total Radionuclide Cancer Risk			3.63E-07
									Total Cancer Risk		3.87E-07

HYPOTHETIC ONSITE RESIDENT
AREA OF CONCERN NO. 1

RME - Ingestion of leafy produces with root uptake

Noncarcinogens

IF = (IR x FC x FP x FH x ME x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	RfD	HQ
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient
Aroclor-1254	1.13E-03	340000	0.06	0.4	0.5	350	30	0.000001	70	10950	5.59E-05	2.00E-05	3.16E-03
Aroclor-1260	3.84E-04	340000	0.06	0.4	0.5	350	30	0.000001	70	10950	5.59E-05	2.00E-05	1.07E-03
Bis(2-ethylhexyl)phthalate	1.54E-02	340000	0.06	0.4	1	350	30	0.000001	70	10950	1.12E-04	2.00E-02	8.61E-05
Chromium	4.37E-02	340000	0.06	0.4	1	350	30	0.000001	70	10950	1.12E-04	1.00E+00	4.88E-06
												Total Hazard Index	4.32E-03

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 1

RME - Ingestion of leafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FPx FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Aroclor-1254	1.13E-03	340000	0.06	0.4	0.5	350	30	0.000001	70	25550	2.40E-05	7.70E+00	2.08E-07
Aroclor-1260	3.84E-04	340000	0.06	0.4	0.5	350	30	0.000001	70	25550	2.40E-05	7.70E+00	7.08E-08
Bis(2-ethylhexyl)phthalate	1.54E-02	340000	0.06	0.4	1	350	30	0.000001	70	25550	4.79E-05	1.40E-02	1.03E-08
											Total Chemical Cancer Risk		2.90E-07

Radionuclides

IF = IR x FC x FP xFH x ME x EF x ED x CF
CR = C x IF x SF

Radionuclide	C Concentration in Produce (pCi/g)	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (g/mg)	IF Intake Factor (g)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	6.94E-02	340000	0.06	0.4	1	350	30	0.001	8.57E+04	2.40E-10	1.43E-06
Plutonium-239/240	1.57E-01	340000	0.06	0.4	1	350	30	0.001	8.57E+04	2.30E-10	3.09E-06
							Total Radionuclide Cancer Risk				4.52E-06
								Total Cancer Risk			4.81E-06

Note: Changes from draft final to final are shown in italics/bold

(1) Fraction of ingested produce that is leafy; transfer coefficient (Bv) is used to estimate root uptake (Baes et al. 1984)

HYPOTHETIC. ONSITE RESIDENT
AREA OF CONCERN NO. 2

CT - Ingestion of leafy produces with root uptake

Noncarcinogens

IF = (IR x FP x FH x FC x ME x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	RfD	HQ
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient
Bis(2-ethylhexyl)phthalate	7.06E-03	340000	0.06	0.25	1	150	9	0.000001	70	3285	2.99E-05	2.00E-02	1.06E-05
Chromium	4.21E-02	340000	0.06	0.25	1	150	9	0.000001	70	3285	2.99E-05	1.00E+00	1.26E-06
												Total Hazard Index	1.18E-05

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 2

CT - Ingestion of leafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FC x FP x FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Bis(2-ethylhexyl)phthalate	7.06E-03	340000	0.06	0.25	1	150	9	0.000001	70	25550	3.85E-06	1.40E-02	3.80E-10
										Total Chemical Cancer Risk			3.80E-10

Radionuclides

IF = IR x FP x FH x FC x ME x EF x ED x CF
CR = C x IF x SF

Radionuclide	C Concentration in Produce (pCi/g)	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (g/mg)	IF Intake Factor (g)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	3.53E-03	340000	0.06	0.25	1	150	9	0.001	6.89E+03	2.40E-10	5.83E-09
Plutonium-239/240	1.98E-03	340000	0.06	0.25	1	150	9	0.001	6.89E+03	2.30E-10	3.14E-09
								Total Radionuclide Cancer Risk			8.97E-09
									Total Cancer Risk		9.35E-09

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 2

RME - Ingestion of leafy produces with root uptake

Noncarcinogens

IF = (IR x FC x FP x FH x ME x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	RfD	HQ
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient
Bis(2-ethylhexyl)phthalate	7.06E-03	340000	0.06	0.4	1	350	30	0.000001	70	10950	1.12E-04	2.00E-02	3.95E-05
Chromium	4.21E-02	340000	0.06	0.4	1	350	30	0.000001	70	10950	1.12E-04	1.00E+00	4.71E-06
												Total Hazard Index	4.42E-05

HYPOTHETIC.. ONSITE RESIDENT
AREA OF CONCERN NO. 2

RME - Ingestion of leafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FPx FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Bis(2-ethylhexyl)phthalate	7.06E-03	340000	0.06	0.4	1	350	30	0.000001	70	25550	4.79E-05	1.40E-02	4.74E-09
											Total Chemical Cancer Risk		4.74E-09

Radionuclides

IF = IR x FC x FP xFH x ME x EF x ED x CF
CR = C x IF x SF

Radionuclide	C Concentration in Produce (pCi/g)	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (g/mg)	IF Intake Factor (g)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	3.53E-03	340000	0.06	0.4	1	350	30	0.001	8.57E+04	2.40E-10	7.26E-08
Plutonium-239/240	1.98E-03	340000	0.06	0.4	1	350	30	0.001	8.57E+04	2.30E-10	3.90E-08
							Total Radionuclide Cancer Risk				1.12E-07
								Total Cancer Risk			1.16E-07

Note: Changes from draft final to final are shown in italics/bold

(1) Fraction of ingested produce that is leafy; transfer coefficient (Bv) is used to estimate root uptake (Baes et al. 1984)

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 2

CT - Ingestion of fruit and nonleafy produces with root uptake

Noncarcinogens

IF = (IR x FP x FH xFC x ME x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	RfD	HQ
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient
Bis(2-ethylhexyl)phthalate	7.06E-03	340000	0.94	0.2	1	150	9	0.000001	70	3285	3.75E-04	2.00E-02	1.32E-04
Chromium	2.52E-02	340000	0.94	0.2	1	150	9	0.000001	70	3285	3.75E-04	1.00E+00	9.46E-06
												Total Hazard Index	1.42E-04

HYPOTHETIC. ONSITE RESIDENT
AREA OF CONCERN NO. 2

CT - Ingestion of fruit and nonleafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FC x FP x FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	SF	CR
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Slope Factor 1/(mg/kg-day)	Cancer Risk
Bis(2-ethylhexyl)phthalate	7.06E-03	340000	0.94	0.2	1	150	9	0.000001	70	25550	4.82E-05	1.40E-02	4.77E-09
											Total Chemical Cancer Risk		4.77E-09

Radionuclides

IF = IR x FP x FH x FC x ME x EF x ED x CF
CR = C x IF x SF

	C	IR	FP	FH	ME	EF	ED	CF	IF	SF	CR
Radionuclide	Concentration in Produce (pCi/g)	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (g/mg)	Intake Factor (g)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	1.61E-04	340000	0.94	0.2	1	150	9	0.001	8.63E+04	2.40E-10	3.33E-09
Plutonium-239/240	1.98E-04	340000	0.94	0.2	1	150	9	0.001	8.63E+04	2.30E-10	3.93E-09
										Total Radionuclide Cancer Risk	7.26E-09
										Total Cancer Risk	1.20E-08

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 2

RME - Ingestion of fruit and nonleafy produces with root uptake

Noncarcinogens

$$IF = (IR \times FC \times FP \times FH \times ME \times EF \times ED \times CF)/(BW \times AT)$$
$$HQ = (C \times IF)/RfD$$

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	RfD	HQ
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient
Bis(2-ethylhexyl)phthalate	7.06E-03	340000	0.94	0.3	1	350	30	0.000001	70	10950	1.31E-03	2.00E-02	4.64E-04
Chromium	2.52E-02	340000	0.94	0.3	1	350	30	0.000001	70	10950	1.31E-03	1.00E+00	3.31E-05
								Total Hazard Index					4.97E-04

HYPOTHETIC ONSITE RESIDENT
AREA OF CONCERN NO. 2

RME - Ingestion of fruit and nonleafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FPx FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Bis(2-ethylhexyl)phthalate	7.06E-03	340000	0.94	0.3	1	350	30	0.000001	70	25550	5.63E-04	1.40E-02	5.56E-08
										Total Chemical Cancer Risk			5.56E-08

Radionuclides

IF = IR x FC x FP xFH x ME x EF x ED x CF
CR = C x IF x SF

Radionuclide	C Concentration in Produce (pCi/g)	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (g/mg)	IF Intake Factor (g)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	1.61E-04	340000	0.94	0.3	1	350	30	0.001	1.01E+06	2.40E-10	3.89E-08
Plutonium-239/240	1.98E-04	340000	0.94	0.3	1	350	30	0.001	1.01E+06	2.30E-10	4.58E-08
										Total Radionuclide Cancer Risk	8.47E-08

Total Cancer Risk 1.40E-07

Note: Changes from draft final to final are shown in italics/bold

(1) Fraction of ingested produce that is fruit or nonleafy; transfer coefficient (Br) is used to estimate root uptake (Baes et al. 1984)

HYPOTHETIC ONSITE RESIDENT
AREA OF CONCERN NO. 2

RME - Ingestion of fruit and nonleafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FPx FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Bis(2-ethylhexyl)phthalate	7.06E-03	340000	0.94	0.3	1	350	30	0.000001	70	25550	5.63E-04	1.40E-02	5.56E-08
										Total Chemical Cancer Risk			5.56E-08

Radionuclides

IF = IR x FC x FP xFH x ME x EF x ED x CF
CR = C x IF x SF

Radionuclide	C Concentration in Produce (pCi/g)	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (g/mg)	IF Intake Factor (g)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	1.61E-04	340000	0.94	0.3	1	350	30	0.001	1.01E+06	2.40E-10	3.89E-08
Plutonium-239/240	1.98E-04	340000	0.94	0.3	1	350	30	0.001	1.01E+06	2.30E-10	4.58E-08
										Total Radionuclide Cancer Risk	8.47E-08

Total Cancer Risk 1.40E-07

Note: Changes from draft final to final are shown in italics/bold

(1) Fraction of ingested produce that is fruit or nonleafy; transfer coefficient (Br) is used to estimate root uptake (Baes et al. 1984)

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 1

CT - Ingestion of leafy produces with root uptake

Noncarcinogens

IF = (IR x FP x FH x FC x ME x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	RfD	HQ
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient
Aroclor-1254	1.13E-03	340000	0.06	0.25	0.5	150	9	0.000001	70	3285	1.50E-05	2.00E-05	8.46E-04
Aroclor-1260	3.84E-04	340000	0.06	0.25	0.5	150	9	0.000001	70	3285	1.50E-05	2.00E-05	2.87E-04
Bis(2-ethylhexyl)phthalate	1.54E-02	340000	0.06	0.25	1	150	9	0.000001	70	3285	2.99E-05	2.00E-02	2.31E-05
Chromium	4.37E-02	340000	0.06	0.25	1	150	9	0.000001	70	3285	2.99E-05	1.00E+00	1.31E-06
												Total Hazard Index	1.16E-03

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 1

CT - Ingestion of leafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FC x FP x FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Aroclor-1254	1.13E-03	340000	0.06	0.25	0.5	150	9	0.000001	70	25550	1.92E-06	7.70E+00	1.67E-08
Aroclor-1260	3.84E-04	340000	0.06	0.25	0.5	150	9	0.000001	70	25550	1.92E-06	7.70E+00	5.69E-09
Bis(2-ethylhexyl)phthalate	1.54E-02	340000	0.06	0.25	1	150	9	0.000001	70	25550	3.85E-06	1.40E-02	8.30E-10
										Total Chemical Cancer Risk			2.33E-08

Radionuclides

IF = IR x FP x FH x FC x ME x EF x ED x CF
CR = C x IF x SF

Radionuclide	C Concentration in Produce (pCi/g)	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (g/mg)	IF Intake Factor (g)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	6.94E-02	340000	0.06	0.25	1	150	9	0.001	6.89E+03	2.40E-10	1.15E-07
Plutonium-239/240	1.57E-01	340000	0.06	0.25	1	150	9	0.001	6.89E+03	2.30E-10	2.49E-07
							Total Radionuclide Cancer Risk				3.63E-07
								Total Cancer Risk			3.87E-07

HYPOTHETICA NSITE RESIDENT
AREA OF CONCERN NO. 1

RME - Ingestion of leafy produces with root uptake

Noncarcinogens

IF = (IR x FC x FP x FH x ME x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	RfD	HQ
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient
Aroclor-1254	1.13E-03	340000	0.06	0.4	0.5	350	30	0.000001	70	10950	5.59E-05	2.00E-05	3.16E-03
Aroclor-1260	3.84E-04	340000	0.06	0.4	0.5	350	30	0.000001	70	10950	5.59E-05	2.00E-05	1.07E-03
Bis(2-ethylhexyl)phthalate	1.54E-02	340000	0.06	0.4	1	350	30	0.000001	70	10950	1.12E-04	2.00E-02	8.61E-05
Chromium	4.37E-02	340000	0.06	0.4	1	350	30	0.000001	70	10950	1.12E-04	1.00E+00	4.88E-06
												Total Hazard Index	4.32E-03

HYPOTHETICA. ONSITE RESIDENT
AREA OF CONCERN NO. 1

RME - Ingestion of leafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FPx FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Aroclor-1254	1.13E-03	340000	0.06	0.4	0.5	350	30	0.000001	70	25550	2.40E-05	7.70E+00	2.08E-07
Aroclor-1260	3.84E-04	340000	0.06	0.4	0.5	350	30	0.000001	70	25550	2.40E-05	7.70E+00	7.08E-08
Bis(2-ethylhexyl)phthalate	1.54E-02	340000	0.06	0.4	1	350	30	0.000001	70	25550	4.79E-05	1.40E-02	1.03E-08
											Total Chemical Cancer Risk		2.90E-07

Radionuclides

IF = IR x FC x FP xFH x ME x EF x ED x CF
CR = C x IF x SF

Radionuclide	C Concentration in Produce (pCi/g)	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (g/mg)	IF Intake Factor (g)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	6.94E-02	340000	0.06	0.4	1	350	30	0.001	8.57E+04	2.40E-10	1.43E-06
Plutonium-239/240	1.57E-01	340000	0.06	0.4	1	350	30	0.001	8.57E+04	2.30E-10	3.09E-06
							Total Radionuclide Cancer Risk				4.52E-06
								Total Cancer Risk			4.81E-06

Note: Changes from draft final to final are shown in italics/bold

(1) Fraction of ingested produce that is leafy; transfer coefficient (Bv) is used to estimate root uptake (Baes et al. 1984)

HYPOTHETICA. ,NSITE RESIDENT
AREA OF CONCERN NO. 1

CT - Ingestion of fruit and nonleafy produces with root uptake

Noncarcinogens

IF = (IR x FP x FH xFC x ME x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	RfD	HQ
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient
Aroclor-1254	1.13E-03	340000	0.94	0.2	0.5	150	9	0.000001	70	3285	1.88E-04	2.00E-05	1.06E-02
Aroclor-1260	3.84E-04	340000	0.94	0.2	0.5	150	9	0.000001	70	3285	1.88E-04	2.00E-05	3.60E-03
Bis(2-ethylhexyl)phthalate	1.54E-02	340000	0.94	0.2	1	150	9	0.000001	70	3285	3.75E-04	2.00E-02	2.89E-04
Chromium	2.62E-02	340000	0.94	0.2	1	150	9	0.000001	70	3285	3.75E-04	1.00E+00	9.83E-06
												Total Hazard Index	1.45E-02

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 1

CT - Ingestion of fruit and nonleafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FC x FP x FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Aroclor-1254	1.13E-03	340000	0.94	0.2	0.5	150	9	0.000001	70	25550	2.41E-05	7.70E+00	2.10E-07
Aroclor-1260	3.84E-04	340000	0.94	0.2	0.5	150	9	0.000001	70	25550	2.41E-05	7.70E+00	7.13E-08
Bis(2-ethylhexyl)phthalate	1.54E-02	340000	0.94	0.2	1	150	9	0.000001	70	25550	4.82E-05	1.40E-02	1.04E-08
											Total Chemical Cancer Risk		2.92E-07

Radionuclides

IF = IR x FP x FH x FC x ME x EF x ED x CF
CR = C x IF x SF

Radionuclide	C Concentration in Produce (pCi/g)	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (g/mg)	IF Intake Factor (g)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	3.16E-03	340000	0.94	0.2	1	150	9	0.001	8.63E+04	2.40E-10	6.54E-08
Plutonium-239/240	1.57E-02	340000	0.94	0.2	1	150	9	0.001	8.63E+04	2.30E-10	3.12E-07
										Total Radionuclide Cancer Risk	3.77E-07
										Total Cancer Risk	6.69E-07

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 1

RME - Ingestion of fruit and nonleafy produces with root uptake

Noncarcinogens

IF = (IR x FC x FP x FH x ME x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	RfD Reference Dose (mg/kg-day)	HQ Hazard Quotient
Aroclor-1254	1.13E-03	340000	0.94	0.3	0.5	350	30	0.000001	70	10950	6.57E-04	2.00E-05	3.71E-02
Aroclor-1260	3.84E-04	340000	0.94	0.3	0.5	350	30	0.000001	70	10950	6.57E-04	2.00E-05	1.26E-02
Bis(2-ethylhexyl)phthalate	1.54E-02	340000	0.94	0.3	1	350	30	0.000001	70	10950	1.31E-03	2.00E-02	1.01E-03
Chromium	2.62E-02	340000	0.94	0.3	1	350	30	0.000001	70	10950	1.31E-03	1.00E+00	3.44E-05
								Total Hazard Index					5.08E-02

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 1

RME - Ingestion of fruit and nonleafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FPx FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Aroclor-1254	1.13E-03	340000	0.94	0.3	0.5	350	30	0.000001	70	25550	2.81E-04	7.70E+00	2.45E-06
Aroclor-1260	3.84E-04	340000	0.94	0.3	0.5	350	30	0.000001	70	25550	2.81E-04	7.70E+00	8.32E-07
Bis(2-ethylhexyl)phthalate	1.54E-02	340000	0.94	0.3	1	350	30	0.000001	70	25550	5.63E-04	1.40E-02	1.21E-07
											Total Chemical Cancer Risk		3.40E-06

Radionuclides

IF = IR x FC x FP xFH x ME x EF x ED x CF
CR = C x IF x SF

Radionuclide	C Concentration in Produce (pCi/g)	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (g/mg)	IF Intake Factor (g)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	3.16E-03	340000	0.94	0.3	1	350	30	0.001	1.01E+06	2.40E-10	7.64E-07
Plutonium-239/240	1.57E-02	340000	0.94	0.3	1	350	30	0.001	1.01E+06	2.30E-10	3.64E-06
										Total Radionuclide Cancer Risk	7.80E-06

Total Cancer Risk 4.40E-06

Note: Changes from draft final to final are shown in italics/bold

(1) Fraction of ingested produce that is fruit or nonleafy; transfer coefficient (Br) is used to estimate root uptake (Baes et al. 1984)

HYPOTHETICAL ONSITE RESIDENT
10-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

CT - Ingestion of leafy produces with root uptake

Noncarcinogens

IF = (IR x FP x FH x FC x ME x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	RfD	HQ
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient
Bis(2-ethylhexyl)phthalate	3.27E-02	340000	0.06	0.25	1	150	9	0.000001	70	3285	2.99E-05	2.00E-02	4.90E-05
Chromium	5.36E-02	340000	0.06	0.25	1	150	9	0.000001	70	3285	2.99E-05	1.00E+00	1.60E-06
												Total Hazard Index	5.06E-05

HYPOTHETICAL ONSITE RESIDENT
10-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

CT - Ingestion of leafy produces with root uptake

Nonradionuclide Carcinogens

$$IF = (IR \times FC \times FP \times FH \times ME \times EF \times ED \times CF)/(BW \times AT)$$
$$CR = C \times IF \times SF$$

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Bis(2-ethylhexyl)phthalate	3.27E-02	340000	0.06	0.25	1	150	9	0.000001	70	25550	3.85E-06	1.40E-02	1.76E-09
										Total Chemical Cancer Risk			1.76E-09

Radionuclides

$$IF = IR \times FP \times FH \times FC \times ME \times EF \times ED \times CF$$
$$CR = C \times IF \times SF$$

Radionuclide	C Concentration in Produce (pCi/g)	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (g/mg)	IF Intake Factor (g)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	2.06E-01	340000	0.06	0.25	1	150	9	0.001	6.89E+03	2.40E-10	3.40E-07
Plutonium-239/240	7.76E-02	340000	0.06	0.25	1	150	9	0.001	6.89E+03	2.30E-10	1.23E-07
								Total Radionuclide Cancer Risk			4.63E-07
									Total Cancer Risk		4.65E-07

HYPOTHETICAL ONSITE RESIDENT
10-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

RME - Ingestion of leafy produces with root uptake

Noncarcinogens

IF = (IR x FC x FP x FH x ME x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	RfD Reference Dose (mg/kg-day)	HQ Hazard Quotient
Bis(2-ethylhexyl)phthalate	3.27E-02	340000	0.06	0.4	1	350	30	0.000001	70	10950	1.12E-04	2.00E-02	1.83E-04
Chromium	5.36E-02	340000	0.06	0.4	1	350	30	0.000001	70	10950	1.12E-04	1.00E+00	5.99E-06
												Total Hazard Index	1.89E-04

HYPOTHETICAL ONSITE RESIDENT
10-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

RME - Ingestion of leafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FPx FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	SF	CR
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Slope Factor 1/(mg/kg-day)	Cancer Risk
Bis(2-ethylhexyl)phthalate	3.27E-02	340000	0.06	0.4	1	350	30	0.000001	70	25550	4.79E-05	1.40E-02	2.19E-08
											Total Chemical Cancer Risk		2.19E-08

Radionuclides

IF = IR x FC x FP xFH x ME x EF x ED x CF
CR = C x IF x SF

	C	IR	FP	FH	ME	EF	ED	CF	IF	SF	CR
Radionuclide	Concentration in Produce (pCi/g)	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (g/mg)	Intake Factor (g)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	2.06E-01	340000	0.06	0.4	1	350	30	0.001	8.57E+04	2.40E-10	4.24E-06
Plutonium-239/240	7.76E-02	340000	0.06	0.4	1	350	30	0.001	8.57E+04	2.30E-10	1.53E-06
								Total Radionuclide Cancer Risk			5.77E-06
									Total Cancer Risk		5.79E-06

Note: Changes from draft final to final are shown in italics/bold

(1) Fraction of ingested produce that is leafy; transfer coefficient (Bv) is used to estimate root uptake (Baes et al. 1984)

HYPOTHETICAL ONSITE RESIDENT
10-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

CT - Ingestion of fruit and nonleafy produces with root uptake

Noncarcinogens

IF = (IR x FP x FH xFC x ME x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	RfD	HQ
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient
Bis(2-ethylhexyl)phthalate	3.27E-02	340000	0.94	0.2	1	150	9	0.000001	70	3285	3.75E-04	2.00E-02	6.14E-04
Chromium	3.22E-02	340000	0.94	0.2	1	150	9	0.000001	70	3285	3.75E-04	1.00E+00	1.21E-05
												Total Hazard Index	6.26E-04

HYPOTHETICAL ONSITE RESIDENT
10-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

RME - Ingestion of fruit and nonleafy produces with root uptake

Noncarcinogens

IF = (IR x FC x FP x FH x ME x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	RfD	HQ
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient
Bis(2-ethylhexyl)phthalate	3.27E-02	340000	0.94	0.3	1	350	30	0.000001	70	10950	1.31E-03	2.00E-02	2.15E-03
Chromium	3.22E-02	340000	0.94	0.3	1	350	30	0.000001	70	10950	1.31E-03	1.00E+00	4.23E-05
								Total Hazard Index					2.19E-03

HYPOTHETICAL ONSITE RESIDENT
10-ACRE MAXIMUM EXPOSURE AREA
IN AREA OF CONCERN NO. 1

RME - Ingestion of fruit and nonleafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FPx FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	SF	CR
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Slope Factor 1/(mg/kg-day)	Cancer Risk
Bis(2-ethylhexyl)phthalate	3.27E-02	340000	0.94	0.3	1	350	30	0.000001	70	25550	5.63E-04	1.40E-02	2.58E-07
												Total Chemical Cancer Risk	2.58E-07

Radionuclides

IF = IR x FC x FP xFH x ME x EF x ED x CF
CR = C x IF x SF

	C	IR	FP	FH	ME	EF	ED	CF	IF	SF	CR
Radionuclide	Concentration in Produce (pCi/g)	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (g/mg)	Intake Factor (g)	Slope Factor (Risk/pCi)	Cancer Risk
Americium-241	9.38E-03	340000	0.94	0.3	1	350	30	0.001	1.01E+06	2.40E-10	2.27E-06
Plutonium-239/240	7.76E-03	340000	0.94	0.3	1	350	30	0.001	1.01E+06	2.30E-10	1.80E-06
										Total Radionuclide Cancer Risk	4.06E-06

Total Cancer Risk 4.32E-06

Note: Changes from draft final to final are shown in italics/bold

(1) Fraction of ingested produce that is fruit or nonleafy; transfer coefficient (Br) is used to estimate root uptake (Baes et al. 1984)

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 2

CT - Ingestion of fruit and nonleafy produces with root uptake

Noncarcinogens

IF = (IR x FP x FH xFC x ME x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	RfD	HQ
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient
Bis(2-ethylhexyl)phthalate	7.06E-03	340000	0.94	0.2	1	150	9	0.000001	70	3285	3.75E-04	2.00E-02	1.32E-04
Chromium	2.52E-02	340000	0.94	0.2	1	150	9	0.000001	70	3285	3.75E-04	1.00E+00	9.46E-06
												Total Hazard Index	1.42E-04

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 2

CT - Ingestion of fruit and nonleafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FC x FP x FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Bis(2-ethylhexyl)phthalate	7.06E-03	340000	0.94	0.2	1	150	9	0.000001	70	25550	4.82E-05	1.40E-02	4.77E-09
												Total Chemical Cancer Risk	4.77E-09

Radionuclides

IF = IR x FP x FH x FC x ME x EF x ED x CF
CR = C x IF x SF

Radionuclide	C Concentration in Produce (pCi/g)	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (g/mg)	IF Intake Factor (g)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	1.61E-04	340000	0.94	0.2	1	150	9	0.001	8.63E+04	2.40E-10	3.33E-09
Plutonium-239/240	1.98E-04	340000	0.94	0.2	1	150	9	0.001	8.63E+04	2.30E-10	3.93E-09
										Total Radionuclide Cancer Risk	7.26E-09

Total Cancer Risk 1.20E-08

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 2

RME - Ingestion of fruit and nonleafy produces with root uptake

Noncarcinogens

IF = (IR x FC x FP x FH x ME x EF x ED x CF)/(BW x AT)
HQ = (C x IF)/RfD

	C	IR	FP	FH	ME	EF	ED	CF	BW	AT	IF	RfD	HQ
Chemical	Concentration in Produce mg/kg	Ingestion Rate (mg/day)	Fraction of Total Produce *(1)*	Fraction Homegrown	Matrix Effect	Exposure Frequency (days/yr)	Exposure Duration (years)	Conversion Factor (kg/mg)	Body Weight (kg)	Averaging Time (days)	Intake Factor (kg/kg-day)	Reference Dose (mg/kg-day)	Hazard Quotient
Bis(2-ethylhexyl)phthalate	7.06E-03	340000	0.94	0.3	1	350	30	0.000001	70	10950	1.31E-03	2.00E-02	4.64E-04
Chromium	2.52E-02	340000	0.94	0.3	1	350	30	0.000001	70	10950	1.31E-03	1.00E+00	3.31E-05
								Total Hazard Index					4.97E-04

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 2

RME - Ingestion of fruit and nonleafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FPx FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Bis(2-ethylhexyl)phthalate	7.06E-03	340000	0.94	0.3	1	350	30	0.000001	70	25550	5.63E-04	1.40E-02	5.56E-08
										Total Chemical Cancer Risk			5.56E-08

Radionuclides

IF = IR x FC x FP xFH x ME x EF x ED x CF
CR = C x IF x SF

Radionuclide	C Concentration in Produce (pCi/g)	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (g/mg)	IF Intake Factor (g)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	1.61E-04	340000	0.94	0.3	1	350	30	0.001	1.01E+06	2.40E-10	3.89E-08
Plutonium-239/240	1.98E-04	340000	0.94	0.3	1	350	30	0.001	1.01E+06	2.30E-10	4.58E-08
										Total Radionuclide Cancer Risk	8.47E-08

Total Cancer Risk 1.40E-07

Note: Changes from draft final to final are shown in italics/bold

(1) Fraction of ingested produce that is fruit or nonleafy; transfer coefficient (Br) is used to estimate root uptake (Baes et al. 1984)

HYPOTHETICAL ONSITE RESIDENT
AREA OF CONCERN NO. 2

RME - Ingestion of leafy produces with root uptake

Nonradionuclide Carcinogens

IF = (IR x FPx FH x ME x EF x ED x CF)/(BW x AT)
CR = C x IF x SF

Chemical	C Concentration in Produce mg/kg	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (kg/mg)	BW Body Weight (kg)	AT Averaging Time (days)	IF Intake Factor (kg/kg-day)	SF Slope Factor 1/(mg/kg-day)	CR Cancer Risk
Bis(2-ethylhexyl)phthalate	7.06E-03	340000	0.06	0.4	1	350	30	0.000001	70	25550	4.79E-05	1.40E-02	4.74E-09
											Total Chemical Cancer Risk		4.74E-09

Radionuclides

IF = IR x FC x FP xFH x ME x EF x ED x CF
CR = C x IF x SF

Radionuclide	C Concentration in Produce (pCi/g)	IR Ingestion Rate (mg/day)	FP Fraction of Total Produce *(1)*	FH Fraction Homegrown	ME Matrix Effect	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	CF Conversion Factor (g/mg)	IF Intake Factor (g)	SF Slope Factor (Risk/pCi)	CR Cancer Risk
Americium-241	3.53E-03	340000	0.06	0.4	1	350	30	0.001	8.57E+04	2.40E-10	7.26E-08
Plutonium-239/240	1.98E-03	340000	0.06	0.4	1	350	30	0.001	8.57E+04	2.30E-10	3.90E-08
							Total Radionuclide Cancer Risk				1.12E-07
								Total Cancer Risk			1.16E-07

Note: Changes from draft final to final are shown in italics/bold

(1) Fraction of ingested produce that is leafy; transfer coefficient (Bv) is used to estimate root uptake (Baes et al. 1984)

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