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U-003-306 .24

**TRANSMITTAL OF COMMENT RESPONSES AND CHANGE PAGES FOR
THE OPERABLE UNIT ONE REMEDIAL INVESTIGATION REPORT**

07/25/94

DOE-2140-94
DOE-FN EPA
101
RESPONSES

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JUL 25 1994
DOE-2140-94

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Mr. Thomas Schneider, Project Manager
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ND

U-003-306.24

Dear Mr. Saric and Mr. Schneider:

**TRANSMITTAL OF COMMENT RESPONSES AND CHANGE PAGES FOR THE OPERABLE UNIT ONE
REMEDIAL INVESTIGATION REPORT**

The purpose of this letter is to transmit the United States Department of Energy (U.S. DOE) comment responses and associated change pages for the Operable Unit 1 (OU 1) Remedial Investigation Report. The resolution to many of the key issues occurred either in the meeting between the United States Environmental Protection Agency (USEPA) and U.S. DOE on July 7, 1994, or during the conference call between U.S. DOE, the Fernald Environmental Restoration Management Corporation (FERMCO) representatives and Ms. Pat VanLeeuwen, Toxicologist for the USEPA Region V, on July 20, 1994. Both the meeting and the conference call were beneficial in achieving resolution on difficult issues in a timely manner.

If you have any questions concerning the above or if there are any additional questions regarding the enclosed submittal, please contact Randy C. Janke at (513) 648-3123.

Sincerely,

Johnny Rensing

for Jack R. Craig
Fernald Remediation Action
Project Manager

FN:RC Janke

Enclosure: As Stated

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**U.S. EPA COMMENTS ON OPERABLE UNIT 1 REMEDIAL INVESTIGATION
SECOND REVIEW**

Commenting Organization: U.S. EPA Commentor: Saric
Section #: Page #: Line #: Code: M
Original Comment #: 1 (15)

Comment: The original comment stated that the amount of uranium detected in each zone is a result of the limited number of samples collected from the zones. Only one sample was collected from the Deep Saturated Sand and Gravel Layer (Boring 4011), and this boring is located upgradient of Operable Unit 1. There is a negative bias in DOE's conclusion that no contamination exists in Zone 4 when this conclusion is based solely on upgradient Boring 4011. DOE should justify the lack of data from downgradient Zone 4 borings.

Response: Agree. The text, as written, appears to state a generalized conclusion based on minimal data points. The text should have clarified that contamination beneath the till (i.e., the depths of 4000-series wells) will be evaluated in the Operable Unit 5 Remedial Investigation Report.

Action: The following text has been added:

Page 4-106. "Additional monitoring wells were also installed in areas outside of the Operable Unit 1 boundary. The data from those borings will be compiled and correlated with the data generated from borings within the Operable Unit 1 boundary and submitted in the Operable Unit 5 Remedial Investigation Report."

Page 4-110. "This information for the deep saturated sand and gravel layer is based, however, on data generated from the boring of one well (4011), located upgradient of the waste pits. The data from well number 4011 will be compiled with data from well borings existing downgradient of the waste pit area as part of the Operable Unit 5 Remedial Investigation. Conclusions regarding the level of radiological contamination will be made at that time."

Page 4-112. "This information for the deep saturated sand and gravel layer is based, however, on data generated from the boring of one well (4011), located upgradient of the waste pits. The data from well number 4011 will be compiled with data from well borings existing downgradient of the waste pit area during the Operable Unit 5 Remedial Investigation. Conclusions regarding the level of radiological contamination will be made at that time."

Page 4-113. "Additional monitoring wells were also installed in areas outside of the Operable Unit 1 boundary. The data from those wells will be compiled and correlated with the data generated from wells within the Operable Unit 1 boundary and submitted in the Operable Unit 5 Remedial Investigation Report."

Page 4-132. "Due to the limited amount of data points for the 4000-series wells located within the Operable Unit 1 Study Area, it is not possible at this time to fully characterize the extent of contamination in the deep horizon of the Great Miami Aquifer. A detailed

site-wide discussion of the nature and extent of contamination in the deep horizon of the Great Miami Aquifer will be conducted as part of the Operable Unit 5 RI report."

Page 4-137. "This data will be correlated with the data generated from within Operable Unit 1 and discussed in detail in the Operable Unit 5 Remedial Investigation Report."

The following text has been deleted:

Page 4-108. "No other soil samples at further depth or deeper units showed uranium or thorium activity concentration."

Page 4-134. "Due to the limited amount of data points for the 4000-series wells located within the Operable Unit 1 Study Area, it is not possible at this time to fully characterize the extent of contamination in the deep horizon of the Great Miami Aquifer. A detailed site-wide discussion of the nature and extent of contamination in the deep horizon of the Great Miami Aquifer will be conducted as part of the Operable Unit 5 RI report."

Commenting Organization: U.S. EPA Commentor: Saric
 Section #: Page #: Line #: Code:
 Original Comment #: 2 (23)
 Comment: The maximum contaminant limit (MCL) for beryllium of 0.004 milligrams per liter is missing in footnote "m" of Table 4-2. The MCL for beryllium should be added to footnote "m".
 Response: The MCL for beryllium should be added to footnote "m".
 Action: **Page 4-216, Table 4-2.** The following was added to footnote m: "Beryllium 0.004 mg/L."

Commenting Organization: U.S. EPA Commentor: Saric
 Section #: Page #: Line #: Code: E
 Original Comment #: 3 (28)
 Comment: The DOE added footnote "u" to Table E.3-18. However, footnote "u" is not referenced and does not appear in the body of Table E.3-18. This table should be revised to include references to footnote "u" in the body of the table, specifically in the parts of the table labeled "Incidental ingestion of soil/sediment" and "Dermal contact with soil/sediment."
 Response: Agree. The footnote "u" should be added to both sections of Table E.3-18.
 Action: **Page E-3-100, Table E.3-18.** Footnote "u" has been added to "Incidental ingestion of soil/sediment" and to "Dermal contact with soil/sediment."

Commenting Organization: U.S. EPA Commentor: Saric
 Section #: E.3 Page #: Table E.3-18 Line #: Code: E
 Original Comment #: 4 (29)
 Comment: The DOE revised the text in Section E.3.5.7.4 to describe the inhalation rate for the homebuilder as 2.5 cubic meters per hour (m³/hr). However, in Table E.3-18 the inhalation rate for the homebuilder is still presented as 0.83 m³/hr. Table E.3-18 should be revised to present inhalation rate for the homebuilder as 2.5 m³/hr. Intake calculations for the homebuilder should also be revised as necessary to reflect this change.
 Response: Agree. The inhalation rate for the homebuilder should be revised to 2.5 m³/hr in Table E.3-18, to be consistent with the text. No change is required to the calculations, due to a typo in the revision of the table that was submitted. In addition, the footnote should be changed to "s" to reflect appropriate EPA guidance (Standard Default Exposure Factors).
 Action: **Table E.3-18.** The IR (m³/hr) for inhalation of dusts, volatiles, and radon, for the On-Property Home Builder, age 19+, was changed to "2.5"; the footnote was changed from "b" to "s".

Commenting Organization: U.S. EPA Commentor: Van Leeuwen
 Section #: 6 Page #: Table 6-3, pg. 6-26 Line #: Code: C
 Original Comment #: 5
 Comment: It does not appear that both radiocarcinogenic risks and chemical carcinogenic risks were included in the "Total" risk. For example, for the air exposure to the off-property young child, the radiological risk is listed as 2×10^{-7} and the chemical risk as 8×10^{-8} , for a total of 2.8×10^{-7} rather than 2×10^{-7} . There are other such disjoints in this table. If such problems are due to rounding, either the table values should be used to calculate the total or two-digit values should be reported. Please review these calculations.
 Response: Agree. A generic footnote should be added to explain the use of significant figures.
 Action: **Page 6-26, Table 6-3.** The following footnote "a" has been added: "This table includes values that have been rounded to one significant figure. Therefore, the total number may be higher or lower than the sum that would result from adding the values in the table, due to rounding. Refer to Attachment E.IV for specific values."

The following is a list of tables in which the above footnote has been added:
 E.5-1, E.5-3, E.5-5, E.5-7, E.7-1, E.7-3, E.7-5, E.7-7, 6-3, 6-5, 6-7, 6-9.

Commenting Organization: U.S. EPA Commentor: Van Leeuwen
Section #: 7 Page #: Table 7-5, pp. 7-51 Line #: Code: M
Original Comment #: 6

Comment: Same as above. (Please review these calculations.)

Response: See response to Comment #5.

Action: **Table 7-5.** A footnote was added, in accordance with the action identified above for Comment #5, as follows: "This summary of risk values table includes, but is not limited to, values that have been rounded to one or two significant figures, as appropriate. Therefore, the total number may be higher or lower than the sum that would result from adding the values in the table due to rounding. Refer to Attachment E.IV for specific values." The hazard indices were reported to two significant figures, to be consistent with Sections 6, E.5, and E.7.

Commenting Organization: U.S. EPA Commentor: Van Leeuwen
Section #: 7 Page #: Table 7-6, pp. 7-53/54 Line #: Code: C
Original Comment #: 7

Comment: Same as above. (Please review these calculations.)

Response: See response to Comment 5. In addition, upon review of the values presented in this table, a number of minor transposition errors were noted from the values transcribed from summary tables in Section 6 to this table. These transposition errors only occurred in this table and do not impact the overall results. These errors did not occur in the summary tables of Sections E.5 and E.7 or Section 6 of the Baseline Risk Assessment.

Action: **Table 7-6.** A footnote was added, in accordance with the action identified above for Comment #5, as follows: "This summary of risk values table includes, but is not limited to, values that have been rounded to one or two significant figures, as appropriate. Therefore, the total number may be higher or lower than the sum that would result from adding the values in the table due to rounding. Refer to Attachment E.IV for specific values." The hazard indices were reported to two significant figures, to be consistent with Sections 6, E.5, and E.7. Values were checked and revised in the table according to the values reported in Section 6.

Commenting Organization: U.S. EPA Commentor: Van Leeuwen
Section #: 7 Page #: Table 7-7, pg. 7-60a Line #: Code: C
Original Comment #: 8

Comment: The discussions regarding the Data Limitations of Tentatively Identified Compounds (TICs) are inconsistent.

(1) I am not convinced that the origin of the TICs is any more uncertain than any other organic contaminant on the CLEP screening list. The compounds are TICs because they have a relative retention time outside a given range for a CLEP compound (which often occurs due to interference by other contaminants), they are not on the CLEP list or an appropriate standard was not included to facilitate their quantitation. A mass spectrum was obtained for all compounds, so a tentative identification is available.

(2) The Table of TICs (included elsewhere) indicates that some are projected to be present at highly elevated concentrations.

(3) If the compounds are thought to be break-down products, as suggested, their presence relative to the toxicity of the parent compounds should be discussed.

(4) The "Significance" column indicates that toxicity and risk to these compounds is uncertain, while the "Recommended Action" column indicates that the TICs are relatively non-toxic; which is correct? Section E.6.3.2 indicates that many of these compounds may in fact be CNS poisons or carcinogens.

(5) The presence of TICs should be reviewed in a manner similar to other site contaminants - i.e., if the estimated concentration is present, will it contribute to the risk to any identified receptor populations? Clearly some rewriting is needed.

Response: Agree. The text should be reviewed and revised for clarity, level of documentation, and compliance with RAGs. In addition, since Section 7 focuses on data limitations and uncertainties within the Remedial Investigation, DOE felt it necessary to add summary text, related to the TIC discussion, to Section 6, which is a summary of the baseline risk assessment.

Action: The text was revised as follows, as a result of a DOE-EPA conference call held July 20, 1994. To facilitate identification of specific revisions, all text changes (both additions and deletions) are shown.

Page 6-20. The following text was added:

"Evaluation of TICs

Tentatively identified compounds (TICs) were evaluated. TICs are those volatile and semivolatile organic compounds not included in the Full HSL/Full Radioisotope list for Operable Unit 1, but show high peaks on the chromatogram. For TICs, there is no minimum percentage of accuracy; identification accuracy can be as low as 40 percent and still be reported. Therefore, the assigned identity and concentrations are uncertain.

"A compilation of TIC data is presented in Appendix E.6.3.2. In conversations with the laboratory, it was determined that TICs could not be positively identified without some level of uncertainty. However, the TICs classes included alcohol-glycols, aldehydes and ketones, aliphatics, amino/nitro compounds, aromatic and polyaromatic compounds, esters, carboxylic acids, furans, dimethyl sulfides, and a series of unknown compounds. Specific compounds from these classes are identified in Table E.6-4. As compared to the

Target Analyte and Target Compound List for Operable Unit 1 media, there were relatively few TICs observed and most of these were in the lower horizon of the waste pit contents.

"Given that there were few TICs, of which some were not positively identified, they were not carried through the quantitative risk assessment. The TICs were evaluated qualitatively, by considering the toxicity as a function of the compound class (refer to Appendix E, Section E.6.3.2.2 for a detailed discussion). The potential for significant impact on overall risk assessment in Operable Unit 1 was assumed to be minimal. This follows from the observation that the TICs identified in the waste pit material were found predominantly at the lower depths typically exceeding four feet. The TICs from these regions were also found to be in relatively small concentrations and therefore would have little impact on the surface or direct pathways. Because the TICs reported from these depths were at relatively low concentrations (as compared to the actual detected analytes) and considering the potential for dilution and dispersion these TICs would have little potential for significant transport through the groundwater pathways."

Page 6-21 and 6-22. Text was added to the last paragraph on page 6-21 as follows:

"The receptors with the highest uncertainty in the current source term are the off-property resident farmer and off-property user of meat/milk from livestock grazed on site. The off-property resident-farmer scenario was evaluated based on modeled concentrations for the air pathway and results in high uncertainty. The bioaccumulation of CPCs into meat/milk were modeled, and as a result, provides moderate to high uncertainty for this receptor. The greatest uncertainty in the risk assessment of Operable Unit 1 is associated with the assumptions made in the future source term. These particular receptors include the on-property resident farmer, the Great Miami River user, and the off-property user of meat and milk. For the on-property RME resident farmer and home builder, the highest uncertainty is associated with the assumed future land use and potential exposure pathways. This receptor scenario was included in response to guidance and is anticipated to have a low likelihood of occurrence due to the history of the site and the particular waste management activities within Operable Unit 1. Uncertainty associated with the off-property resident farmer and Great Miami River user is primarily the result of surface water, groundwater, and air modeling used to support those scenarios. The modeling assumptions were conservative, and this resulted in conservative estimates for the exposure point concentrations (the term "conservative" indicates high end risk commensurate with reasonable maximum exposure). Based on the discussion in Section 6.7.4 (Evaluation of TICs), and recognizing the uncertainty in risk characterization relative to TICs, it is assumed that the overall impact on the Operable Unit 1 risk assessment is minimal."

TABLE 7-7

DATA LIMITATIONS AND RECOMMENDED ACTIONS

Data Limitation	Significance to Alternatives Evaluation	Significance to Baseline Risk Assessment	Recommended Action/Justification
<p>A number of Tentatively Identified Compounds (TICs) were found in pit material samples in the low ppm and ppb ranges. These constituents were removed from the quantitative analysis based on EPA risk assessment guidance and protocols. Qualifiers used to evaluate TICs indicate that the presence of the compounds and their concentrations were unreliable for quantitative statistical evaluation and quantitative risk assessment.</p>	<p>TICs are of uncertain origin and are defined as those compounds that may result from chromatographic responses that exceed 10 percent of the nearest internal standard. Evaluation of TICs, therefore, may impact statistical evaluations of CPCs, total risk, and PRLs. If (according to RAGs Part A) many TICs are present, more analyses may be required.</p>	<p>The potential for toxicity and risk of TICs is uncertain since their estimated levels and availability of expert and clinical information on dose response and toxicity is non-existent. There is potential for TICs to contribute to overall risk. However, given the uncertainty associated with the data that would normally give the identity and concentration, evaluation of impact to total risk is not precise. For the purpose of the Operable Unit 1 risk assessment, TIC classes were evaluated for overall toxicity and were found to have minimal impact to baseline risk assessment.</p>	<p>No further action is required. The TICs appear to be relatively non-toxic with a minimum potential for exposure, primarily from the pit material. Although there is risk of hazard from the exposure to the eyes and skin, this appears to be minimal because the source material has a very low level concentration in the pit material. The volume of pit material required for ingestion to produce an adverse effect from these levels of materials would be in excess of a few kilograms (2-3 lbs or more) and is highly unlikely. Any possible risk would likely be occupational considering its likely that a construction or remedial worker, digging in the soil, would be exposed to the pit material TICs.</p> <p>Some of these These materials may be present due to the residuals blown over from crop farms and/or present due to existing biological (plants, insects, microbes) products present naturally in the soils. This would tend to reduce the expectation that these materials would be toxic.</p> <p>There are few only at very small amounts and Based on the toxicity assessment by compound class (as discussed in Section E.6), it would require the receptor to consume inordinately large volumes of pit material to reach toxic levels. Under chronic conditions of exposure, a positive impact on risk always exists. The primary potential of such materials is to irritate the mucous membranes of the eyes and the respiratory tract. Given their presence in the lower horizons of the pit material, the impact is minimal, if at all.</p> <p>Comment #8</p>

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The following text has been rewritten:

Page E-6-21. "...in order to ascertain the degree of uncertainty they impose on site risk."

Page E-6-21. "Tentatively identified compounds ~~are of uncertain origin and~~ are defined as those compounds that may result from chromatographic responses that exceed 10 percent of the response of the nearest internal standard (EPA, 1989a). Reporting requirements for analyses presume a maximum of 10 TICs to be reported for volatiles and a maximum of 20 TICs to be reported for semivolatiles. In general, TICs may be associated with the presence of blank contamination, laboratory artifacts such as aldol condensation products, chromatographic column bleed, biological compounds present in soil, residual compounds from previous analyses, degradation products and exotic organics, esters, and nitrogenous compounds from soil and plant life, as well as other contaminants."

Page E-6-21a. "Organic compounds may exhibit response factors in the range of 0.05 to 2.0, as opposed to a factor of 1.0 for equal chromatographic responses based upon the reference to the nearest internal standard. Due to the variability in potential response factors of organic compounds, ~~any when no internal standard is available, then estimation~~ of TIC presence, origin, or concentration is ~~questionable~~ made more difficult. Given a response factor range of 0.05 to 2.0, the quantitative sum of all TICs in a given sample with 10 parts per million, ~~would could~~ have an actual value as low as 0.25 parts per million, or a maximum value as high as 400 parts per million. The range, which ~~may be reduced with additional analyses or evaluations,~~ is based on the uncertainty of identification, response, and concentration. The TICs listed in Table E.6-4, such as tributyl phosphate and the several solvents, may be associated with residual process products or materials."

(2) No action.

(3) **Page E-6-21a.** The following sentence has been deleted: "Various compounds appear to be either chemical degradation or condensation products, generated during chemical separation-chromatographic analysis, or progeny of solid phase constituents in the chromatographic column."

Commenting Organization: U.S. EPA Commentor: Van Leeuwen
Section #: E.1 Page #: E-1-21a Line #: Code: C
Original Comment #: 9

Comment: DOE has received guidance on this issue from ECAO; the comments in this section are no longer appropriate and should be revised.

Response: Agree. However, DOE would prefer to use the median number. Therefore, DOE will write an exception to ECAO on this topic. Refer to the EPA memo dated May 11, 1994 from K. Hammerstrom to J. Dollarhide.

Action: Page E-1-21a. The following text has been deleted: "DOE disagrees with this guidance and has presented a dissenting opinion. The matter will be examined by EPA, but until such time that EPA acts upon this matter, the above value will be used."

Commenting Organization: U.S. EPA Commentor: Van Leeuwen
Section #: E.2 Page #: E-2-15 Line #: 25-31 Code: C
Original Comment #: 10 (44-12)

Comment: The new statement which refers to the "95th percentile background value as a decision making point" is not clear. Paragraph 1, page E-2-12, describes a two-step process, whereby a "location" test (Student's t-test or Wilcoxon Rank Sum test) is followed by the "95th Percentile Test." My understanding is that the 95th Percentile Test is applied to see if any eliminated contaminants exceed this value; if so, the eliminated chemical is added to the CPC list. I think that the intent/methodology is correct in the bullet, but the explanation is not clear. Also, this bullet does not really describe the "tox" screening process, which is the given topic for the bullets.

Response: Agree. The bullet should be moved to the discussion regarding selection of CPCs, at the end of E.2.3.1.1, and rewritten to be clearer.

Action: Text was moved to the end of Section E.2.3.1.1 and revised to read as follows: "The 95th percentile test is used as the second step in the statistical CPC screening. If a potential contaminant was not identified by the first step (location test), then the 95th percentile test was applied. The 95th percentile test is used to identify potential contaminants with maximum concentration significantly greater than background. Those constituents that would be eliminated based on the location test but fail the 95th percentile test, remain as CPCs."

Commenting Organization: U.S. EPA Commentor: Van Leeuwen
 Section #: E.3 Page #: E-3-66 Line #: Code: C
 Original Comment #: 11 (40)

Comment: (a) I am totally confused by the response and action here. The first question raised in the comment was how did DOE resolve the apparent inconsistent exposures for the on-site CT and RME farmer exposure scenarios - e.g., the gamma exposure for the RME scenario assumes that the farmer spends 2,000 hours per year (hrs/yr) outdoors (Footnote h, Table E.3-18), while the explanation of the soil ingestion rate lists the time farming/outdoors as 800 hrs/yr; the gamma exposure value for the CT scenario is 1,155 hrs/yr and the calculation for the ingestion rate is not given. I do not understand why the gamma exposure time period is significantly different than the ingestion exposure time period. DOE's response to this comment was to eliminate the rationale for the ingestion rate for the RME exposure in section E.3.5.7.5, rather than explain the difference. This is even more unacceptable because the total description of the farmer ingestion rate was added in response to a request for this detail in an earlier comment! We have now gone full circle on this one, and I am no closer to an explanation.

(b) The second question raised in my original comment was if the values used were based on the activities of the "average" farmer (1987 Census of Agriculture data), did they represent the CT exposure rather than the RME exposure. I asked if a farmer whose exposure would not incur a risk using the listed values might in fact constitute a risk if he chose to plant more than 10% of his land in hay, and what a realistic upper bound might be for the RME scenario. I expected to see a discussion of this point in this section and in the uncertainties section. This question was not addressed at all. I indicated that these questions may not be important in the Operable Unit 1 report, but they may well be important if some land is returned to the public (as in Operable Unit 5), and I would like to see a consistent approach used throughout the site.

I am further disappointed to see that the ingestion rate explanation was replaced by a reference to the Operable Unit 4 Remedial Investigation Report (DOE 1993f), as though the use of the value in that Operable Unit grants validity for its use here. Actually, these questions were raised during the review of the Operable Unit 4 document, and we were informed that a further explanation would be provided in the current Operable Unit under preparation. When the explanation for the values were included in this Operable Unit report, it was apparent that there might be some inconsistencies in the exposure scenarios, both in the Operable Unit 4 report as well as in this one. We had pointed out that this situation might occur when two or three Operable Unit reports were on the same time-line, and issues were not being addressed concurrently within and between documents.

Response: Agree. Text is confusing. The soil ingestion pathway and gamma exposure pathway did not use different exposure time for total exposure because both pathways assume continuous exposure for 350 days per year for 70 years. However, the external gamma exposure pathway must consider exposure time to account for indoor versus outdoor exposure (to determine the appropriate shielding factor) while exposure times for incidental ingestion must be considered to account for days when the farmer is actually tilling the soil (which assumes a higher average daily soil ingestion rate) versus the time the farmer is engaged in normal activities that do not involve tilling the soil (which assumes the default soil ingestion rate for an adult). Since gamma-exposures can occur

regardless of the farmers activity, the exposure from tilling the soil was not considered different than that from other activities. A detailed description is provided as an action item.

Although the text is unclear as to the exact methodology that was used to consider exposure time for external exposure versus soil ingestion, both scenarios assumed continuous exposure for 350 days/year for 70 years. Exposure time was only used to determine parameters that effect calculation within a particular pathway (ie., exposure time outdoors versus indoors for gamma exposure; and exposure frequency farming versus non-farming for soil ingestion rates).

Action: Page E.3-64. The following text was added:

"The total gamma exposure time assumed for the RME farmer is 24 hours per day, 350 days per year for 70 years. However, the exposure time per day was divided into two exposure times, exposure time outdoors (ET_{out}) which assumes no shielding factor, and exposure time indoors (ET_{in}) which assumes a shielding factor of 0.5.

Page E.3-66. The following text was added:

"The literature was consulted to determine an appropriate soil incidental ingestion rate for a farmer. However, no default values were found. Therefore, this value was estimated assuming the following:

- Soil ingestion rate to use on days while tilling, plowing, planting or harvesting would use a higher average daily value of 0.48 g/day from EPA default exposure assumptions (EPA 1991j).
- For other activities, use an average daily soil ingestion rate of 0.1 g/day.

To determine the amount of time a farmer is engaged in these activities, a review of farming parameters (farm size and crop configuration) were considered for Hamilton County. The 1987 Census of Agriculture (U.S. DOC 1989) indicates that 1,284 of the 1,364 farms in Hamilton and Butler County (95 percent) are under 500 acres (5 percent are 500 acres or above). Therefore, 500 acres was selected as the RME farm size. The soil ingestion rate for the CT farmer was based on similar farm configuration but using an average (CT) farm size of 125 acres. To determine the times associated with farming, a farmer was assumed to follow recommended agricultural practices for the region. A farmer is assumed to rotate their crops and plant 35 percent (175 acres) in corn, 35 percent in soybeans, 20 percent (100 acres) in wheat, and 10 percent (50 acres) in hay. It must be acknowledge that this configuration is a typical configuration and may represent an average value because each crop has a different time associated with field preparation, planting and harvesting. However, data is not available to determine a RME configuration. Therefore, an alternative configuration could result in a slightly higher or slightly lower exposure. A RME farm size (500 acres) was assumed to be adequate to compensate for this uncertainty.

Table E.3-17a presents the detailed calculations for soil ingestion rate for the RME and CT farmer. The U.S. Soil Conservation Service Field Technical Guide (U.S. SCS 1992) indicates that a farmer spends about 1.24 hours per acre farming corn, 1 hour per acre farming soybeans, 1.28 hours per acre farming wheat and 2.73 hours per acre farming hay. Assuming the farm configuration described above, an RME farmer would spend approximately 660 hours farming (plowing, discing, planting and/or harvesting). An additional 20 percent is added to this time to account for miscellaneous activities and the uncertainty with the farm configuration described above, to give a total of 800 hours, or 100 working days. Therefore, it is assumed that a farmer would incidentally ingest 0.48 g/day of soil for 100 days per year spent tilling the soil and 0.1 g/day for the remaining 250 days per year, for a combined average ingestion rate of 0.18 grams/day for 350 days per year, assuming an average (CT) farm produces a CT soil ingestion rate of 0.120 g/day."

Table E.3-17a. This table was added to reflect calculations for the soil ingestion rate for the RME and CT farmer as described above.

Commenting Organization: U.S. EPA Commentor: Van Leeuwen
Section #: E Page #: Table E.3-18 Line #: Code: E, E, C
Original Comment #: 12

Comment: (a) Footnote r was removed as indicated in response to Comment No. 35. The remaining reference to footnote "r" in the table is incorrect.
(b) The use of footnote "a" in reference to the on-site CT resident farmer soil/sediment ingestion rate is incorrect. No explanation is provided in the text/table for this value.
(c) The averaging time for the on-property homebuilder (Comment No. 39) might be too conservative, unless it is assumed that the builder spends 7 days a week on site; an AT value of 205 days might be more appropriate.

Response: (a) Agree. Footnote "r" should be deleted from the table.
(b) Agree. The text provided in response to Comment 11 explains the CT soil ingestion rate.
(c) Comment Acknowledged. The averaging time is conservative; however, this receptor is not used in the development of remedial alternatives for Operable Unit 1.

Action: (a) Table E.3-18. Footnote "r" was deleted.
(b) Reference to footnote "a" was deleted from the IR (g/day), under Incidental ingestion of soil/sediment, for the On-Property CT Resident Adult Farmer, Age 1-70.
(c) No action.

Commenting Organization: U.S. EPA Commentor: Van Leeuwen
Section #: E.4 Page #: E-4-46 Line #: Code: E
Original Comment #: 13 (41c)

Comment: The new sentence is still not quite correct.
(1) The version of the IEUBK model for Lead referenced should be "version 0.99d."
(2) Actually the SAB has reviewed versions 0.5 and 0.6; version 0.99d and the revised manual reflect changes made in response to comments from those reviews.
(3) The sentence appears to be rather out-of-place; perhaps it would fit better at the end of the previous paragraph.

Response: Agree. The correct IEUBK model version, as well as its current status, should be used. The entire sentence, as revised, should be moved to the end of the previous paragraph.

Action: Page E-4-46. The following sentence has been moved to the end of the previous paragraph: "Version 0.99d of the IEUBK model for lead, which resulted from Science Advisory Board review of versions 0.5 and 0.6, is currently being distributed."

Commenting Organization: U.S. EPA Commentor: Van Leeuwen
 Section #: E.4 Page #: Table E.4-5, p. E-4-109 Line #: Code: E
 Original Comment #: 14
 Comment: The Relative Potency Factor for chrysene is incorrect; it should be 0.001. The oral slope factor for benzo(a)pyrene is 7.3 (mg/kg-day)⁻¹. We do not usually round off the toxicity values; why is it done here?
 Response: Agree. The proper Relative Potency Factor for chrysene (.001), should be used. Comment Acknowledged regarding rounding off toxicity values.
 Action: Table E.4-5. The non-rounded values, as well as the correct value for chrysene, have been incorporated.

Commenting Organization: U.S. EPA Commentor: Van Leeuwen
 Section #: E.5 Page #: E-5-21 Line #: Code: C
 Original Comment #: 15 (415)
 Comment: I am not certain that all readers understand the difference between the average and the median value, or know that the two values may differ depending on the distribution. Why introduce this complexity?
 Response: (1) Agree. The use of "median" is confusing and should be deleted. (2) Agree. The example is also confusing and should be deleted.
 Action: Page E.5-21. The word "median" has been deleted from the text.

Second, the reference to the use of the upper 95 percent confidence interval value on the mean for the exposure point concentrations confuses the issues. The text discussion is centered on differences in exposure considered in the RME and CT scenarios. However, the use of the upper-bound value for the exposure point concentration addresses a different issue - the inability to fully determine contaminant media concentrations due to incomplete or less than perfect sampling schemes, rather than the inability to characterize the exposure pattern. The resulting explanation obscures the two issues. Some revision is needed here.

Page E.5-21. The following sentence has been deleted: "For example, the CT adult scenario in this analysis uses the upper 95 percent confidence interval on the mean as the exposure concentration. Thus the results presented for this receptor are not true average or median risks."

Commenting Organization: U.S. EPA Commentor: Van Leeuwen
 Section #: E-5 Page #: Table E.5-1 Line #: Code: C
 Original Comment #: 16
 Comment: See comments on Sections 6.0 and 7.0 tables regarding summing problems.
 Response: See response to Comment #5.
 Action: Table E.5-1. A footnote was added, in accordance with the action identified above for Comment #5.

Commenting Organization: U.S. EPA Commentor: Van Leeuwen
 Section #: E-6 Page #: E-6-14 Line #: 38 Code: E
 Original Comment #: 17
 Comment: The reference to Clement International 1990 does not appear to be correct here. This paper deals with PAH TEFs, not dioxins and furans. I think you want the EPA 1986 document on interim procedures for dioxins.
 Response: Agree. The reference to the EPA document, which was actually published in 1989, should be used in place of "Clement International, 1990."
 Action: Page E-6-14, fourth bullet. "Clement International, 1990" has been deleted and replaced with "EPA 1989j."

Commenting Organization: U.S. EPA Commentor: Van Leeuwen
 Section #: E-6 Page #: E-6-21a Line #: Para. 1 Code: C
 Original Comment #: 18
 Comment: I'm not certain I agree with all of this discussion.

(1) The TIC concentrations may be in error due to the lack of appropriate standards for quantitation, but the mass spectra are available so the identities are usually fairly well known. Therefore, grouping of TICs and estimation of impact on risk to receptor populations is possible.
 (2) The instrumentation should correct for the release of solid phase bleed during temperature programming, so I am not certain what constituents are referred to in the last sentence.
 (3) If significant levels of degradation compounds are present, the discussion of these compounds should include the toxicity/exposure to the parent compounds.
 Response: (1) Agree. The text should be rewritten to delete any reference to the "impossibility" of TIC identification.
 (2) Agree. As indicated in RAGs, when there are many TICs and potential for significant risk, special analytical procedures, with greater dollar and time costs, may be used. In addition, since Section 7 focuses on data limitations and uncertainties within the Remedial Investigation, DOE felt it necessary to add summary text, related to the TIC discussion, to Section 6, which is a summary of the baseline risk assessment.
 (3) The Operable Unit 1 data are not conclusive that the TICs result from degradation products; as such, the last sentence of paragraph 1 was deleted.
 Action: (1) The following text has been rewritten:

Page E-6-21. "...in order to ascertain the degree of uncertainty they impose on site risk."

Page E-6-21. "Tentatively identified compounds ~~are of uncertain origin and~~ are defined as those compounds that may result from chromatographic responses that exceed 10 percent of the response of the nearest internal standard (EPA, 1989a). Reporting requirements for analyses presume a maximum of 10 TICs to be reported for volatiles and a maximum of 20 TICs to be reported for semivolatiles. In general, TICs may be associated with the presence of blank contamination, laboratory artifacts such as aldol condensation products, chromatographic column bleed, biological compounds present in soil, residual compounds from previous analyses, degradation products and exotic

organics, esters, and nitrogenous compounds from soil and plant life, as well as other contaminants."

Page E-6-21a. "Organic compounds may exhibit response factors in the range of 0.05 to 2.0, as opposed to a factor of 1.0 for equal chromatographic responses based upon the reference to the nearest internal standard. Due to the variability in potential response factors of organic compounds, any when no internal standard is available, then estimation of TIC presence, origin, or concentration is questionable made more difficult. Given a response factor range of 0.05 to 2.0, the quantitative sum of all TICs in a given sample with 10 parts per million, would could have an actual value as low as 0.25 parts per million, or a maximum value as high as 400 parts per million. The range, which may be reduced with additional analyses or evaluations, is based on the uncertainty of identification, response, and concentration. The TICs listed in Table E.6-4, such as tributyl phosphate and the several solvents, may be associated with residual process products or materials."

(2) Page 6-20. The following text was added:

"Evaluation of TICs

Tentatively identified compounds (TICs) were evaluated. TICs are those volatile and semivolatile organic compounds not included in the Full HSL/Full Radioisotope list for Operable Unit 1, but show high peaks on the chromatogram. For TICs, there is no minimum percentage of accuracy; identification accuracy can be as low as 40 percent and still be reported. Therefore, the assigned identity and concentrations are uncertain.

"A compilation of TIC data is presented in Appendix E.6.3.2. In conversations with the laboratory, it was determined that TICs could not be positively identified without some level of uncertainty. However, the TICs classes included alcohol-glycols, aldehydes and ketones, aliphatics, amino/nitro compounds, aromatic and polyaromatic compounds, esters, carboxylic acids, furans, dimethyl sulfides, and a series of unknown compounds. Specific compounds from these classes are identified in Table E.6-4. As compared to the Target Analyte and Target Compound List for Operable Unit 1 media, there were relatively few TICs observed and most of these were in the lower horizon of the waste pit contents.

"Given that there were few TICs, of which some were not positively identified, they were not carried through the quantitative risk assessment. The TICs were evaluated qualitatively, by considering the toxicity as a function of the compound class (refer to Appendix E, Section E.6.3.2.2 for a detailed discussion). The potential for significant impact on overall risk assessment in Operable Unit 1 was assumed to be minimal. This follows from the observation that the TICs identified in the waste pit maerial were found predominantly at the lower depths typically exceeding four feet. The TICs from these regions were also found to be in relatively small concentrations and therefore would have little impact on the surface or direct pathways. Because the TICs reported from these depths were at relatively low concentrations (as compared to the actual detected analytes) and considering the potential for dilution and dispersion these TICs would have little potential for significant transport through the groundwater pathways."

Page 6-21 and 6-22. Text was added to the last paragraph on page 6-21 as follows:

"The receptors with the highest uncertainty in the current source term are the off-property resident farmer and off-property user of meat/milk from livestock grazed on site. The off-property resident-farmer scenario was evaluated based on modeled concentrations for the air pathway and results in high uncertainty. The bioaccumulation of CPCs into meat/milk were modeled, and as a result, provides moderate to high uncertainty for this receptor. The greatest uncertainty in the risk assessment of Operable Unit 1 is associated with the assumptions made in the future source term. These particular receptors include the on-property resident farmer, the Great Miami River user, and the off-property user of meat and milk. For the on-property RME resident farmer and home builder, the highest uncertainty is associated with the assumed future land use and potential exposure pathways. This receptor scenario was included in response to guidance and is anticipated to have a low likelihood of occurrence due to the history of the site and the particular waste management activities within Operable Unit 1. Uncertainty associated with the off-property resident farmer and Great Miami River user is primarily the result of surface water, groundwater, and air modeling used to support those scenarios. The modeling assumptions were conservative, and this resulted in conservative estimates for the exposure point concentrations (the term "conservative" indicates high end risk commensurate with reasonable maximum exposure). Based on the discussion in Section 6.7.4 (Evaluation of TICs), and recognizing the uncertainty in risk characterization relative to TICs, it is assumed that the overall impact on the Operable Unit 1 risk assessment is minimal."

(3) Page E-6-21a. The following sentence has been deleted: "Various compounds appear to be either chemical degradation or condensation products, generated during chemical separation-chromatographic analysis, or progeny of solid phase constituents in the chromatographic column."

Commenting Organization: U.S. EPA Commentor: Van Leeuwen
 Section #: E-6 Page #: E-6-21b Line #: 3 Code: E
 Original Comment #: 19
 Comment: Do you mean "epidemics?"
 Response: No. The term should be deleted.
 Action: Page E-6-21b. The following text has been deleted: "epidemics and in."

Commenting Organization: U.S. EPA Commentor: Van Leeuwen
Section #: E-6 Page #: E-6-21b Line #: 30 Code: C
Original Comment #: 20

Comment: When you say effects occur at "fairly high" exposure, it would be helpful to the reader if you include a number, so that this impact can be evaluated in relation to site exposures. Please consider this approach throughout the TIC section.

Response: Agree. Reference to subjective terms, such as "high" and "fairly high", should be defined or deleted. In addition, all conclusions should be made less emphatic.

Action: The text was revised as follows, as a result of a DOE-EPA conference call held July 20, 1994. To facilitate identification of specific revisions, all text changes (both additions and deletions) are shown.

Page E-6-21b. "Hexanol (like hexane) can be metabolized to hexanone 2, 5-hexanedione. This metabolite may initiate nerve damage and if the exposure is chronic, it could cause serious peripheral neuropathies. However, this occurs only under chronic exposure and at fairly high concentrations (such as 500 parts per million for hexane). It is generally found in the industrial setting. This is unlikely at the FEMP. Alcohol solvents are liquid and highly volatile. Because of their widespread use there is a potential for adverse effects from the industrial setting. FEMP concentrations of the alcohols do not contribute to the site risk."

Page E-6-21c. The conclusion has been revised to read: "CONCLUSION: IMPACT FROM ALCOHOLS/GLYCOLS ON RISK IS PROBABLY LOW."

Page E-6-21c. The conclusion has been revised to read: "CONCLUSION: IMPACT ON RISK FROM ALDEHYDE/KETONES IS PROBABLY LOW."

Page E-6-21d. The conclusion has been revised to read: "CONCLUSION: THE IMPACT ON RISK FROM ALIPHATICS IS PROBABLY LOW."

Page E-6-21d. The conclusion has been revised to read: "CONCLUSION: IMPACT TO RISK FROM AMINO/NITRO GROUPS IS PROBABLY MODERATE."

Page E-6-21e. The conclusion has been revised to read: "CONCLUSION: THE IMPACT ON SITE RISK FROM AROMATIC/POLYAROMATIC HYDROCARBONS IS PROBABLY MODERATE."

Page E-6-21e. The conclusion has been revised to read: "CONCLUSION: IMPACT ON RISK FROM CARBOXYLIC ACIDS IS PROBABLY BE LOW."

Page E-6-21f. The conclusion has been revised to read: "CONCLUSION: THE IMPACT TO RISK FROM THESE ESTERS IS PROBABLY LOW."

Page E-6-21f. The conclusion has been revised to read: "CONCLUSION: THE IMPACT ON RISK IS PROBABLY LOW FROM THESE FURANS."

Page E-6-21f. The following paragraphs have been revised to read: "The overall impact on risk from these compounds is low. This is due to the fact that these materials appear

~~to be relatively non-toxic, and because the potential for exposure is minimal, are primarily from the lower horizons of pit material. Although there is risk of hazard from the exposure to the eyes and skin, this appears to be minimal because the source material has a very low level concentration in the pit materials. The volume of soil required for ingestion to produce an adverse effect from these levels of materials would be in excess of a few kilograms (2-3 pounds or more) and is highly unlikely. Any possible risk, would likely be occupational, considering its likely that a construction or remedial worker, digging in the soil, would be exposed to the sub-surface soil TICs: pit media."~~

Page E-6-21g. "These materials may be present due to the various reasons stated ~~previously above, from residuals blown over from crop farms and/or~~ present due to existing biological (plants, insects, microbes) products present naturally in the soils. This would tend to reduce the expectation that these materials would be toxic, except under fairly large exposure conditions. Although plant alkaloids can be toxic, there are few only at very small amounts and it would require the receptor to consume inordinately large volumes of pit material to reach toxic levels."

Page E-6-21g. "The question of the degree of impact is a professional judgment: the certainty of its lack of impact on risk is fairly high. ~~The low concentrations and the low potential for an exposure, effects of these TICs, if present, and their bioavailability, would be non-existent to very low. The impact on the overall site risk is very low. Given the low concentrations and locations of TICs, and the lack of complete exposure pathways, the degree of impact on total baseline risk is considered to be minimal.~~"

Commenting Organization: U.S. EPA Commentor: Van Leeuwen
Section #: E-6 Page #: E-6-21c Line #: Para. 1 Code: E
Original Comment #: 21

Comment: I did not understand this comment. I thought we were evaluating chronic and subchronic exposures in the RI. Maybe we need to identify the acute/short-term effects as being of importance in the FS report.

Response: Agree. Text was confusing.

Action: **Page E-6-21c.** Text has been rewritten to state that "Derivatives of butanone and 2-hexanone ~~may be considered harmful, can produce both chronic and short-term effects,~~ especially to muscle/nerve tissue in ~~that they are able of causing~~ peripheral polyneuropathies. ~~However, chronic exposures are required to initiate such pathology.~~" The last sentence of the paragraph, line 10, was deleted.

Commenting Organization: U.S. EPA Commentor: Van Leeuwen
Section #: E-6 Page #: E-6-21d Line #: Para. 3 Code: E
Original Comment #: 22

Comment: The first sentence and the last sentence are not compatible.

Response: Agree.

Action: **Page E-6-21d.** The last sentence of the paragraph, "Thus the hydrocarbons identified above as TICs are not likely to be of serious concern," has been deleted.

Commenting Organization: U.S. EPA Commentor: Van Leeuwen
Section #: E-6 Page #: E-6-21f Line #: Para. 1 Code: E
Original Comment #: 23

Comment: The Conclusion does not seem to follow from the last sentence. Perhaps the level of exposure which causes liver and kidney damage should be indicated.

Response: Agree. The reference to liver and kidney damage should be deleted.

Action: **Page E-6-21f.** The following sentence has been deleted: "In experimental animals, liver and kidney damage have been caused by furan exposures." The following sentence has been added: "Carcinogenicity in furans is assumed and although furans are a significant compound class with respect to risk, the relatively few TICs in this class that were reported would indicate that the impact on total risk is low."

Commenting Organization: U.S. EPA Commentor: Van Leeuwen
 Section #: E-6 Page #: E-6-21f Line #: Code: C
 Original Comment #: 24

Comment: Again, I am not certain I agree with all the comments made in this section.
 (1) From the discussion of the individual classes, it is obvious that some of these classes of TICs contain some constituents which are pretty toxic at higher concentrations or with prolonged exposures. Therefore, the statement that the TICs appear to be relatively non-toxic does not seem to follow from the preceding discussions.
 (2) The text indicates that the TICs may be present from residuals blown over from the crop farms, and that the compounds would have reduced toxicity. If this were the case, such TICs should have been detected in background samples at concentrations which were orders of magnitude greater. Was this the case? Also, many compounds applied to crops are very toxic.
 (3) Maybe it would help the discussion to relate to the potential receptor populations being considered when discussing the impact of these TICs - e.g., which receptor populations are likely to be impacted by the TIC exposure.
 (4) The second to last sentence in this section is not clear.

Response: (1) Agree. Clarification is needed.
 (2) Agree. The text referring to "residuals blown over from crop farms" should be deleted.
 (3) Partially agree. Text identifying receptors is not needed because the overall impact of TICs on risk is low.
 (4) Agree. The kilogram-to-pound comparison is inaccurate and should be deleted.

Action: (1) Page E-6-21f. The following text has been deleted: "appears to be relatively non-toxic, and because the potential for exposure is minimal."
 (2) Page E-6-21g. The following text has been deleted: "above, from residuals blown over from crop farms".
 (3) No action.
 (4) Page E-6-21f. The following text has been deleted: "(2-3 pounds or more)".

Commenting Organization: U.S. EPA Commentor: Van Leeuwen
 Section #: E-6 Page #: Table E.6-4 Line #: Code: E
 Original Comment #: 25

Comment: (1) Indicate the units for the values in parentheses.

(2) Clarify notation in the esters section - e.g., esters of these acids.

Response: Agree. The values should be provided in the table, as well as in the text of Section E.6.3.2. The esters should also be clarified.

Action: **Table E.6-4.** The following footnote was added: "All concentrations are reported in $\mu\text{g}/\text{kg}$, unless otherwise noted. These concentrations are considered to be relatively low (ppb range), as compared to the detected analytes on the target analyte list."

The title of the esters list was modified to read: "Esters (of the following acids)."

Commenting Organization: U.S. EPA Commentor: Van Leeuwen
 Section #: E-7 Page #: E-7-2 Line #: 11 Code: E
 Original Comment #: 26

Comment: The revised notations used for uranium (U-238) and cesium (CS subscript 137) are not consistent.

Response: Agree. Consistent notations should be used.

Action: **Page E-7-2.** "U238" has been changed to "U-238" and "Cs₁₃₇" has been changed to "Cs-137".

Commenting Organization: U.S. EPA Commentor: Van Leeuwen
 Section #: E-7 Page #: Table E.7-1 Line #: Code: C
 Original Comment #: 27
 Comment: Refer to prior discussions of the apparent discrepancies in the summation of totals.
 Response: See response to Comment 5.
 Action: Table E.7-1. A footnote was added, in accordance with the action identified above for Comment #5.

Commenting Organization: U.S. EPA Commentor: Van Leeuwen
 Section #: E-7 Page #: Table E.7-9 Line #: Code: C
 Original Comment #: 28
 Comment: It is not clear whether the values listed under "Cancer Risks/Operable Unit 1" include background risks. This should be indicated in the header/footnotes if background is included in this calculation.
 Response: Agree. A footnote should be added that explains total cancer risks include risk to background concentrations.
 Action: Table E.7-9. The following footnote has been added:
 "Total cancer risks for Operable Unit 1 include risk to background concentrations of CPCs."

SECTION 4

pesticides/herbicides in the waste pit area for control of insects and weeds. PCBs, in the form of Aroclor 1254, were detected in surface soil (0 to 6 inches deep) samples WPA-4, WPA-7, WPA-38, and WPA-43 at concentrations ranging from 53 $\mu\text{g}/\text{kg}$ to 1,400 $\mu\text{g}/\text{kg}$. These sampling locations are located east and west of the Operable unit 1 area. No PCBs were detected in the southern portion of the waste pit area. PCBs in the surface soils may be attributed to indirect transport mechanisms, e.g., surface runoff, or contaminated borrow fill.

4.3.2 Subsurface Soil

Radiological and chemical contamination in the subsurface soil zone, i.e., subsurface soil at depths below 24 inches from surface, were investigated as part of the RI/FS soil boring and groundwater monitoring programs. RI/FS investigation of subsurface soil contamination included radiological analysis of surface soil samples collected during installation of monitoring wells throughout the Operable Unit 1 area. Details of these investigations and results are discussed below. Additional monitoring wells were also installed in areas outside of the Operable Unit 1 boundary. The data from those borings will be compiled and correlated with the data generated from borings within the Operable Unit 1 boundary and submitted in the Operable Unit 5 Remedial Investigation Report.

4.3.2.1 Radiological Characterization

As part of the RI/FS program, subsurface soil samples within Operable Unit 1 were collected in distinct subsurface geological units during the installation of monitoring wells and soil borings. Subsurface soil sampling locations are shown in Figure 2-12. Upon completion of each boring, subsurface soil samples were submitted to the on-site gamma spectrometry laboratory for analysis of radiological constituents. Based on the radiological screening results, the subsurface soil samples with the highest counts from each geologic unit were submitted to an off-site laboratory for analysis of specific radiological parameters. Results of the off-site laboratory analysis are presented in Appendix C. Radiological constituents in the subsurface soil that were detected above background concentrations are summarized in Table 4-20.

Based on the available site geologic information from subsurface boring logs Appendix C, geologic units in the Operable Unit 1 area can be generalized as follows:

- Glacial overburden - Dry, stiff-hard, yellowish/grayish brown clay with trace of gravel and/or sand; low blow count; USCS symbol: CL 1
- 2
- 3
- Upper sand and gravel layer - Wet, dense, yellowish brown sand with trace of gravel; medium blow count; USCS symbol: SP-SM-SW 4
- 5
- 6

Figure 4-30 shows the distribution of U-238 in the subsurface soil of the glacial overburden within Operable Unit 1. The depth interval for the glacial overburden ranges from 1 to 37.5 feet below ground surface. As shown in the figure, the data do not exhibit any discernible trends worthy to be plotted as isoconcentration contours. The maximum concentration of U-238 was detected in Boring 1644 located between the Burn Pit and Pit 4. However, Boring 1944, located just a few feet away, does not exhibit high uranium concentrations. Therefore, the high uranium concentration in Boring 1644 is considered a localized hot spot with very limited extent. Also, a cluster of borings between the Burn Pit and Pit 5 exhibit relatively higher uranium concentrations. This area is within the pathway of a drainageway south of Pit 5. It is possible that contamination from Pit 5 and the Burn Pit have accumulated in this area over a period of time.

There were seven subsurface soil samples from the upper saturated sand and gravel layer and two soil samples from the lower saturated sand and gravel layer. Only one subsurface soil sample was collected from the deep saturated sand layer. The soil samples from each borehole were initially screened by a scintillation detector (SPA-3) and the sample with the highest radiation reading within each geologic horizon was selected for radiochemical laboratory analysis. As shown in Table 4-20, slightly elevated uranium concentrations (U-234 and U-238) were detected in two subsurface soil samples from Boring 3004 and Boring 2028, both located west of Waste Pit 3 in the upper saturated sand and gravel layer at depth of 35.0 feet and 66.5 feet, respectively. Thorium (Th-230) was detected in Boring 3084 at a depth of 61.5 feet. ~~No other soil samples at further depth or deeper units showed uranium or thorium activity concentration.~~

The uranium contamination may be attributed to spills during disposal of radiological waste materials, if at shallow depth, or horizontal and downward migration of pit contents, if at deeper intervals. The detected U-238 and U-234 activity concentrations represent the highest concentrations in the individual boring due to the sample collection scheme. Although the SPA-3 screening was essentially utilized for selection of laboratory samples, the vertical extent of radiological contamination in the subsurface soils may be qualitatively determined by using the SPA-3 screening results. The SPA-3 screening results are presented in Appendix B.1.2. The vertical extent of radiological contamination in the subsurface soils in Operable Unit 1 area is primarily located in the glacial overburden at depths up to 30 feet below ground

In the upper sand and gravel layer, radiological constituents were detected at levels significantly lower than those in the glacial overburden. Three of the seven subsurface soil samples contain useable results for radionuclides detected at above background concentrations. A detection of 9.5 pCi/g for Ra-226 and 3.8 pCi/g for U-238 were reported from a sample obtained at a depth of 35.0 feet below grade in Boring 3004, located southwest corner of Waste Pit 3. The same sample also exhibited a concentration of 6.9 pCi/g for Sr-90 and 4.1 pCi/g for U-234. A sample obtained from a depth of 66.5 feet below grade in Boring 2028, located on the west boundary of Waste Pit 3, detected Sr-90 activity concentration at 1.03 pCi/g and U-234 activity concentration of 1.24 pCi/g. Thorium-230 was detected at a concentration of 3.1 pCi/g in a sample from Boring 3084, located in an area surrounded by Waste Pits 4, 5, and 6, at a depth of 61.5 feet below grade. No detections above background were reported for Ra-228, Tc-99, Th-228, Th-232, and U-235/236 in the upper sand and gravel layer. The radiological contamination in the upper sand and gravel layer may be attributed by migration from the pit contents.

In the lower saturated sand and gravel layer and the deep saturated sand and gravel layer, no radiological constituents were reported exceeding background concentrations in any of the samples analyzed. This information for the deep saturated sand and gravel layer is based, however, on data generated from the boring of one well (4011), located upgradient of the waste pits. The data from well number 4011 will be compiled with data from well borings existing downgradient of the waste pit area as part of the Operable Unit 5 Remedial Investigation. Conclusions regarding the level of radiological contamination will be made at that time.

4.3.2.2 Chemical Characterization

All of the subsurface soil samples were field screened for volatile organic compounds (VOCs) using an OVA. If VOCs were detected, the subsurface soil sample was submitted to an off-site laboratory for a full HSL analysis. Five samples were submitted for HSL volatile organic analysis. Only one sample, boring 1078, revealed the presence of volatile compounds. Complete analytical data for the samples are presented in Appendix C.

The sample with the reported concentrations of organic compounds was collected from Boring 1078, located between the Burn Pit and Waste Pit 5, at a depth interval of 4.5 feet to 6.0 feet. The organic compounds detected included 2-butanone, acetone, and carbon disulfide at

concentrations of 0.001 mg/kg, 0.016 mg/kg, and 0.004 mg/kg, respectively. Acetone was 1
 reported for the associated blank which makes the reported sample concentration less 2
 significant. 2-Butanone may be attributed by migration from pit contents. However, acetone 3
 and carbon disulfide are common laboratory chemicals and, therefore, may be detected in 4
 samples due to laboratory cross-contamination. 5

the upper sand and gravel layer included Ra-226, Sr-90, Th-230, U-234, and U-238. No radiological constituents were reported exceeding background concentrations in any of the samples collected from the lower saturated sand and gravel layer and the deep saturated sand and gravel layer. This information for the deep saturated sand and gravel layer is based, however, on data generated from the boring of one well (4011), located upgradient of the waste pits. The data from well number 4011 will be compiled with data from well borings existing downgradient of the waste pit area during the Operable Unit 5 Remedial Investigation. Conclusions regarding the level of radiological contamination will be made at that time.

The highest activity concentrations for uranium isotopes were detected at a depth interval of 1.5 feet to 3.0 feet below grade in an area immediately southeast of the Burn Pit and at a depth interval of 21.5 feet and 22.5 feet below grade in an area immediately north of Waste Pit 1. Other areas that revealed contaminated subsurface soil samples, although at much lower concentrations, include the center of the waste pit area and the area immediately northwest of Waste Pit 1. The highest activity concentrations of Th-232 were detected at an area immediately north of Waste Pit 1 at depths between 13.5 feet and 22.5 feet below grade. The highest activity concentrations for Ra-226 were detected in areas to the east of Waste Pit 2 and north of Waste Pit 1 at depths between 16.5 feet and 22.5 feet.

The uranium contamination in the glacial overburden may be attributed to spills during disposal of radiological waste materials, if at shallow depth, or horizontal and downward migration of pit contents, if deep in the interval. Distribution of Th-232 and Ra-226 activity concentrations in the glacial overburden is significantly different from those for U-238 and U-234. This observation may be attributed to the characteristics of the radiological constituents. Nevertheless, activity concentrations for radiological constituents represented the highest concentrations in the individual boring due to the sample collection scheme. Therefore, they should only be regarded as localized points in the subsurface soils.

In the upper sand and gravel layer, radiological constituents were detected in an area southwest of Waste Pit 3, an area to the west of Waste Pit 3, and an area surrounded by Waste Pits 4, 5, and 6, at depth between 35.0 feet and 66.5 feet below grade. No detection above background were reported for Ra-228, Tc-99, Th-228, Th-232, and U-235/236 in the

upper sand and gravel layer. The radiological contamination in the upper sand and gravel
layer may be attributed by migration from the pit contents.

1
2
3

Chemical Characterization

One sample revealed the presence of some volatile organic compounds at very low concentrations. The detected VOCs may be attributed to laboratory cross-contamination or migration from pit contents.

4.4 GROUNDWATER CHARACTERIZATION

Groundwater samples were collected from four groundwater horizons within the Operable Unit 1 study area as part of the RI/FS and supporting RCRA investigations. This subsection discusses the data results of samples collected by the RI/FS quarterly sampling program from 1987 to 1992 and samples collected for the RCRA Groundwater Assessment quarterly sampling program from 1990 to the second quarter of 1993, as discussed in Section 2.0.

Within the Operable Unit 1 study area twenty-five 1000-series wells monitor perched groundwater within the glacial overburden in the Operable Unit 1 study area. Thirteen 2000-series wells monitor the upper sand and gravel (water table) of the regional aquifer above the clay layer. Eight 3000-series wells monitor the middle sand and gravel of the regional aquifer above the clay layer, and two 4000-series wells monitor the lower sand and gravel of the regional aquifer above bedrock. The locations of the 1000-, 2000-, 3000-, and 4000-series wells within or near the Operable Unit 1 study area are presented on Figures 2-14, 2-15, 2-16, and 2-17, respectively, in Section 2.0. Figure 2-18 depicts the monitoring well completion depths. Figures 2-19 and 2-20 in Section 2.0 show the typical well construction schematics for each series of well.

1 Additional monitoring wells were also installed in areas outside of the Operable Unit 1 boundary. The data from those wells will be compiled and correlated with the data generated from wells within the Operable Unit 1 boundary and submitted in the Operable Unit 5 Remedial Investigation Report.

Groundwater samples were analyzed for both radiological and chemical (inorganic and organic) parameters. The sample collection methods and analytical procedures are described in Section 2.0. Results of the groundwater radiological and chemical analyses and the dates each well was sampled are tabulated in Appendix B.2. Data summary Tables 4-21 through 4-32 present the analytical minimum, maximum, and average concentrations, and number of sampling rounds per well (count) for both the RI/FS and RCRA groundwater investigation programs.

Activity concentrations for the glacial overburden and Great Miami Aquifer wells which are 1
upgradient from the FEMP property are very low, near the analytical detection limits for 2
radionuclides. Therefore, any reported radionuclide detection is likely to be considered above 3
background level. Table 4-2 presents the FEMP site-wide background UTL concentrations 4
5

RCRA Investigation Analyses

The results of the RCRA 3000-series organic analyses indicate the absence of the organic compounds detected in the RI/FS samplings. All organic chemical data were either very low (near or estimated below detection limits) or nondetect. The only exceptions to this are the detections of carbon disulfide at 0.5 to 27 µg/L in Well 3008, located southeast of Operable Unit 1; and at 0.5 to 16 µg/L in Well 3043, located west and upgradient of Operable Unit 1, near Paddys Run Road. Chloroform detected at a maximum 22 µg/L in Well 3019 and acetone detected at 37.2 µg/L in Well 3084, were the only organic compounds detected within the waste pit area boundary.

4.4.2.3 4000-Series Well Data

Two 4000-series RI/FS and six RCRA wells were used to characterize the radiological and chemical nature of the bottom zone of the regional aquifer.

Due to the limited amount of data points for the 4000-series wells located within the Operable Unit 1 Study Area, it is not possible at this time to fully characterize the extent of contamination in the deep horizon of the Great Miami Aquifer. A detailed site-wide discussion of the nature and extent of contamination in the deep horizon of the Great Miami Aquifer will be conducted as part of the Operable Unit 5 RI report.

Radionuclide Characterization

Appendix B.2 presents the RI/FS and RCRA 4000-series radionuclide laboratory analytical results. Table 4-27 presents a summary of radionuclides detected in the RI/FS 4000-series wells and their respective average, minimum and maximum concentrations, as well as, the number of samples collected per well (count). Table 4-28 presents the same information for the RCRA 4000-series wells.

RI/FS Investigation Analyses

Only Wells 4001 and 4011 were sampled under the RI/FS program. Groundwater flow in the lower portion of the Great Miami Aquifer is from west to east in the area (Section 3.4). Uranium-234 and U-238 were detected at concentrations of 2.44 pCi/L and 2.23 pCi/L, respectively, in Well 4011, located northwest of the pit areas (upgradient). These concentrations are near or below background levels. The only radiological constituent

detected at Well 4001, located at the southeastern boundary of the waste pit area 1
 (downgradient), was Th-230 at 1.3 pCi/L, which is below background concentrations. 2

RCRA Investigation Analyses 4

Average total uranium concentrations were detected below background in Well 4011, located 5
 upgradient of the waste pit area; at 2.07 µg/L. The maximum concentration of total uranium 6

concentrations in Well 4011. There are no discernable source areas for inorganic
contamination of the 4000-series wells based on the RCRA data. However, it does appear that
the waste pit area has influenced the deep sands and gravels of the aquifer based on elevated
downgradient well detections.

Organic Results

The 4000-series RI/FS and RCRA organic data summaries are presented in Tables 4-31 and 4-
32, respectively.

RI/FS Investigation Analyses

Only four organic constituents were detected in low concentrations in the 4000-series wells
samples. Trichloroethene (5 µg/L), tetrachloroethene (5 µg/L) and 1,1-dichloroethane (5
µg/L) were detected in Well 4001 near the detection limits and chlorobenzene was detected in
Well 4011 at 5 µg/L. There is no indication of significant organic contamination in the
4000-series wells. However, since the majority of the organic contamination is present in the
downgradient well (4001), it appears that the waste pit area is contributing organic
contaminants to the deep sands and gravels of the Great Miami Aquifer. All three of the
volatile organic compounds detected have a specific density greater than water, thus, would
tend to sink to the bottom of the aquifer. Therefore, the detections in the deep horizon of the
aquifer are not unexpected given these same compounds were detected in the shallower wells
within the Great Miami Aquifer.

1 ~~Due to the limited amount of data points for the 4000-series wells located within the
Operable Unit 1 Study Area, it is not possible at this time to fully characterize the extent of
contamination in the deep horizon of the Great Miami Aquifer. A detailed site wide discussion
of the nature and extent of contamination in the deep horizon of the Great Miami Aquifer will
be conducted as part of the Operable Unit 5 RI report.~~

RCRA Investigation Analyses

Almost all organic compounds analyzed for in the RCRA 4000-series wells were either
undetected or detected near or estimated below their respective minimum detection limits.

Acetone was the only significant volatile organic detection in Well 4011 at 10.0 µg/L.
Because the RCRA data have not been validated, this common laboratory contaminate may not

Elevated uranium concentrations were detected in every RI/FS 3000-series well sampled, except Well 3011, which is located in the northwest corner (upgradient of the waste pit area). The highest levels of total uranium occurred in wells 3084 (218 µg/L) and 3019 (56 µg/L), both located in the northeast (downgradient) part of the area, within the influence of Waste Pit 4.

The RCRA 3000-series well radionuclide data showed a marked increase over the RI/FS data. In particular concentrations of total uranium in Wells 3019 and 3084 rose by one to two orders of magnitude, respectively. Also, Tc-99 concentrations exceeded background in all RCRA wells, whereas, Tc-99 was not detected in the 3000-series RI/FS data.

It appears that a definite increase of contamination to the middle sand and gravel of the Great Miami Aquifer is occurring, possibly from vertical migration from the perched zones above in the vicinity of Waste Pit 4.

Data from wells to the southeast (4008, 4101, 4102, 4103) demonstrate higher concentrations and a greater number of radiological constituents than the 4000-series wells within Operable Unit 1 (4001 and 4011). The only contaminant found above background in wells within Operable Unit 1 was total uranium with a maximum concentration of 5.3 ug/L in Well 4011 (Table 4-28). The 4000-series wells outside of Operable Unit 1 show several radiological contaminants, including total uranium that exceeded background. Wells 4101 and 4102 showed maximum concentrations of Th-228 (1.64 pCi/L), Ra-226 (1.77 pCi/L),

1 Sr-90 (0.26 pCi/L), total thorium (13.8 ug/L), and total uranium (6.4 ug/L). This data will be correlated with the data generated from within Operable Unit 1 and discussed in detail in the Operable Unit 5 Remedial Investigation Report.

Inorganic Characterization

Twenty-six inorganic analytes were detected at above background levels in the RI/FS 1000-series well data, most of which correlate to what was detected in the pit waste material and leachate samples. The following analytes were elevated in both the perched groundwater and the pit waste material and/or leachate samples: calcium, manganese, magnesium, beryllium, copper, lead, nickel, cadmium, selenium, molybdenum, and vanadium.

The RCRA 1000-series well inorganic analyses, overall, showed much lower concentrations 1
of inorganics and at less frequencies. The predominant inorganic constituents detected above 2
background concentrations in the RCRA wells were calcium, magnesium, manganese, and 3

**TABLE 4-2
BACKGROUND CONCENTRATIONS FOR SOILS AND GROUNDWATER**

Analyte	Background Concentrations ^a				
	Soils		Groundwater		Riverwater
	Surface (0-6 inches)	Subsurface (48-54 inches)	Perched ^b	Shandon Tributary ^c	Great Miami River
Radionuclides	(pCi/g)	(pCi/g)	(pCi/L)	(pCi/L)	(pCi/g)
Actinium-227	0.15 ^d	0.13 ^d	0.0 ^e	0.0 ^e	NA
Bismuth-210	1.33 ^f	0.7 ^f	0.0 ^e	0.0 ^e	NA
Bismuth-214	1.33 ^f	0.7 ^f	0.0 ^e	0.0 ^e	NA
Cesium-137 ^B	0.71	0.0 ^e	0.0 ^e	0.0 ^e	NA
Lead-210	1.33	0.70	0.0 ^e	0.0 ^e	NA
Neptunium-237	0.0 ^e	0.0 ^e	<1 ^h	<1 ^h	1 ^h
Plutonium-238	0.0 ^e	0.0 ^e	<1 ^h	<1 ^h	1 ^h
Plutonium-239	0.0 ^e	0.0 ^e	<1 ^h	<1 ^h	1 ^h
Plutonium-240	0.0 ^e	0.0 ^e	<1 ^h	<1 ^h	1 ^h
Polonium-210	1.33 ^f	0.7 ^f	0.0 ^e	0.0 ^e	NA
Protactinium-231	0.15 ^f	0.13 ^f	0.0 ^e	0.0 ^e	NA
Radium-224	0.90	0.96	0.0 ^e	0.0 ^e	NA
Radium-226	1.45	1.27	1 ⁱ	1.77	1 ^h
Radium-228	1.19	1.25	4.57	4.8	3 ^h
Ruthenium-106 ^B	<0.07	<0.06	0.0 ^e	0.0 ^e	NA
Strontium-90 ^B	<0.5	<0.5	0.0 ^e	0.0 ^e	5
Technetium-99 ^B	<0.9	<0.9	0.0 ^e	0.0 ^e	30
Thorium-228	1.43	1.25	1.6 ⁱ	1.6 ⁱ	1 ^h
Thorium-230	1.97	1.85	2 ⁱ	2.5 ⁱ	1 ^h
Thorium-232	1.36	1.24	<1 ^h	<1 ^h	1 ^h
Total Thorium	12.4 mg/kg ^j	13.3 mg/kg ^j	3µg/L ⁱ	2.47µg/L ⁱ	NA
Uranium-234	1.24	0.94	1.88	2.43	1.1
Uranium-235/236	0.15	0.13	<1 ^j	<1 ^j	1 ^h
Uranium-238	1.22	0.92	1.5 ⁱ	4.4 ⁱ	1 ^h
Total Uranium	3.17 mg/kg ^j	3.68 mg/kg ^j	1.23 µg/L ^j	2.92 µg/L ^j	1 µg/L

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**TABLE 4-2
BACKGROUND CONCENTRATIONS FOR SOILS AND GROUNDWATER**

Analyte	Background Concentrations ^a				
	Soils		Groundwater		Riverwater
	Surface (0-6 inches)	Subsurface (48-54 inches)	Perched ^b	Shandon Tributary ^c	Great Miami River
Metals(mg/kg)	(mg/kg)	(mg/kg)	(mg/L)	(mg/L)	(mg/L)
Aluminum	11,880	14,700	0.123	0.188	NA
Antimony	7.7 ^h	6.7 ^h	0.0 ^e	0.038 ^{i m}	NA
Arsenic	8.45	8.79	0.058 ^m	0.088 ^m	0.002
Barium	91.3	99.2	0.477	.077	0.1
Beryllium	0.60 ⁱ	0.62	0.002 ^m	0.002 ^m	NA
Boron	21.8 ^k	42.7	0.0 ^e	0.0 ^f	NA
Cadmium	0.82	0.59 ⁱ	0.006 ^m	0.006 ^m	0.0098 ^m
Calcium	4340	145,000	124,000	142,000	77
Chromium	15.5	19	0.034	0.067 ^m	0.02
Cobalt	15.2	15.7	<0.01 ^h	<0.01 ^h	NA
Copper	14.1	16.3	0.029	0.022	0.01
Cyanide	0.25	0.11 ^h	0.0 ^e	0.0 ^e	NA
Iron	22,300	28,000	9.22	4.67 ^m	0.22
Lead	25.6	13.4	0.021 ^m	0.028 ^m	0.01
Magnesium	3350	43,100	48.5	40.7	34.9
Manganese	1770	922	0.15 ^m	0.514 ^m	0.02
Mercury	0.3 ⁱ	0.29 ⁱ	0.004 ^m	0.0004	0.0095 ^m
Molybdenum	2.6 ^h	2.7 ⁱ	0.028 ⁱ	0.02	0.02
Nickel	20.9	28.5	0.026	0.026	0.0105
Potassium	1230	2100	27	4.31	6.2
Selenium	0.7 ⁱ	0.6 ^h	<0.003 ^h	0.006 ⁱ	0.002
Silicon	1760	1700	0.0 ^e	0.0 ^e	NA
Silver	2.6 ^h	2.2 ^h	0.038	0.014	0.1
Sodium	51.1	198	57.6	52.9	77.2
Thallium	0.58 ⁱ	0.43 ^h	0.0 ^e	<0.012 ^{h m}	NA
Vanadium	30.4	36.9	0.002	0.026	NA
Zinc	62.2	59	0.032 ⁱ	0.48	NA

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5625 = 575

**TABLE 4-2
BACKGROUND CONCENTRATIONS FOR SOILS AND GROUNDWATER**

Analyte	Background Concentrations ^a				
	Soils		Groundwater		Riverwater
	Surface (0-6 inches)	Subsurface (48-54 inches)	Perched ^b	Shandon Tributary ^c	Great Miami River
All Organic Compounds	0.0^c	0.0^c	0.0^c	0.0^c	0.0^c
General Water Chemistry	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Ammonia	NA ⁱ	NA	4.58	18.2	1.2
Chloride	NA	NA	97	83.5	325
Fluoride	NA	NA	1.3	1.24	0.9
Nitrate	NA	NA	0.286	1.25	6.58
Total Phosphorus	NA	NA	0.208	0.979	101
Sulfate	NA	NA	138	346 ^m	4310 ^m

- ^a Source: DOE 1993b (soils), DOE 1993a (Groundwater). Background concentrations are based on the 95th percentile of the data distribution from site-specific background data except as noted.
- ^b Wells used to evaluate the perched groundwater background concentrations include 1040, 1059, and 1060.
- ^c Wells used to evaluate the Shandon Tributary background concentrations include 2043, 2050, 2056, 2066, 2383, 3024, 3043, and 4011.
- ^d Because of poor SQL values, this nuclide was assumed to be in secular equilibrium with its parent, U-235.
- ^e Value assumed to be zero.
- ^f Value assumed based on secular equilibrium for radioactive decay chain.
- ^g This radionuclide is a fission product, and its presence in the environment is due only to atmospheric releases of radiation (e.g., weapons testing). This radionuclide is not naturally occurring and is only expected to be present at or near detectable activities in the surface soil.
- ^h All of the values in the data set were not detectable. The average SQL was substituted as the best representative value for the 95th percentile.
- ⁱ Less than or equal to 10 percent of measured concentrations were above the SQL. The maximum detected value was substituted as the 95th percentile.
- ^j Individual activity concentrations of the three isotopes for uranium and thorium were converted to mass concentrations. The three isotope mass concentrations were added to obtain the total thorium or uranium mass concentration.
- ^k The calculated standard deviation was greater than 2.00. This was caused by the combination of only 12 values out of 30 above SQL and the maximum concentration of 1140 µg/g. Summary statistics for 0 to 6 inches without suspected outliers were used as the representative statistics for this data set.

- ^l NA - Not applicable
- ^m 95th percentile values which exceed the Federal Maximum Contaminant Levels:
- | | |
|-----------------------------|---------------------|
| Arsenic 0.05 mg/L | Lead 0.015 mg/L |
| Antimony 0.006 mg/L | Manganese 0.05 mg/L |
| Beryllium 0.004 mg/L | Mercury 0.002 mg/L |
| Cadmium 0.005 mg/L | Sulfate 300 mg/L |
| Chromium 0.05 mg/L | Thallium 0.002 mg/L |
| Iron 0.3 mg/L | |

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SECTION 6

For the additional CPCs, the analysis found that phenanthrene has been identified as a class D chemical and has no reference values in IRIS, HEAST, nor the Region III Screening Criteria (EPA 1993.). Accordingly it is not considered to be a chemical of concern.

For Octachlorodibenzo-p-dioxin (OCDD), the toxicity equivalence factor has been identified as 0.001 as compared to the 2,3,7,8 tetrachlorodibenzo-p-dioxin. The contribution to the toxicity and associated risk is judged to be inconsequential. Accordingly, it can be concluded that the additional data has not affected the risks nor would they affect the previous list of COCs.

DOE Evaluation of TICs

Tentatively identified compounds (TICs) were evaluated. TICs are those volatile and semivolatile organic compounds not included in the Full HSL/Full Radioisotope list for Operable Unit 1, but show high peaks on the chromatogram. For TICs, there is no minimum percentage of accuracy; identification accuracy can be as low as 40 percent and still be reported. Therefore, the assigned identity and concentrations are uncertain.

A compilation of TIC data is presented in Appendix E.6.3.2. In conversations with the laboratory, it was determined that TICs could not be positively identified without a some level of uncertainty. However, the TIC classes included: alcohol-glycols, aldehydes and ketones, aliphatics, amino/nitro compounds, aromatic and polyaromatic compounds, esters, carboxylic acids, furans, dimethyl sulfides, and a series of unknown compounds. Specific compounds from these classes are identified in Table E.6-4. As compared to the Target Analyte and Target Compound Lists for Operable Unit 1 media there were relatively few TICs observed and most of these were in the lower horizon of the waste pit contents.

Given that there were few TICs, of which some were not positively identified, they were not carried through the quantitative risk assessment. The TICs were evaluated qualitatively, by considering the toxicity as a function of the compound class (refer to Appendix E, Section E.6.3.2.2 for a detailed discussion). The potential for significant impact on overall risk assessment in Operable Unit 1 was assumed to be minimal. This follows from the observation that the TICs identified in the waste pit material were found predominantly at the lower depths typically exceeding four feet. The TICs from these regions were also found to be in relatively small concentrations and therefore would have little impact on the surface or

direct pathways. Because the TICs reported from these depths were at relatively low concentrations (as compared to the actual detected analytes) and considering the potential for dilution and dispersion these TICs would have little potential for significant transport through the groundwater pathways.

6.7.5 Summary of Uncertainties in Operable Unit 1 Baseline Risk Assessment

Table 6-3 presents a qualitative evaluation of the uncertainties described in the preceding sections. Generally, uncertainty arises wherever data gaps exist. Data gaps in the risk assessment were mitigated by making conservative assumptions for individual parameters. Significant uncertainty results for those particular pathways that required fate and transport modeling to support the assessment of exposure. Such uncertainty was generated for the air and groundwater pathways of exposure. The high uncertainty, therefore, must be addressed in the interpretation of risk from these media. Certain exposure pathways for a particular medium also tend to have higher or lower uncertainty depending on their assumptions. For example, incidental ingestion of soils by residents tends to have significantly less uncertainty than ingestion of fruits and vegetables, meat, and milk raised on contaminated soils. To assess these indirect exposure pathways, assumptions must be made regarding contaminant uptake from soil to plant, and plant to livestock that are not required for the soil ingestion pathway.

The receptors with the highest uncertainty in the current source term are the off-property resident farmer and off-property user of meat/milk from livestock grazed on site. The off-property resident-farmer scenario was evaluated based on modeled concentrations for the air pathway and results in high uncertainty. The bioaccumulation of CPCs into meat/milk were modeled, and as a result, provides moderate to high uncertainty for this receptor. The greatest uncertainty in the risk assessment of Operable Unit 1 is associated with the assumptions made in the future source term. These particular receptors include the on-property resident farmer, the Great Miami River user, and the off-property user of meat and milk. For the on-property RME resident farmer and home builder, the highest uncertainty is associated with the assumed future land use and potential exposure pathways. This receptor scenario was included in response to guidance and is anticipated to have a low likelihood of occurrence due to the history of the site and the particular waste management activities within Operable Unit 1. Uncertainty associated with the off-property resident farmer and Great

DOE Miami River user is primarily the result of surface water, groundwater, and air modeling used to support those scenarios. The modeling assumptions were conservative, and this resulted in conservative estimates for the exposure point concentrations (the term "conservative" indicates high end risk commensurate with reasonable maximum exposure). Based on the discussion in Section 6.7.4 (Evaluation of TICs), and recognizing the uncertainty in risk characterization relative to TICs, it is assumed that the overall impact on the Operable Unit 1 risk assessment is minimal.

Taken together, the uncertainties identified with site data, exposure parameters, fate and transport, toxicity assessment and risk characterization are judged to be high (i.e., potential to overestimate risk by two or more orders of magnitude).

TABLE 6-3

INCREMENTAL LIFETIME CANCER RISK SUMMARY
CURRENT LAND USE, CURRENT SOURCE TERM ^a

Media	Groundskeeper	Off-property Farmer	Off-property Young Child	Trespassing Youth	Off-property User of Meat and Milk Products
Air					
Radiocarcinogenic Risk	6E-06	3E-06	2E-07	7E-07	NA
Chemical Carcinogenic Risk	1E-08	2E-07	8E-08	2E-09	NA
Total ^b :	6E-06	3E-06	2E-07	7E-07	NA
Surface Soil					
Radiocarcinogenic Risk	8E-05	NA	NA	3E-05	5E-04
Chemical Carcinogenic Risk	1E-05	NA	NA	9E-06	9E-04
Total ^b :	9E-05	NA	NA	4E-05	1E-03
Buried Pit Material					
Radiocarcinogenic Risk	5E-05	NA	NA	2E-05	NA
Chemical Carcinogenic Risk	NA	NA	NA	NA	NA
Total ^b :	5E-05	NA	NA	2E-05	NA
On-property Surface Water					
Radiocarcinogenic Risk	NA	NA	NA	NA	2E-04
Chemical Carcinogenic Risk	NA	NA	NA	NA	6E-06
Total ^b :	NA	NA	NA	NA	2E-04
Sum All Media					
Radiocarcinogenic Risk	1E-04	3E-06	2E-07	5E-05	7E-04
Chemical Carcinogenic Risk	1E-05	2E-07	8E-08	9E-06	9E-04
Total ^b :	1E-04	3E-06	2E-07	5E-05	2E-03

NA - Not applicable. Exposure route not evaluated for receptor.

^a This table includes values that have been rounded to one significant figure. Therefore, the total number may be higher or lower than the sum that would result from adding the values in the table, due to rounding. Refer to Attachment E.IV for specific values.

^b Radiocarcinogenic and chemocarcinogenic risks are not truly additive. A total is provided for reference only.

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TABLE 6-5

INCREMENTAL LIFETIME CANCER RISK SUMMARY
 CURRENT LAND USE, FUTURE SOURCE TERM ^a

Medium	Trespassing Youth	Great Miami River User
Air		
Radiocarcinogenic Risk	8E-05	NA
Chemical Carcinogenic Risk	4E-05	NA
Total ^b :	1E-04	NA
Surface Soil		
Radiocarcinogenic Risk	1E-04	NA
Chemical Carcinogenic Risk	7E-05	NA
Total ^b :	2E-04	NA
Buried Pit Material		
Radiocarcinogenic Risk	7E-06	NA
Chemical Carcinogenic Risk	NA	NA
Total ^b :	7E-06	NA
Paddys Run Surface Water		
Radiocarcinogenic Risk	7E-08	NA
Chemical Carcinogenic Risk	6E-08	NA
Total ^b :	1E-07	NA
Paddys Run Sediment		
Radiocarcinogenic Risk	4E-06	NA
Chemical Carcinogenic Risk	9E-06	NA
Total ^b :	1E-05	NA
Great Miami River Surface Water		
Radiocarcinogenic Risk	NA	3E-07
Chemical Carcinogenic Risk	NA	3E-08
Total ^b :	NA	3E-07
All Media		
Radiocarcinogenic Risk	2E-04	3E-07
Chemical Carcinogenic Risk	1E-04	3E-08
Total ^b :	3E-04	3E-07

NA - Not Applicable. Exposure route not evaluated for this receptor.

^a This table includes values that have been rounded to one significant figure. Therefore, the total number may be higher or lower than the sum that would result from adding the value in the table, due to rounding. Refer to Attachment E.IV for specific values.

^b Radiocarcinogenic risk and chemocarcinogenic risk are not truly additive. A total is provided for reference only.

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TABLE 6-7

**INCREMENTAL LIFETIME CANCER RISK SUMMARY
 FUTURE LAND USE (GOVERNMENT RESERVE)
 FUTURE SOURCE TERM ^a**

Medium	On-property Groundskeeper	Expanded Trespasser
Air		
Radiocarcinogenic Risk	7E-04	1E-04
Chemical Carcinogenic Risk	2E-04	6E-05
Total^b:	9E-04	2E-04
Surface Soil/Exposed Pit Material		
Radiocarcinogenic Risk	4E-04	3E-04
Chemical Carcinogenic Risk	2E-04	2E-04
Total^b:	7E-04	5E-04
Buried Pit Material		
Radiocarcinogenic Risk	5E-05	3E-05
Chemical Carcinogenic Risk	NA	NA
Total^b:	5E-05	3E-05
Paddys Run Surface Water		
Radiocarcinogenic Risk	NA	7E-08
Chemical Carcinogenic Risk	NA	6E-08
Total^b:	NA	1E-07
Paddys Run Sediment		
Radiocarcinogenic Risk	NA	4E-06
Chemical Carcinogenic Risk	NA	9E-06
Total^b:	NA	1E-05
All Media		
Radiocarcinogenic Risk	1E-03	4E-04
Chemical Carcinogenic Risk	4E-04	3E-04
Total^b:	2E-03	7E-04

NA – Not Applicable. Exposure route not evaluated for this receptor.

^a This table includes values that have been rounded to one significant figure. Therefore, the total number may be higher or lower than the sum that would result from adding the values in the table, due to rounding. Refer to Attachment E.IV for specific values.

^b Radiocarcinogenic risk and chemocarcinogenic risk are not truly additive. A total is provided for reference only.

**TABLE 6-9
INCREMENTAL LIFETIME CANCER RISK SUMMARY
FUTURE LAND USE (AGRICULTURAL USE)
FUTURE SOURCE TERM ^a**

Media	On-property RME Farmer ^c	On-property (User of RME Farmer ^c Perched GW)	On-property CT Farmer	On-property Young Child	Off-property Farmer	Off-property Young Child	Homebuilder	Off-property User of Meat and Milk Products
Air								
Radiocarcinogenic Risk	5E-03	5E-03	4E-04	9E-05	2E-04	4E-06	1E-04	1E-05
Chemical Carcinogenic Risk	5E-03	5E-03	3E-04	1E-03	3E-04	7E-05	4E-05	8E-04
Total ^b :	1E-02	1E-02	7E-04	1E-03	5E-04	8E-05	2E-04	8E-04
Exposed Waste Pit Materials								
Radiocarcinogenic Risk	2E-02	2E-02	2E-03	2E-03	NA	NA	7E-05	NA
Chemical Carcinogenic Risk	9E-03	9E-03	6E-04	4E-03	NA	NA	2E-04	NA
Total ^b :	3E-02	3E-02	3E-03	6E-03	NA	NA	2E-04	NA
Surface Soil								
Radiocarcinogenic Risk	7E-04	7E-04	4E-05	1E-04	NA	NA	NA	5E-04
Chemical Carcinogenic Risk	1E-03	1E-03	6E-05	5E-04	NA	NA	NA	9E-04
Total ^b :	2E-03	2E-03	1E-04	6E-04	NA	NA	NA	1E-03
Buried Pit Material								
Radiocarcinogenic Risk	1E-03	1E-03	2E-04	2E-07	NA	NA	7E-09	NA
Chemical Carcinogenic Risk	NA	NA	NA	NA	NA	NA	NA	NA
Total ^b :	1E-03	1E-03	2E-04	2E-07	NA	NA	7E-09	NA
On-property Surface Water								
Radiocarcinogenic Risk	3E-04	3E-04	1E-05	4E-05	NA	NA	NA	3E-04
Chemical Carcinogenic Risk	6E-06	6E-06	4E-07	1E-06	NA	NA	NA	6E-06
Total ^b :	3E-04	3E-04	1E-05	4E-05	NA	NA	NA	3E-04
Groundwater								
Radiocarcinogenic Risk	2E-02	5E-01 b	2E-03	1E-03	2E-03	9E-05	NA	NA
Chemical Carcinogenic Risk	4E-02	9E-01 b	3E-03	9E-03	0E+00	0E+00	NA	NA
Total ^b :	6E-02	1E+00 b	4E-03	1E-02	2E-03	9E-05	NA	NA
All Media								
Radiocarcinogenic Risk	5E-02	5E-01 b	4E-03	3E-03	2E-03	1E-04	2E-04	8E-04
Chemical Carcinogenic Risk	5E-02	9E-01 b	4E-03	1E-02	3E-04	7E-05	2E-04	2E-03
Total ^b :	1E-01	1E+00 b	8E-03	2E-02	2E-03	2E-04	4E-04	2E-03

NA – Not applicable. Exposure route not evaluated for receptor.

^a This table includes values that have been rounded to one significant figure. Therefore, the total number may be higher or lower than the sum would result from adding the values in the table, due to rounding. Refer to Attachment E.IV for specific values.

^b Radiocarcinogenic and chemocarcinogenic risks are not truly additive. A total is provided for reference only.

^c Risks calculated and total summed based on the use of the 1-hit equation for calculating risks from higher doses (EPA 1989a), therefore, total risks will not exceed 1.0.

5795

SECTION 7

000052

TABLE 7-5

**SUMMARY OF BASELINE RISK BY MEDIA AND RECEPTOR^a
CURRENT LAND USE, CURRENT SOURCE TERM**

Media	Groundskeeper	Off-Property RME Resident Farmer	Off-Property Young Child	Trespassing Youth	Off-Property User of Meat and Dairy Products
Incremental Lifetime Cancer Risk Summary					
Air					
Radiocarcinogenic risk	6 x 10 ⁻⁶	3 x 10 ⁻⁶	2 x 10 ⁻⁷	7 x 10 ⁻⁷	NA ^b
Chemical carcinogenic risk	1 x 10 ⁻⁸	2 x 10 ⁻⁷	8 x 10 ⁻⁸	2 x 10 ⁻⁹	NA
Total ^c	6 x 10 ⁻⁶	3 x 10 ⁻⁶	2 x 10 ⁻⁷	7 x 10 ⁻⁷	NA
Buried Pit Material					
Radiocarcinogenic risk	5 x 10 ⁻⁵	NA	NA	2 x 10 ⁻⁵	NA
Chemical carcinogenic risk	NA	NA	NA	NA	NA
Total ^c	5 x 10 ⁻⁵	NA	NA	2 x 10 ⁻⁵	NA
Surface Soil					
Radiocarcinogenic risk	8 x 10 ⁻⁵	NA	NA	3 x 10 ⁻⁵	5 x 10 ⁻⁴
Chemical carcinogenic risk	1 x 10 ⁻⁵	NA	NA	9 x 10 ⁻⁶	9 x 10 ⁻⁴
Total ^c	9 x 10 ⁻⁵	NA	NA	4 x 10 ⁻⁵	1 x 10 ⁻³
Surface Water					
Radiocarcinogenic risk	NA	NA	NA	NA	2 x 10 ⁻⁴
Chemical carcinogenic risk	NA	NA	NA	NA	6 x 10 ⁻⁶
Total ^c	NA	NA	NA	NA	2 x 10 ⁻⁴
All Media					
Radiocarcinogenic risk	1 x 10 ⁻⁴	3 x 10 ⁻⁶	2 x 10 ⁻⁷	5 x 10 ⁻⁵	7 x 10 ⁻⁴
Chemical carcinogenic risk	1 x 10 ⁻⁵	2 x 10 ⁻⁷	8 x 10 ⁻⁸	9 x 10 ⁻⁶	9 x 10 ⁻⁴
Total ^c	1 x 10 ⁻⁴	3 x 10 ⁻⁶	2 x 10 ⁻⁷	5 x 10 ⁻⁵	2 x 10 ⁻³

**TABLE 7-5
(Continued)**

Media	Groundskeeper	Off-Property RME Resident Farmer	Off-Property Young Child	Trespassing Youth	Off-Property User of Meat and Dairy Products
Toxicity Summary					
Air	0	0.00027	0.0013	0	NA
Surface Soil	0.30	NA	NA	0.49	2.7
Surface Water	NA	NA	NA	NA	0.23
Total - All Media	0.30	0.00027	0.0013	0.49	2.9

*This summary of risk values table includes, but is not limited to, values that have one or two significant figures, as appropriate. Therefore, the total number may be higher or lower than the sum that would result from adding the values in the table, due to rounding. Refer to Attachment E.IV for specific values.

^bNA - Not applicable. Exposure route not evaluated.

^cRadiocarcinogenic and chemocarcinogenic risks are not truly additive. Provided for reference only.

TABLE 7-6

SUMMARY OF BASELINE RISK BY MEDIA AND RECEPTOR*
FUTURE SOURCE TERM

	Current Land Use		Future Land Use Government Reserve		Future Land Use Agricultural				
	Trespassing Youth	Great Miami River User	Groundskeeper	Expanded Trespasser	On-Property RME Adult Farmer	On-Property CT Adult Farmer	On-Property RME Child	Home Builder	Off-Property Farmer
Incremental Lifetime Cancer Risk									
Air									
Radiocarcinogenic Risk	8 x 10 ⁻⁵	NA ^b	7 x 10 ⁻⁴	1 x 10 ⁻⁴	5 x 10 ⁻³	4 x 10 ⁻⁴	9 x 10 ⁻⁵	5 x 10 ⁻⁵	2 x 10 ⁻⁴
Chemical Carcinogenic Risk	4 x 10 ⁻⁵	NA	2 x 10 ⁻⁴	6 x 10 ⁻⁵	5 x 10 ⁻³	3 x 10 ⁻⁴	1 x 10 ⁻³	2 x 10 ⁻⁵	3 x 10 ⁻⁴
Total ^c	1 x 10 ⁻⁴	NA	9 x 10 ⁻⁴	2 x 10 ⁻⁴	1 x 10 ⁻²	7 x 10 ⁻⁴	1 x 10 ⁻³	7 x 10 ⁻⁵	5 x 10 ⁻⁴
Buried Pit Material									
Radiocarcinogenic Risk	7 x 10 ⁻⁶	NA	5 x 10 ⁻⁵	3 x 10 ⁻⁵	1 x 10 ⁻³	2 x 10 ⁻⁴	2 x 10 ⁻⁷	7 x 10 ⁻⁹	NA
Chemical Carcinogenic Risk	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total ^c	7 x 10 ⁻⁶	NA	5 x 10 ⁻⁵	3 x 10 ⁻⁵	1 x 10 ⁻³	2 x 10 ⁻⁴	3 x 10 ⁻⁷	7 x 10 ⁻⁹	NA
Surface Soil/Exposed Pit Material									
Radiocarcinogenic Risk	1 x 10 ⁻⁴	NA	4 x 10 ⁻⁴	3 x 10 ⁻⁴	7 x 10 ⁻⁴	4 x 10 ⁻⁵	2 x 10 ⁻³	7 x 10 ⁻⁵	NA
Chemical Carcinogenic Risk	7 x 10 ⁻⁵	NA	2 x 10 ⁻⁴	2 x 10 ⁻⁴	1 x 10 ⁻³	6 x 10 ⁻⁵	4 x 10 ⁻³	2 x 10 ⁻⁴	NA
Total ^c	2 x 10 ⁻⁴	NA	6 x 10 ⁻⁴	5 x 10 ⁻⁴	2 x 10 ⁻³	1 x 10 ⁻⁴	6 x 10 ⁻³	2 x 10 ⁻⁴	NA
Sediment									
Radiocarcinogenic Risk	4 x 10 ⁻⁶	NA	NA	4 x 10 ⁻⁶	NA	NA	NA	NA	NA
Chemical Carcinogenic Risk	9 x 10 ⁻⁶	NA	NA	1 x 10 ⁻⁵	NA	NA	NA	NA	NA
Total ^c	1 x 10 ⁻⁵	NA	NA	1 x 10 ⁻⁵	NA	NA	NA	NA	NA
Groundwater									
Radiocarcinogenic Risk	NA	NA	NA	NA	2 x 10 ⁻²	2 x 10 ⁻³	1 x 10 ⁻³	NA	2 x 10 ⁻³
Chemical Carcinogenic Risk	NA	NA	NA	NA	4 x 10 ⁻²	3 x 10 ⁻³	9 x 10 ⁻³	NA	0
Total ^c	NA	NA	NA	NA	6 x 10 ⁻²	4 x 10 ⁻³	1 x 10 ⁻²	NA	2 x 10 ⁻³

7-53

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**TABLE 7-6
(Continued)**

	Current Land Use		Future Land Use Government Reserve		Future Land Use Agricultural				
	Trespassing Youth	Great Miami River User	Groundskeeper	Expanded Trespasser	On-Property RME Adult Farmer	On-Property CT Adult Farmer	On-Property RME Child	Home Builder	Off-Property Farmer
Incremental Lifetime Cancer Risk									
Surface Water									
Radiocarcinogenic Risk	NA	3 x 10 ⁻⁷	NA	7 x 10 ⁻⁸	3 x 10 ⁻⁴	1 x 10 ⁻⁵	4 x 10 ⁻⁵	NA	NA
Chemical Carcinogenic Risk	NA	3 x 10 ⁻⁸	NA	6 x 10 ⁻⁸	6 x 10 ⁻⁶	4 x 10 ⁻⁷	1 x 10 ⁻⁶	NA	NA
Total ^c	NA	3 x 10 ⁻⁷	NA	1 x 10 ⁻⁷	3 x 10 ⁻⁴	1 x 10 ⁻⁵	4 x 10 ⁻⁵	NA	NA
All Pathways^d									
Radiocarcinogenic Risk	2 x 10 ⁻⁴	3 x 10 ⁻⁷	1 x 10 ⁻³	4 x 10 ⁻⁴	5 x 10 ⁻²	4 x 10 ⁻³	3 x 10 ⁻³	2 x 10 ⁻⁴	2 x 10 ⁻⁴
Chemical Carcinogenic Risk	1 x 10 ⁻⁴	3 x 10 ⁻⁸	4 x 10 ⁻⁴	3 x 10 ⁻⁴	5 x 10 ⁻²	4 x 10 ⁻³	1 x 10 ⁻²	2 x 10 ⁻⁴	2 x 10 ⁻³
Total ^c	3 x 10 ⁻⁴	3 x 10 ⁻⁷	2 x 10 ⁻³	7 x 10 ⁻⁴	1 x 10 ⁻¹	8 x 10 ⁻³	2 x 10 ⁻²	4 x 10 ⁻⁴	2 x 10 ⁻³
Toxicity Summary									
Air	0.25	NA	0.62	0.29	8.4	4.3	28	6.4	0.52
Surface Soil/Exposed Pit Material	1.5	NA	1.6	3.5	28	13	130	54	NA
Sediment	0.11	NA	NA	0.11	NA	NA	NA	NA	NA
Groundwater	NA	NA	NA	NA	500	270	1,400	NA	31
Surface Water	0.039	0.0042	NA	0.039	0.33	0.15	2.7	NA	NA
Total - All Media ^c	1.9	0.0042	2.2	4.0	540	290	1,600	60	32

^aThis summary of risk values table includes, but is not limited to, values that have one or two significant figures, as appropriate. Therefore, the total number may be higher or lower than the sum that would result from adding the values in the table, due to rounding. Refer to Attachment E.IV for specific values.

^bNA - Not applicable. Exposure route not evaluated.

^cRadiocarcinogenic and chemical risks not readily summable. Provided for reference only.

^dTotals do not include ingestion of perched water.

**TABLE 7-7
(continued)**

Data Limitation	Significance to Alternatives Evaluation	Significance to Baseline Risk Assessment	Recommended Action/Justification
<p>A number of Tentatively Identified Compounds (TICs) were found in pit material samples in the low ppm and ppb ranges. These constituents were removed from the quantitative analysis based on EPA risk assessment guidance and protocols. Qualifiers used to evaluate TICs indicate that the presence of the compounds and their concentrations were unreliable for quantitative statistical evaluation and quantitative risk assessment.</p>	<p>TICs are of uncertain origin and are defined as those compounds that may result from chromatographic responses that exceed 10 percent of the nearest internal standard. Evaluation of TICs, therefore, may impact statistical evaluations of CPCs, total risk, and PRLs. If (according to RAGs Part A) many TICs are present, more analyses may be required.</p>	<p>The potential for toxicity and risk of TICs is uncertain since their estimated levels and availability of expert and clinical information on dose response and toxicity is non-existent. There is potential for TICs to contribute to overall risk. However, given the uncertainty associated with the data that would normally give the identity and concentration, evaluation of impact to total risk is enigmatic. For the purpose of the Operable Unit 1 risk assessment, TIC classes were evaluated for overall toxicity and were found to have minimal impact to baseline risk assessment.</p>	<p>No further action is required. The TICs appear to be relatively non-toxic with a minimum potential for exposure, primarily from the pit material. Although there is risk of hazard from the exposure to the eyes and skin, this appears to be minimal because the source material has a very low level concentration in the pit material. The volume of pit material required for ingestion to produce an adverse effect from these levels of materials would be in excess of a few kilograms (2-3 lbs or more) and is highly unlikely. Any possible risk would likely be occupational considering its likely that a construction or remedial worker, digging in the soil, would be exposed to the pit material TICs.</p> <p>Some of these These materials may be present due to the residuals blown over from crop farms and/or present due to existing biological (plants, insects, microbes) products present naturally in the soils. This would tend to reduce the expectation that these materials would be toxic.</p> <p>There are few only at very small amounts and Based on the toxicity assessment by compound class (as discussed in Section E.6), it would require the receptor to consume inordinately large volumes of pit material to reach toxic levels. Under chronic conditions of exposure, a positive impact on risk always exists. The primary potential of such materials is to irritate the mucous membranes of the eyes and the respiratory tract. Given their presence in the lower horizons of the pit material, the impact is minimal, if at all.</p> <p>Comment #8</p>

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APPENDIX E

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APPENDIX E.1

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Dermal Exposures to PAHs

Reliable cancer slope factors for dermal exposure to (PAHs) are currently unavailable. Current policy indicates it is inappropriate to extrapolate dermal slope factors from oral slope factors for PAHs. Also, extrapolation from other routes of exposure is inappropriate due to varied absorption, metabolic transformations and target organ end point responses. However, PAHs are potent skin carcinogens. Current information on the contribution to cancer risk from dermal exposure to PAHs indicates the toxicity from the dermal pathway may be as toxic as from the oral route of exposure. In order to provide an estimate of the risk contribution from PAHs via dermal exposure for all direct contact pathways, the risk posed for dermal exposure was assumed equal to the risk from oral exposure.

Child Inhalation Rates

DOE calculated a value of 0.5 m³/hr. for use as the appropriate value for the child's inhalation rate to be used for residential exposure scenarios. This value was developed utilizing currently used physiological parameters by pediatric medical practitioners from the Children's Hospital at the University of Cincinnati Medical Center. The ventilation volumes and rates used approximate the normal active child, in a conservative manner. The value developed for risk assessments is an upward adjustment of the normal child, to the moderately active child whose ventilation rate and volume are on the high side of the normal range. Accordingly, the value of 0.5m³/hour is used as the inhalation rate for children, 0-6 years of age, and accounts for an increased activity above the normal resting level of activity. This value, developed in consultation with the physicians, is based upon current medical parameters used to treat patients. A value of 0.83m³/hour was used for trespassing scenarios to account for even higher ventilation volumes.

Body Surface Area for Dermal Exposure

The 95th percentile body surface area value of 2.3m², recommended by EPA was the physiological parameter used for the human body surface area during calculation of dermal exposures for all risk assessments. ~~DOE disagrees with this guidance and has presented a dissenting opinion. The matter will be examined by EPA, but until such time that EPA acts upon this matter, the above value will be used.~~

9

APPENDIX E.2

Because organic chemicals, some fission product radionuclides, and activation product radionuclides are not naturally occurring at measurable levels, background concentrations are assumed to be zero. Consequently, if these organic chemicals, fission products, or activation products are selected as CPCs, they are not based on comparison to background.

Inorganic and radiological constituents not significantly above background levels were excluded from the CPC list and assigned symbol "A" in Attachment E.II.

10 The 95th percentile test is used as the second step in the statistical CPC screening. If a potential contaminant was not identified by the first step (location test) then the 95th percentile test was applied. The 95th percentile test is used to identify potential contaminants with maximum concentration significantly greater than background. Those constituents that would be eliminated based on the location test, but fail the 95th percentile test, remain as CPCs.

E.2.3.1.2 Toxicological Screening

After statistical comparisons to background were made, detected compounds which were shown to exceed background were subjected to toxicological screening to exclude constituents that are unlikely to have a human health risk at the levels detected. The following process was used:

- Essential macronutrients for which there are no known toxic effects at the concentrations defined were deleted. Examples of chemicals in this class include magnesium, calcium, potassium, and sodium. The deletion symbol "B" was assigned to chemicals deleted from the CPC list for this reason in Attachment E.II.
- Essential micronutrients for which there are no toxic effects at the concentrations found were deleted. Examples of chemicals in this class include iron and nitrate. Chemicals deleted for this reason were assigned the deletion symbol "C" in Attachment E.II.
- Ubiquitous elements in soil, not toxic except at high levels were deleted from the CPC list. Examples of chemicals in this class include Silicon, Aluminum, Chloride, Sulfide and Sulfate. Chemicals deleted for this reason were assigned the deletion symbol "D" in Attachment E.II.
- Nonspecific chemical classes that are either too general to be useful for risk assessment (e.g., Total Organic Carbon) or for which chemical-specific results are presented in the same analysis (e.g., polynuclear aromatic hydrocarbons and chlorinated hydrocarbons) were excluded from the CPC list and assigned the deletion symbol "E" in Attachment E.II.

- Chemicals with representative concentrations lower than screening values calculated from USEPA RAGs Part B, based on a HQ of 0.1 and a risk level of 10^{-7} , were removed from the CPC list and assigned the deletion symbol "F" in Attachment E.II.

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APPENDIX E.3

The total gamma exposure time assumed for the RME farmer is 24 hours per day, 350 days per year for 70 years. However, the exposure time per day was divided into two exposure times, exposure time outdoors (ET_o) which assumes no shielding factor, and exposure time indoors (ET_i) which assumes a shielding factor of 0.5.

The RME adult farmer scenarios constructed for this assessment assume the receptor works outside of the residence for 2000 hours per year. Spreading this time over the 350 days per year of on-site exposure yields an average outdoor exposure time of 5.7 hours per day. This leaves an indoor exposure time of 18.3 hours per day for this receptor. Thus, about 25 percent of the receptor's time on-site is spent outside of the residence. These values apply to the off-property RME resident adult farmer and the on-property RME resident adult farmer. The on-property RME resident child is assumed to spend only 2 hours per day outdoors, for a total of 700 hours per year.

It is assumed that the CT resident adult farmer is exposed outdoors for 1,152 hours (equal to 48 days of continuous exposure) out of the 275 days spent within the boundaries of the operable unit each year (EPA 1993h). This is equivalent to an exposure time of 4.2 hours per day of exposure. It is assumed that the CT resident adult farmer is exposed outdoors approximately 4.2 hours per day for 275 days per year, which is equivalent to 1155 hours of outdoor exposure in a year. This leaves an indoor exposure time of 19.8 hours per day for this receptor. Thus, about 20 percent of the receptor's time on-site is spent outside of the residence. These values apply only to the CT receptor.

The trespassing youth and the extended trespasser are assumed to spend time on the site. Current trespassing activities are minimal because Operable Unit 1 is currently surrounded by two fences and patrolled on a regular basis by a security force. If these patrols are relaxed, trespassing may occur, but the time spent on the property is unknown. EPA Region V suggests that the exposure time of the trespassing youth to be set at 4 hours per day if site-specific information is not available (DOE 1993d). The extended trespasser is assumed to spend 2 hours per day outdoors on the site.

The home builder is evaluated to assess the health impacts of exposures incurring while building a home on the property. This activity is assumed to be completed after 500 hours (NRC 1984). Assuming a worker constructs a house in 50 days, the total exposure time for

the home builder is 10 hours per day. This time is divided equally into 5 hours per day
outside of the structure and 5 hours per day inside of the structure.

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The RME adult farmer and child receptors are assumed to receive skin exposures via bathing
or showering once a day. Since no site-specific information on this activity is available, the
adult exposure time selected for this activity is 0.25 hours per day, as suggested by guidance
(EPA 1989a). The exposure time selected for the RME child performing this activity is 0.25
hour per day, as suggested by guidance (EPA 1992e).

The literature was consulted to determine an appropriate soil incidental ingestion rate for a farmer. However, no default values were found. Therefore, this value was estimated assuming the following:

Soil ingestion rate to use on days while tilling, plowing, planting or harvesting would use a higher average daily value of 0.48 g/day from EPA default exposure assumptions (EPA 1991j).

For other activities, use an average daily soil ingestion rate of 0.1 g/day.

To determine the amount of time a farmer is engaged in these activities, a review of farming parameters (farm size and crop configuration) were considered for Hamilton County. The 1987 Census of Agriculture (U.S. DOC 1989) indicates that 1,284 of the 1,364 farms in Hamilton and Butler County (95 percent) are under 500 acres (5 percent are 500 acres or above). Therefore, 500 acres was selected as the RME farm size. The soil ingestion rate for the CT farmer was based on similar farm configuration but using an average (CT) farm size of 125 acres. To determine the times associated with farming, a farmer was assumed to follow recommended agricultural practices for the region. A farmer is assumed to rotate their crops and plant 35 percent (175 acres) in corn, 35 percent in soybeans, 20 percent (100 acres) in wheat, and 10 percent (50 acres) in hay. It must be acknowledge that this configuration is a typical configuration and may represent an average value because each crop has a different time associated with field preparation, planting and harvesting. However, data is not available to determine a RME configuration. Therefore, an alternative configuration could result in a slightly higher or slightly lower exposure. A RME farm size (500 acres) was assumed to be adequate to compensate for this uncertainty.

Table E.3-17a presents the detailed calculations for soil ingestion rate for the RME and CT farmer. The U.S. Soil Conservation Service Field Technical Guide (U.S. SCS 1992) indicates that a farmer spends about 1.24 hours per acre farming corn, 1 hour per acre farming soybeans, 1.28 hours per acre farming wheat and 2.73 hours per acre farming hay. Assuming the farm configuration described above, an RME farmer would spend approximately 660 hours farming (plowing, discing, planting

and/or harvesting). An additional 20 percent is added to this time to account for miscellaneous activities and the uncertainty with the farm configuration described above, to give a total of 800 hours, or 100 working days. Therefore, it is assumed that a farmer would incidentally ingest 0.48 g/day of soil for 100 days per year spent tilling the soil and 0.1 g/day for the remaining 250 days per year, for a combined average ingestion rate of 0.18 grams/day for 350 days per year, assuming an average (CT) farm produces a CT soil ingestion rate of 0.120 g/day.

The soil ingestion rates for the trespassing youth and extended trespasser (0.1g/day) and the on-property resident child (0.2g/day) are specified by EPA 1991j. It was assumed that all on-property receptors received 100 percent of their soil intake from the site. This includes the on-property RME child and adult, the on-property CT adult, and the home builder. The trespassing child was assumed to only receive 25 percent of his daily soil intake from the site, as only 4 of 16 waking hours are spent on property.

E.3.5.7.6 Water Ingestion Rates

The water ingestion rate is the volume of water drunk daily by a receptor. Generally this intake is from drinking water, but may be from incidental ingestion during swimming. Tables E.3-17 and E.3-18 list the values and sources of the water ingestion rates used to calculate exposures to the hypothetical receptors evaluated in this assessment.

TABLE E.3-17A
CALCULATION OF SOIL INGESTION RATE FOR RME^a AND CT^b FARMER

	RME Farmer ^a		CT Farmer ^b	
Farm Size (acres)	500 RME farm size (95 th percentile)		125 CT farm size (50 th percentile)	
Acreage in corn	175 acres	35%	44 acres	35%
Acreage in soybeans	175 acres	35%	44 acres	35%
Acreage in wheat	100 acres	20%	25 acres	20%
Acreage in hay	50 acres	10%	13 acres	10%
Hours farming corn	217 hrs/yr	1.24 hrs/acre	54 hrs/yr	1.24 hrs/acre
Hours farming soybeans	175 hrs/yr	1 hrs/acre	44 hrs/yr	1 hrs/acre
Hours farming wheat	128 hrs/yr	1.28 hrs/acre	32 hrs/yr	1.28 hrs/acre
Hours farming hay	136.5 hrs/yr	2.73 hrs/acre	34 hrs/yr	2.73 hrs/acre
TOTAL:	656.5 hrs/yr		164 hrs/yr	
Hours Farming (Total + 20%)	800 hours		200 hours	
Days spent farming	100 days/yr		25 days/yr	
Years farming	50 years		50 years	
Ingest rate while farming	0.48 g/day		0.48 g/day	
Soil Ingestion farming	2400 g		600 g	
Days not farming	250 days/yr		325 days/yr	
Years farming	50 years		50 years	
Ingest rate for adult	0.1 g/day		0.1 g/day	
Soil Ingestion not farming	1250 g		1625 g	
Days for child	350 days/yr		350 days/yr	
Years as a child	6 years		6 years	
Ingest rate for child	0.2 g/day		0.2 g/day	
Soil Ingestion for child	420 g		420 g	
Days per year	350 days/yr		350 days/yr	
Years not farming	14 years		14 years	
Ingest rate for adult	0.1 g/day		0.1 g/day	
Soil Ingestion - not farming	490 g		490 g	
Soil ingestion over a lifetime	4560 g/lifetime		3135 g/lifetime	
Ave. Daily Soil Ingest. Rate	0.18 g/day		0.12 g/day	

^a RME - Reasonable maximum exposure scenario.

^b CT - Central tendency scenario.

Reference

U.S. Dept. of Energy, 1989, Census of Agriculture, Geographic Area Series, Part 35, Ohio, State and County Data.

U.S. Dept. of Commerce, Bureau of the Census.

U.S. Soil Conservation Service, 1992, Revised Field Office Technical Guide, U.S.D.A. Soil Conservation Service, Cincinnati, OH.

U.S. Soil Conservation Service, 1979, Soil Survey of Hamilton County, Ohio, U.S.D.A. Soil Conservation Service, Cincinnati, OH.

U.S. Soil Conservation Service, 1976, Soil Survey of Butler County, Ohio, U.S.D.A. Soil Conservation Service, Hamilton, OH.

TABLE E.3-18

EXPOSURE INPUT PARAMETERS
FUTURE LAND USE RECEPTORS

Pathway Parameters (units)	Trespassing Youth Age 7-18	Off-Property RME Resident Adult Farmer Age 1-70	Off-Property RME Resident Child Age 0-6	User of Meat & Milk Grown Within OUI Age 1-70	User of Great Miami River Water Age 1-70	On-Property CT Resident Adult Farmer Age 1-70	On-Property RME Resident Adult Farmer Age 1-70	On-Property RME Resident Child Age 0-6	Expanded Trespasser Age 7-18	Expanded Trespasser Age 19-50	On-Property Groundskeeper	On-Property Home Building Age 19+
All pathways except where noted												
EF (day/yr)	52 ^a	350 ^b	350 ^b	NA	350 ^b	275 ^l	350 ^b	350 ^b	110 ^m	40 ^m	35 ^p	175 ^d
ED (yr)	12 ^a	70 ^b	6 ^b	NA	70 ^b	9	70 ^b	6 ^b	12 ^m	32 ^m	25 ^s	1 ^d
BW (kg)	43 ^b	70 ^b	15 ^b	NA	70 ^b	70 ^b	70 ^b	15 ^b	43 ^b	70 ^b	70 ^b	70 ^b
AT-Noncancer (day)	4380 ^b	25550 ^b	2190 ^b	NA	25550 ^b	3285 ^b	25550 ^b	2190 ^b	4380 ^b	11680 ^b	9125 ^b	175 ^b
AT-Cancer (day)	25550 ^b	25550 ^b	25550 ^b	NA	25550 ^b	25550 ^b	25550 ^b	25550 ^b	25550 ^b	25550 ^b	25550 ^b	25550 ^b
Inhalation of dusts, volatiles, and radon												
IR (m ³ /hr)	0.83 ^b	0.83 ^b	0.5 ^{e,a}	NA	NA	0.83 ^b	0.83 ^b	0.5 ^e	0.83 ^b	0.83 ^b	2.5 ^s	2.5 ^s
IR indoor (m ³ /d)	NA	15 ^f	15 ^f	NA	NA	15 ^f	15 ^f	15 ^f	NA	NA	NA	NA
ET outdoors (hr/day)	4 ^a	5.7 ^h	2 ^l	NA	NA	4.2 ^l	5.7 ^h	2 ^l	2.0 ^m	1.0 ^m	8.0 ^s	8 ^d
Drinking water												
IR (L/day)	NA	2.0 ^b	1.0 ^b	NA	2.0 ^b	1.4	2 ^b	1.0 ^b	NA	NA	NA	NA
FI (L/day)	NA	1.0 ^b	1.0 ^b	NA	1.0 ^b	1.0 ^b	1.0 ^b	1.0 ^b	NA	NA	NA	NA
Dermal contact while bathing												
SA (m ²)	NA	2.3 ^k	0.8 ^k	NA	2.3 ^k	2.0 ^k	2.3 ^k	0.8 ^k	NA	NA	NA	NA
DA _c (mg/cm ² -event)	NA	csv ^l	csv ^l	NA	csv	csv	csv	csv	NA	NA	NA	NA
ET (hr/day)	NA	0.25 ^k	0.25 ^k	NA	0.25 ^k	0.17 ^k	0.25 ^k	0.25 ^k	NA	NA	NA	NA
Incidental ingestion of surface water while swimming or wading												
IR (L/hr)	0.035 ^a	NA	NA	NA	0.05 ^k	NA	NA	NA	0.035 ^a	NA	NA	NA
ET (hr/day)	1.0 ^a	NA	NA	NA	2.6 ^k	NA	NA	NA	1.0	NA	NA	NA
EF _{wading} (day/yr)	52 ^a	NA	NA	NA	NA	NA	NA	NA	52 ^a	NA	NA	NA
EF _{swim} (day/yr)	NA	NA	NA	NA	7 ^k	NA	NA	NA	na	NA	NA	NA
ED (yrs)	12 ^a	NA	NA	NA	30	NA	NA	NA	12 ^a	NA	NA	NA

TABLE E.3-18
(Continued)

Pathway Parameters (units)	Trespassing Youth Age 7-18	Off-Property RME Resident Adult Farmer Age 1-70	Off-Property RME Resident Child Age 0-6	User of Meat & Milk Grown Within OUI Age 1-70	User of Great Miami River Water Age 1-70	On-Property CT Resident Adult Farmer Age 1-70	On-Property RME Resident Adult Farmer Age 1-70	On-Property RME Resident Child Age 0-6	Expanded Trespasser Age 7-18	Expanded Trespasser Age 19-50	On-Property Groundskeeper	On-Property Home Building Age 19+
Dermal contact with surface water while swimming or wading												
SA (m ²)	5130 ^a	NA	NA	NA	2.3 ^k	NA	NA	NA	5130 ^a	NA	NA	NA
DA _e (mg/cm ² -event)	csv ^l	NA	NA	NA	csv ^l	NA	NA	NA	csv ^l	NA	NA	NA
ET (hr/day)	1.0	NA	NA	NA	2.6 ^k	NA	NA	NA	1.0	NA	NA	NA
EF _{swim} (day/yr)	NA	NA	NA	NA	7 ^k	NA	NA	NA	NA	NA	NA	NA
EF _{wading} (day/yr)	52 ^a	NA	NA	NA	NA	NA	NA	NA	52 ^a	NA	NA	NA
ED (yrs)	12 ^a	NA	NA	NA	30	NA	NA	NA	12 ^a	NA	NA	NA
Incidental ingestion of soil/sediment^g												
IR (g/day)	0.1 ^b	NA	NA	NA	NA	0.122	0.18	0.2 ^b	0.1 ^b	0.1 ^b	0.1 ^b	0.48 ^s
FI _{sed} (unitless)	0.06 ^t	NA	NA	NA	NA	NA	NA	NA	0.1 ^t	NA	NA	NA
FI _{soil} (unitless)	0.19 ^t	NA	NA	NA	NA	1.0 ^b	1.0 ^b	1.0 ^b	0.1 ^t	.05 ^t	1.0 ^b	1.0 ^d
Dermal contact with soil/sediment^g												
SA (m ²)	0.42 ^k	NA	NA	NA	NA	0.5 ^k	0.575 ^k	0.2 ^k	.42 ^k	.575 ^k	.575 ^k	0.575 ^k
AF (mg/cm ²)	1.00 ^k	NA	NA	NA	NA	0.2 ^k	1.0 ^k	1.0 ^k	1.0 ^k	1.0 ^k	1.0 ^k	1.0 ^k
ABS (unitless)	csv	NA	NA	NA	NA	csv	csv	csv	csv	csv ^l	csv	csv
External radiation exposure												
DR (mrem/hr)	csv	NA	NA	NA	NA	csv	csv	csv	csv	csv	csv	csv
ET indoors (hr/day)	NA	NA	NA	NA	NA	19.8 ^l	18.3 ^h	22 ^j	NA	NA	NA	4 ^d
ET outdoor _{sediment} (hr/day)	1 ^a	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ET outdoors _{soil} (hr/day)	3 _a	NA	NA	NA	NA	4.2 ^l	5.7 ^h	2 ^j	2.0 ^m	1.0 ^m	8.0 ^s	4 ^d
SH indoors (unitless)	NA	NA	NA	NA	NA	0.5 ^b	0.5 ^b	0.5 ^b	NA	NA	NA	0.5 ^b
SH outdoors (unitless)	0 ^b	NA	NA	NA	NA	0 ^b	0 ^b	0 ^b	0 ^b	0 ^b	0 ^b	0 ^b

TABLE E.3-18
(Continued)

Pathway Parameters (units)	Trespassing Youth Age 7-18	Off-Property RME Resident Adult Farmer Age 1-70	Off-Property RME Resident Child Age 0-6	User of Meat & Milk Grown Within OUI Age 1-70	User of Great Miami River Water Age 1-70	On-Property CT Resident Adult Farmer Age 1-70	On-Property RME Resident Adult Farmer Age 1-70	On-Property RME Resident Child Age 0-6	Expanded Trespasser Age 7-18	Expanded Trespasser Age 19-50	On-Property Groundskeeper	On-Property Home Building Age 19+
Ingestion of vegetables, fruit, meat, milk products and fish												
IR _{fruit} (g/day)	NA	140 ^{b,n}	204 ^{o,b}	NA	140 ^b	140 ^{n,b}	140 ^{n,b}	204 ^{o,b}	NA	NA	NA	NA
FI (unitless)	NA	0.3 ^{n,b}	0.3 ^{n,b}	NA	0.3 ^{n,b}	0.2	0.3 ^{n,b}	0.3 ^{n,b}	NA	NA	NA	NA
IR _{vegetables} (g/day)	NA	200 ^{b,n}	100 ^{o,b}	NA	200 ^{b,n}	200 ^b	200 ^{n,b}	100 ^{o,b}	NA	NA	NA	NA
FI (unitless)	NA	0.4 ^{n,b}	0.4 ^{n,b}	NA	0.4 ^{n,b}	0.25	0.4 ^{n,b}	0.4 ^{n,b}	NA	NA	NA	NA
IR _{meat} (g/day)	NA	100 ^b	39 ^{o,b}	100 ^b	100 ^b	100 ^b	100 ^b	39 ^{o,b}	NA	NA	NA	NA
FI (unitless)	NA	.75 ^b	0.75 ^b	.75 ^b	0.75 ^b	0.44	0.75 ^b	0.75 ^b	NA	NA	NA	NA
IR _{milk} (L/day)	NA	0.4 ^b	0.9 ^b	0.4 ^b	0.4 ^b	0.16	0.3 ^b	0.9 ^b	NA	NA	NA	NA
FI (unitless)	NA	.75 ^b	0.75 ^b	0.75 ^b	0.75 ^b	0.75 ^b	0.75 ^b	0.75 ^b	NA	NA	NA	NA
IR(fish)	NA	NA	NA	NA	54 ^b	NA	NA	NA	NA	NA	NA	NA

^a DOE 1993d, Comment Responses - Site Wide Characterization Report. Assumes a youth trespasses on site 3 days/wk from June through August, plus 1 day/wk in April, May, September, and October, for a total of 52 days/yr, 4hr/day (of which one hour is spent playing in Paddys Run).

^b DOE 1992a

^c EPA 1993c

^d Assumes a home builder spends 175 8-hour days building a home, spending 50% of his time working in/on the house, and 50% of the time working in/on the soil/waste.

^e EPA 1988c, Derived from an algorithm relating respiratory rate to body rate, corrected by a factor of 2.11

^f EPA, 1991f

^g Assumes a youth swallows 0.035 L/hr while wading. Also assumes approximately 30% body surface area exposure for a wading scenario.

^h Assumes the RME farmer spends 2000 hours outdoors during the 350 days of exposure a year (5.7 h/d = 2000 h/y / 350 d/y). Indoor duration is the remaining time in a day.

ⁱ EPA 1992j Assumes the CT farmer spends the equivalent of 48 days during a 275 day exposure period outdoors each year. (4.2 h/d = 24 h/d x 48 d/275 d/y). (4.2 h/d = [24 h/d * 48 d/y]/275 d/y). Indoor duration is the remaining time in a day.

^j Assumes a resident small child spends 700 hours/year outdoors.

^k EPA 1992e, EPA/600/8-91/011b.

^l csv - Chemical Specific Value.

^m Assumes the expanded trespasser visits the site 110 days/yr (2 hr/day) as a youth, and 40 days/yr (1hr/day) as an adult for a total of 44 years. Only the youth plays in Paddys Run.

ⁿ EPA 1990d, EPA/600/8-89/043

^o USDA 1986, NFCS, CSFII Report No. 85-1.

^p Assumes the groundskeeper works in the on the grounds of OUI, 35 days/yr.

^q NA - Not applicable.

^r EPA 1991j

^s DOE 1993e Response to Comment 265 of the OU4 RI (FI for soil and sediment are based on the number of hours exposed out of 16 waking hours).

^t Parameters represent values used for exposure to both media, sediment, and soil which apply to that receptor.

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APPENDIX E.4

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exposure. Finally, the dose-response relationships common to many toxicants, and upon which derivation of an RfD is based, do not hold true for lead. This is because the fate of lead within the body depends, in part, on the amount and rate of previous exposures, the age of the recipient, and the rate of exposure. There is, however, a reasonably good correlation between blood lead concentration and effect. Therefore, blood lead concentration is the appropriate parameter on which to base the regulation of lead.

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The EPA UBK lead model is an iterated set of equations that estimate blood lead concentration in children aged 0 to 7 years (EPA 1990c; 1991c). The biokinetic part of the model describes the movement of lead between the plasma and several body compartments and estimates the resultant blood lead concentration. The rate of the movement of lead between the plasma and each compartment is a function of the transition or residence time (i.e., the mean time for lead to leave the plasma and enter a given compartment, or the mean residence time for lead in that compartment). Compartments modeled include the erythrocytes, liver, kidneys, all the other soft tissue of the body, cortical bone, and trabecular bone. Excretory pathways and their rates are also modeled. These include the mean time for excretion from the plasma to the urine, from the liver to the bile, and from the other soft tissues to the hair, skin, sweat, etc. The model permits the user to adjust the transition and residence times. Version 0.99d of the IEUBK model for lead, which resulted from has undergone Science Advisory Board review and of versions 0.5 and 0.6, is currently being distributed.

13

EPA guidance (EPA, 1989k) establishes an interim soil cleanup level for lead of 500 to 1000 parts per million (ppm) to be applied at Superfund sites. This range is considered by EPA to be protective for direct contact with lead-contaminated soils in residential settings. The guidance adopts recommendations of the Centers for Disease Control and is to be followed when current or predicted land use is residential.

TABLE E.4-5
TOXICITY EQUIVALENCY FACTORS (TEFs)^a
AND CORRESPONDING ORAL AND INHALATION SLOPE FACTORS
FOR THE GROUP B2 PAHs

PAH	Relative Potency	Oral Slope Factor (mg/kg-day) ⁻¹	Inhalation Slope Factor (mg/kg-day) ⁻¹
Benzo(a)pyrene	1.0	7.3	6.1
Benzo(a)anthracene	0.1	0.73	0.61
Benzo(b)fluoranthene	0.1	0.73	0.61
Benzo(k)fluoranthene	0.01	0.073	0.061
Chrysene	0.001	0.0073	0.0061
Dibenzo(a,h)anthracene	1.0	7.3	6.1
Indeno(1,2,3-cd)pyrene	0.1	0.73	0.61

^aEPA, 1993f

APPENDIX E.5

and vegetables irrigated with groundwater contribute about half of the total risk. Metals are the primary carcinogenic constituents.

Another 25 percent of the total risk is caused by direct exposures to surface soil and exposed waste pit material. Arsenic, beryllium, and total PCBs contribute most of the total risk.

Chemical Toxicants

The total Hazard Index for the RME child is 1600, as shown on Table E.5-8. The results of the risk assessment indicate that ingestion of groundwater contributes over 50 percent of the total Hazard Index. Food pathways also play a major role in the risk, both via air pathways and groundwater pathways. Uranium in soil and exposed waste pit material and groundwater is one of the major toxicants acting on potential child receptors at this facility.

Concentrations of lead in soil at Operable Unit 1 were compared to interim soil cleanup levels of 500 to 1000 ppm, which is recommended for use at Superfund sites where current or predicted land use is residential (EPA 1989k). The area-weighted average lead concentration of 52 ppm for Operable Unit 1 soils is well below this recommended range, indicating that lead levels are not expected to pose a significant health hazard to sensitive receptors, including children.

E.5.5.3 On-Property CT Farmer

This hypothetical receptor is defined as residing on the Operable Unit 1 study area for a period of 9 years, with all exposure routes considered using the parameters presented in Table E.3-18. Although this receptor is similar to the RME resident adult discussed in the preceding section, parameter values have been selected to evaluate risks that are closer to the expected average values.

As suggested by EPA guidance (EPA 1992d), the resident CT adult is included in this assessment because calculated risks to this receptor provide a useful perspective on the uncertainty involved with exposure parameters used in calculating risks to the RME adult. While the central tendency evaluation calculates an incidence of health effects that is closer to the expected average of ~~of median~~ incidence rate, it is important to note that many of the parameter values used exceed ~~the median~~ the average values. ~~For example, the CT adult~~

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~~scenario in this analysis uses the upper 95 percent confidence interval on the mean as the exposure concentration. Thus the results presented for this receptor are not true average or median risks.~~

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TABLE E.5-1
TOTAL CARCINOGENIC RISKS
CURRENT LAND USE, CURRENT SOURCE TERM^a

Source Medium	Exposure Route	RECEPTORS WITH ACCESS CONTROLS									ADDITIONAL RECEPTORS WITHOUT ACCESS CONTROLS					
		On-property Groundskeeper			Off-property Farmer			Off-property Young Child			Trespassing Youth			Off-property User of Meat and Milk Products		
		Radiological	Chemical ^b (TEF for PAHs)(BaP for PAHs)		Radiological	Chemical (TEF for PAHs)(BaP for PAHs)		Radiological	Chemical (TEF for PAHs)(BaP for PAHs)		Radiological	Chemical (TEF for PAHs)(BaP for PAHs)		Radiological	Chemical (TEF for PAHs)(BaP for PAHs)	
Air	Inhalation	6E-06	1E-08	1E-08	3E-06	6E-09	6E-09	2E-07	1E-09	1E-09	7E-07	2E-09	2E-09	NA	NA	NA
	Ingestion of Fruits and Vegetables	NA	NA	NA	2E-08	3E-08	3E-08	2E-09	9E-09	9E-09	NA	NA	NA	NA	NA	NA
	Ingestion of Meat	NA	NA	NA	3E-10	5E-08	5E-08	1E-11	8E-09	8E-09	NA	NA	NA	NA	NA	NA
	Ingestion of Milk Products	NA	NA	NA	3E-09	6E-08	7E-08	6E-10	6E-08	6E-08	NA	NA	NA	NA	NA	NA
Surface Soil	Incidental Ingestion	2E-06	1E-06	1E-06	NA	NA	NA	NA	NA	NA	4E-07	4E-07	4E-07	NA	NA	NA
	Dermal Contact	NA	1E-05	1E-05	NA	NA	NA	NA	NA	NA	NA	9E-06	9E-06	NA	NA	NA
	External Exposure	7E-05	NA	NA	NA	NA	NA	NA	NA	NA	3E-05	NA	NA	NA	NA	NA
	Ingestion of Meat	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7E-05	4E-04	5E-04
	Ingestion of Milk Products	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4E-04	5E-04	5E-04
Buried Pit Material	External Exposure	5E-05	NA	NA	NA	NA	NA	NA	NA	NA	2E-05	NA	NA	NA	NA	NA
On-property Surface Water	Ingestion of Meat	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5E-05	5E-06	5E-06
	Ingestion of Milk Products	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2E-04	6E-07	6E-07
Subtotal:		1E-04	1E-05	1E-05	3E-06	2E-07	2E-07	2E-07	8E-08	8E-08	5E-05	9E-06	9E-06	7E-04	9E-04	1E-03
Total Carcinogenic Risk:			1E-04	1E-04		3E-06	3E-06		2E-07	2E-07		5E-05	5E-05		2E-03	2E-03

NA - Not Applicable. Exposure route not evaluated for this receptor.

^a This table includes values that have been rounded to one significant figure. Therefore, the total number may be higher or lower than the sum that would result from adding the values in the table, due to rounding.

Refer to Attachment E.IV for specific values.

^b Separate carcinogenic risk values were calculated assuming the toxicity equivalency factors (TEF approach) for PAHs and assuming all PAHs as carcinogenic as benzo(a)pyrene (BaP approach).

TABLE E.5-3
TOTAL CARCINOGENIC RISKS
CURRENT LAND USE, FUTURE SOURCE TERM ^a

Medium	Exposure Route	Trespassing Youth			Great Miami River User		
		Radiological	Chemical ^b		Radiological	Chemical	
		(TEF for PAHs)	(BaP for PAHs)	(BaP for PAHs)	(TEF for PAHs)	(BaP for PAHs)	(BaP for PAHs)
Air	Inhalation	8E-05	4E-05	4E-05	NA	NA	NA
Surface Soil	Incidental Ingestion	1E-06	4E-05	4E-05	NA	NA	NA
	Dermal Contact	NA	4E-05	4E-05	NA	NA	NA
	External Exposure	1E-04	NA	NA	NA	NA	NA
Buried Pit Material	External Exposure	7E-06	NA	NA	NA	NA	NA
Paddys Run Surface Water	Incidental Ingestion	7E-08	4E-09	4E-09	NA	NA	NA
	Dermal Contact	NA	5E-08	5E-08	NA	NA	NA
Paddys Run Sediment	Incidental Ingestion	4E-08	8E-08	8E-08	NA	NA	NA
	Dermal Contact	NA	9E-06	9E-06	NA	NA	NA
	External Exposure	3E-06	NA	NA	NA	NA	NA
Great Miami River Surface Water	Ingestion	NA	NA	NA	2E-07	5E-09	5E-09
	Ingestion of Fruits and Vegetables	NA	NA	NA	5E-08	2E-09	2E-09
	Ingestion of Meat	NA	NA	NA	2E-09	3E-10	3E-10
	Ingestion of Milk Products	NA	NA	NA	1E-08	1E-10	1E-10
	Inhalation of VOCs	NA	NA	NA	NA	0E+00	0E+00
	Dermal Contact while Bathing	NA	NA	NA	NA	3E-09	3E-09
	Dermal Contact while Swimming	NA	NA	NA	NA	2E-10	2E-10
	Incidental Ingestion while Swimming	NA	NA	NA	1E-10	3E-12	3E-12
	Ingestion of Fish	NA	NA	NA	7E-09	2E-08	2E-08
Subtotal:		2E-04	1E-04	1E-04	3E-07	3E-08	3E-08
Total Carcinogenic Risk:			3E-04	3E-04		3E-07	3E-07

NA - Not Applicable. Exposure route not evaluated for this receptor.
^a This table includes values that have been rounded to one significant figure. Therefore, the total number may be higher or lower than the sum that would result from adding the values in the table, due to rounding.
Refer to Attachment E.IV for specific values.
^b Separate carcinogenic risk values were calculated assuming the toxicity equivalency factors (TEF approach) for PAHs and and assuming all PAHs as carcinogenic as benzo(a)pyrene (BaP approach).

TABLE E.5-5

**TOTAL CARCINOGENIC RISKS
FUTURE LAND USE (GOVERNMENT RESERVE), FUTURE SOURCE TERM.^a**

Source Medium	Exposure Route	On-property Groundskeeper ^b			Expanded Trespasser		
		Radiological	Chemical ^b		Radiological	Chemical	
			(TEF for PAHs)	(BaP for PAHs)		(TEF for PAHs)	(BaP for PAHs)
Air	Inhalation	7E-04	2E-04	2E-04	1E-04	6E-05	6E-05
Surface Soil and Exposed Waste Pit Contents	Incidental Ingestion	7E-06	2E-04	2E-04	2E-06	5E-05	5E-05
	Dermal Contact	NA	5E-05	5E-05	NA	2E-04	2E-04
	External Exposure	4E-04	NA	NA	3E-04	NA	NA
Buried Pit Material	External Exposure	5E-05	NA	NA	3E-05	NA	NA
Paddys Run Surface Water	Incidental Ingestion	NA	NA	NA	7E-08	4E-09	4E-09
	Dermal Contact	NA	NA	NA	NA	5E-08	5E-08
Paddys Run Sediment	Incidental Ingestion	NA	NA	NA	4E-08	8E-08	8E-08
	Dermal Contact	NA	NA	NA	NA	9E-06	9E-06
	External Exposure	NA	NA	NA	3E-06	NA	NA
Subtotal:		1E-03	4E-04	4E-04	4E-04	3E-04	3E-04
Total Carcinogenic Risk:			2E-03	2E-03		7E-04	7E-04

NA - Not Applicable. Exposure route not evaluated for this receptor.

^a This table includes values that have been rounded to one significant figure. Therefore, the total number may be higher or lower than the sum that would result from adding the values in the table, due to rounding.

Refer to Attachment E.IV for specific values.

^b Separate carcinogenic risk values were calculated assuming the toxicity equivalency factors (TEF approach) for PAHs and assuming all PAHs as carcinogenic as benzo(a)pyrene (BaP approach).

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TABLE E.5-7

TOTAL CARCINOGENIC RISKS
FUTURE LAND USE (AGRICULTURAL USE)
FUTURE SOURCE TERM ^a

Source Medium	Exposure Route	On-property RME Farmer ^b			On-property RME Farmer Use of Perched Groundwater ^b			On-property CT Farmer			On-property Young Child		
		Chemical ^c			Chemical			Chemical			Chemical		
		Radiological	(TEF for PAHs)	(BaP for PAHs)	Radiological	(TEF for PAHs)	(BaP for PAHs)	Radiological	(TEF for PAHs)	(BaP for PAHs)	Radiological	(TEF for PAHs)	(BaP for PAHs)
Air	Inhalation	5E-03	1E-03	1E-03	5E-03	1E-03	1E-03	4E-04	1E-04	1E-04	9E-05	1E-04	1E-04
	Ingestion of Fruits and Vegetables	6E-05	2E-03	2E-03	6E-05	2E-03	2E-03	4E-06	2E-04	2E-04	4E-06	9E-04	9E-04
	Ingestion of Meat	2E-06	7E-04	7E-04	2E-06	7E-04	7E-04	1E-07	4E-05	4E-05	5E-08	1E-04	1E-04
	Ingestion of Milk Products	1E-05	1E-04	1E-04	1E-05	1E-04	1E-04	6E-07	6E-06	6E-06	2E-06	1E-04	1E-04
Exposed Waste Pit Materials	Incidental Ingestion	4E-04	8E-03	8E-03	4E-04	8E-03	8E-03	2E-05	6E-04	6E-04	3E-05	4E-03	4E-03
	Dermal Contact	NA	1E-03	1E-03	NA	1E-03	1E-03	NA	2E-05	2E-05	NA	2E-04	2E-04
	External Exposure	2E-02	NA	NA	2E-02	NA	NA	2E-03	NA	NA	2E-03	NA	NA
Surface Soil	Ingestion of Fruits and Vegetables	2E-04	2E-04	2E-04	2E-04	2E-04	2E-04	1E-05	1E-05	1E-05	1E-05	6E-05	6E-05
	Ingestion of Meat	7E-05	4E-04	5E-04	7E-05	4E-04	5E-04	5E-06	3E-05	3E-05	2E-06	7E-05	7E-05
	Ingestion of Milk Products	4E-04	5E-04	5E-04	4E-04	5E-04	6E-04	2E-05	2E-05	3E-05	9E-05	4E-04	5E-04
	External Exposure	1E-03	NA	NA	1E-03	NA	NA	2E-04	NA	NA	2E-07	NA	NA
On-property Surface Water	Ingestion of Meat	5E-05	5E-06	5E-06	5E-05	5E-06	5E-06	4E-06	4E-07	4E-07	2E-06	8E-07	8E-07
	Ingestion of Milk Products	2E-04	7E-07	7E-07	2E-04	7E-07	7E-07	1E-05	4E-08	4E-08	4E-05	6E-07	6E-07
	Ingestion	2E-02	3E-02	3E-02	6E-01	1E-01	2E-01	1E-03	2E-03	2E-03	7E-04	6E-03	6E-03
Groundwater	Ingestion of Fruits and Vegetables	5E-03	1E-02	1E-02	5E-03	1E-02	1E-02	3E-04	6E-04	6E-04	4E-04	3E-03	3E-03
	Ingestion of Meat	4E-05	1E-03	1E-03	4E-05	1E-03	1E-03	3E-06	9E-05	9E-05	1E-06	2E-04	2E-04
	Ingestion of Milk Products	5E-04	2E-04	2E-04	5E-04	2E-04	2E-04	3E-05	9E-06	9E-06	9E-05	2E-04	2E-04
	Inhalation of VOCs	NA	1E-13	1E-13	NA	3E-02	3E-02	NA	1E-14	1E-14	NA	5E-14	5E-14
	Dermal Contact while Bathing	NA	8E-05	8E-05	NA	9E-01	9E-01	NA	5E-06	5E-06	NA	1E-05	1E-05
	Subtotal:	5E-02	5E-02	5E-02	6E-01	9E-01	9E-01	4E-03	4E-03	4E-03	3E-03	1E-02	2E-02
Total Carcinogenic Risk:			1E-01	1E-01		1E+00	1E+00		8E-03	8E-03		2E-02	2E-02

FER/OU1FS/BH/APP-E/07/26/9410:58am

E-5-36

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TABLE E.5-7 (cont)

TOTAL CARCINOGENIC RISKS
FUTURE LAND USE (AGRICULTURAL USE)
FUTURE SOURCE TERM^a

Source Medium	Exposure Route	Off-property Farmer			Off-property Young Child			On-property Homebuilder			Off-property User of Meat and Milk Products		
		Chemical ^b			Chemical			Chemical			Chemical		
		Radiological	(TEF for PAHs)	(BaP for PAHs)	Radiological	(TEF for PAHs)	(BaP for PAHs)	Radiological	(TEF for PAHs)	(BaP for PAHs)	Radiological	(TEF for PAHs)	(BaP for PAHs)
Air	Inhalation	2E-04	9E-05	9E-05	4E-06	8E-06	8E-06	1E-04	4E-05	4E-05	NA	NA	NA
	Ingestion of Fruits and Vegetables	3E-06	2E-04	2E-04	2E-07	5E-05	5E-05	NA	NA	NA	NA	NA	NA
	Ingestion of Meat	9E-08	4E-05	4E-05	3E-09	6E-06	6E-06	NA	NA	NA	2E-06	7E-04	7E-04
	Ingestion of Milk Products	6E-07	7E-06	7E-06	1E-07	6E-06	6E-06	NA	NA	NA	1E-05	1E-04	1E-04
Exposed Waste Pit Materials	Incidental Ingestion	NA	NA	NA	NA	NA	NA	7E-06	2E-04	2E-04	NA	NA	NA
	Dermal Contact	NA	NA	NA	NA	NA	NA	NA	9E-06	9E-06	NA	NA	NA
	External Exposure	NA	NA	NA	NA	NA	NA	7E-05	NA	NA	NA	NA	NA
Surface Soil	Ingestion of Fruits and Vegetables	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Ingestion of Meat	NA	NA	NA	NA	NA	NA	NA	NA	NA	7E-05	4E-04	5E-04
	Ingestion of Milk Products	NA	NA	NA	NA	NA	NA	NA	NA	NA	4E-04	5E-04	5E-04
Buried Pit Material	External Exposure	NA	NA	NA	NA	NA	NA	7E-09	NA	NA	NA	NA	NA
On-property Surface Water	Ingestion of Meat	NA	NA	NA	NA	NA	NA	NA	NA	NA	5E-05	5E-06	5E-06
	Ingestion of Milk Products	NA	NA	NA	NA	NA	NA	NA	NA	NA	2E-04	7E-07	7E-07
Groundwater	Ingestion	1E-03	0E+00	0E+00	6E-05	0E+00	0E+00	NA	NA	NA	NA	NA	NA
	Ingestion of Fruits and Vegetables	4E-04	0E+00	0E+00	3E-05	0E+00	0E+00	NA	NA	NA	NA	NA	NA
	Ingestion of Meat	3E-06	0E+00	0E+00	1E-07	0E+00	0E+00	NA	NA	NA	NA	NA	NA
	Ingestion of Milk Products	4E-05	0E+00	0E+00	7E-06	0E+00	0E+00	NA	NA	NA	NA	NA	NA
	Inhalation of VOCs	NA	0E+00	0E+00	NA	0E+00	0E+00	NA	NA	NA	NA	NA	NA
	Dermal Contact while Bathing	NA	0E+00	0E+00	NA	0E+00	0E+00	NA	NA	NA	NA	NA	NA
Subtotal:		2E-03	3E-04	3E-04	1E-04	7E-05	7E-05	2E-04	2E-04	2E-04	8E-04	2E-03	2E-03
Total Carcinogenic Risk:			2E-03	2E-03		2E-04	2E-04		4E-04	4E-04		2E-03	3E-03

NA - Not Applicable. Exposure route not evaluated for this receptor.

^a This table includes values that have been rounded to one significant figure. Therefore, the total number may be higher or lower than the sum that would result from adding the values in the table, due to rounding. Refer to Attachment E.IV for specific values.

^b Risks calculated and total summed based on the use of the 1-hit equation for calculating risks from higher doses (EPA 1989a), therefore, total risks will not exceed 1.0 for this receptor.

^c Separate carcinogenic risk values were calculated assuming the toxicity equivalency factors (TEF approach) for PAHs and assuming all PAHs as carcinogenic as benzo(a)pyrene (BaP approach).

FER/OU1FS/BH/APP-E/07/26/9411:01am

E-5-37

000083

FEMP-OU01-5 DRAFT FINAL
Rev. 3 - July 27, 1994

5295

APPENDIX E.6

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levels. Accurate exposure data are needed to more definitively determine the risk attributable to uranium exposure. The human studies of cancer from exposure to uranium frequently reveal a slight excess risk above the natural risk. These facts weaken the power of the human studies to detect any excess risk. These uncertainties are not well known or easily determined and, as a consequence, introduce moderate to high uncertainty into the Operable Unit 1 risk assessment.

Other toxicity information used in the Operable Unit 1 risk assessment that introduces uncertainty include:

- The EPA inhalation slope factor of 7.7×10^{-12} pCi⁻¹ for Rn-222 plus its daughters is used to calculate risks resulting from indoor inhalation of radon gases. The EPA bases this slope factor on a 50% equilibrium ratio between Rn-222 and its short-lived daughters. Studies cited in NCRP Report No. 78 (NCRP, 1984) report a lower value for this equilibrium ratio in indoor air (i.e.: 100/50/30/20/20 for Ra-222, Po-218, Pb-214, Bi-214, and Po-214, respectively). Since the concentration of daughters expected in indoor air is lower than the EPA assumption, the slope factor is probably conservative in this respect.
- PAHs that are classified as B2 probable human carcinogens for which no toxicity data were available are evaluated using benzo(a)pyrene toxicity data. This assumption likely leads to an overestimation of the carcinogenicity of those PAHs because conservative assumptions were used to relate their carcinogenicity to that of benzo(a)pyrene. However, when toxicity equivalency factors were used in this assessment to evaluate their carcinogenicity, this may either underestimate or overestimate the carcinogenic risks. Overall, this increased conservatism does not significantly impact the overall risks from Operable Unit 1 since the majority of risks are posed by other CPCs.
- The only PCB with positive carcinogenicity results is Aroclor-1260. The carcinogenicity of all PCB isomers were assumed to be equal to the carcinogenicity of Aroclor-1260 because the dose-response data for other isomers are inconclusive. Statistically significant cancer results were not seen for Aroclors with lower percentages of chlorine atoms. The conservatism introduced in the evaluation of PCBs is not anticipated to impact the selection of CPCs for final risks because they did not exceed the concentration-toxicity screen.
- As with PAHs, the carcinogenicity of dioxins and furans other than the 2,3,7,8-isomer were determined using EPA's revised Toxicity Equivalency Factors (TEFs) in the absence of toxicity values for the different isomers (~~Clement International, 1990~~ (EPA 1989)). The TEFs are based on the assumption that all dioxin and furan congeners are carcinogenic. This may introduce a large positive bias to the results of the assessment.

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A significant source of uncertainty for calculating risks from radionuclides in surface soil is the use of EPA slope factors for external radiation exposure. In deriving these slope factors, EPA has assumed that an individual continuously stands on an infinitely thick slab of soil with a uniform radionuclide

run for the RME resident farmer under the future source term, future scenario. The model considered the contribution of risk due to OCDD in surface soil via all applicable pathways used in the baseline risk assessment. The calculated incremental lifetime causes risk to the RME resident farmer due to 0.9 ppb of OCDD in surface soil is 5.1×10^{-5} . Under this same scenario, the total risk due to non-radiological constituents in surface soil is 5.4×10^{-2} . In other words, the risk due to OCDD is 1/1000th of the total ILCR due to non-radiological constituents in surface soil. Based upon this comparison, it is projected that the presence of 0.9 ppb OCDD in Operable Unit 1 surface soil has virtually no impact on the risk values presented in the baseline risk assessment.

E.6.3.2 Evaluation of TICs

Based upon the methods used for the analysis, validation and the quantification of COCs, a number of tentatively identified compounds (TICs) were removed from the list of chemicals destined for quantitative analysis. These constituents were removed based upon the protocol established in the risk assessment guidelines. Qualifiers used for evaluation of these constituents indicate the positive nature of the compound and the concentration was in question and insufficiently reliable for quantitative assessment. However, a qualitative toxicological evaluation of Operable Unit 1's TICs was prepared,

8, 18 in order to ascertain the degree of uncertainty they impose the probable impact to site risk.

The evaluation of potential toxicity and contribution to site risk of TICs is examined in relation to the chemical classes to which they belong. Related target organ systems, and a toxic effect, based upon estimated levels and the potential for exposure were also considered. A list of TICs and their chemical classes are presented. Estimated maximum concentrations are in ($\mu\text{g}/\text{kg}$) unless otherwise noted.

E.6.3.2.1 General Discussion

8, 18 Tentatively identified compounds are of uncertain origin and are defined as those compounds that may result from chromatographic responses that exceed 10 percent of the response of the nearest internal standard (EPA, 1989a). Reporting requirements for analyses presume a maximum of 10 TICs to be reported for volatiles and a maximum of 20 TICs to be reported for semivolatiles. In general, TICs may be associated with the presence of blank contamination, laboratory artifacts such as aldol condensation products, chromatographic column bleed, biological compounds present in soil, residual compounds from previous analyses, degradation products and exotic organics, esters, and

8, 18 nitrogenous compounds from soil and plant life, as well as other contaminants.

Organic compounds may exhibit response factors in the range of 0.05 to 2.0, as opposed to a factor of 1.0 for equal chromatographic responses based upon the reference to the nearest internal standard.

8, 18 Due to the variability in potential response factors of organic compounds, ~~any when no internal standard is available, then estimation~~ of TIC presence, origin, or concentration is ~~questionable~~ made more difficult. Given a response factor range of 0.05 to 2.0, the quantitative sum of all TICs in a given sample with 10 parts per million, ~~would could~~ have an actual value as low as 0.25 parts per million, or a maximum value as high as 400 parts per million. The range, ~~which may be reduced with additional analyses or evaluations,~~ is based on the uncertainty of identification, response, and concentration. The TICs listed in Table E-6-4, such as tributyl phosphate and the several solvents, may be associated with residual process products or materials. ~~Various compounds appear to be either chemical degradation or condensation products, generated during chemical separation chromatographic analysis, or progeny of solid phase constituents in the chromatographic column.~~

Tentatively identified compounds were found in 25 of 61 semivolatile samples and 17 of 68 volatile samples of pit material. Concentrations were detected at low ug/kg (ppb) levels, and occasionally in the low parts per million range (mg/kg). Generally, they were detected in analyses of samples of pit media below 4 feet and at concentrations that would preclude any serious cause for concern.

The potential for toxicity of TICs is qualitative since their estimated levels are uncertain and the availability of experimental or clinical information on dose response and toxicity for most TICs is non-existent.

Chromatographic separation and analysis is known to produce synthetic artifacts. Degradation and/or condensation products are well known and occur on the solid phase during separation. Such compounds are usually present in low concentrations and usually of varying composition.

The disparity of the magnitude of concentrations between the results of concurrent analyses of total organic contents and TIC items adds to uncertainty, suggesting these estimated values cannot be relied upon as factual. Accordingly, toxicity cannot be adequately defined.

E.6.3.2.2 Toxicity Assessment By TIC Classes

8, 18 Table E.6-4 presents ~~a~~ the TICs found in Operable Unit 1 by compound class.

Alcohol-Glycols

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Most alcohols and glycols do not usually present a serious hazard to most individuals, even in the industrial setting. Specific compounds such as methanol and ethylene glycol are involved in either widespread or epidemics and in isolated instances of intoxication. ~~However, these observations indicate they are generally the result of intentional consumption.~~

Industrial exposure to most alcohols and glycol compounds rarely produce symptoms of chronic systemic intoxication. Methanol can cause blindness in humans and ethylene glycol has produced fatalities. Toxicity from the vapors are generally to the conjunctivae of the eyes and the mucous membranes of the upper respiratory tract and possibly the skin. The low vapor pressure of the low molecular weight alcohols (ethanol and methanol) and glycols (ethylene glycol) would not achieve significant air concentrations unless the compound was heated or sprayed as a mist. Also at the soil depths discussed above, they would not be likely to produce concern. Although they have narcotic properties, they are much less prominent than those associated with solvent or halogenated hydrocarbons. Alcohols are rapidly removed from the body via the dehydrogenase enzymes present in the liver. The potential for toxicity rests on the amount consumed; generally large doses are required for toxicity.

Propanols have little potential for serious or chronic toxicity. Ingestion causes symptoms typical of ethanol intoxication; central nervous system depression, drowsiness and headaches. Butanols have been shown to be toxic when ingested, but systemic effects have not been noted at concentrations below 100 parts per million. At 200 parts per million air concentration, optic irritation, blurred vision, burning and lacrimation of the eyes are noted. Pentanols are irritating and narcotic and produce illness when ingested. Methanol, 2-propanol, 2-butanol and 2-methyl propanol mimic the effects of ethanol poisoning and, like many ketones, can increase the hepatic effects of halogenated hydrocarbons. Toxicologically, this group appears to be of very little significance to risk.

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Hexanol (like hexane) can be metabolized to hexanone 2, 5-hexanedione. This metabolite may initiate nerve damage and if the exposure is chronic, it could cause serious peripheral neuropathies. However, this occurs only under chronic exposure and at fairly high concentrations (such as 500 parts per million for hexane). It is generally found in the industrial setting. This is unlikely at the FEMP. Alcohol solvents are liquid and highly volatile. Because of their widespread use there is a potential for adverse effects from the industrial setting. FEMP concentrations of the alcohols do not contribute to the site risk.

20 CONCLUSION: IMPACT FROM ALCOHOLS/GLYCOLS ON RISK IS PROBABLY LOW

Aldehydes/Ketones

Together this group comprises a group of chemicals known as carbonyl compounds. There are a few that are toxicologically important and affect the eyes, skin and mucous membranes. Some are irritants of the eyes, skin and mucous membranes. However, their metabolism is too rapid to produce any cumulative effects needed for systemic toxicity. Halogenated ketones can be considered highly toxic; however there are no such compounds in this list of TICs. Derivatives of butanone and 2-hexanone ~~maybe be considered harmful, can produce both chronic and short-term effects,~~ especially to muscle/nerve tissue in ~~that they are able of causing~~ peripheral polyneuropathies. ~~However, chronic exposures are required to initiate such pathology.~~

2-heptanone, 2-pentanone, methyl isobutyl ketone is also used as a solvent for lacquer thinner. Its strong odor limits use and minimizes exposures. Most of these compounds irritate the mucous membranes and are strongly narcotic at higher concentrations, possibly requiring levels above 200 parts per million to demonstrate these effects.

20 CONCLUSION: IMPACT ON RISK FROM ALDEHYDE/KETONES IS PROBABLY LOW.

Aliphatics

The aliphatic hydrocarbons includes saturated as well as unsaturated compounds. They are products of petroleum cracking. The lower weight compounds are gaseous (methane, ethane, propane, and butanes). The pentane series (C₅-C₁₆) tends to be volatile liquids. These materials are not chronic toxins. These are simple asphyxiants and tend only to displace oxygen when present in high concentration causing hypoxia. In general the saturated hydrocarbons (C₄-C₈) show very strong narcotic properties. Heavier members of the series are not highly volatile and require heat to generate vapor concentrations capable of causing narcosis.

The hexane molecule is capable of peripheral neuropathies. Large doses over long periods of time would be required for this adverse effect to occur. The closely related pentane and heptane molecules (C₅ and C₇), are unlikely to cause any such adverse effects. However, high concentrations of vapors from heptane (C₇) and octane (C₈) molecules can cause giddiness, vertigo headache and anesthetic stupor. These symptoms tend to be reversible and full recovery generally occurs. Based upon the levels and at the depths present of these materials in the pits, these responses are unlikely.

20 CONCLUSION: THE IMPACT ON RISK FROM ALIPHATICS IS PROBABLY LOW.

Amino/Nitro Compounds

Aromatic amino and nitro compounds are fundamental to manufacture of explosives, pharmaceuticals, herbicides, plastic, paint and rubber industries. Aniline and coal tar dyes are products that contain nitrogen groups. There are general toxic properties characteristic of this group in that many of these compounds can cause methemoglobinemia. However, some are proven to be bladder carcinogens while others affect the oxidative phosphorylation mechanism.

Several herbicides contain nitrile compounds. The nitriles have been shown to cause headache, fever, dizziness, vomiting, weight loss and leg myalgia. The lethal dose in rats occurs at levels above 270 mg/kg.

20 CONCLUSION: IMPACT TO RISK FROM AMINO/NITRO GROUPS IS PROBABLY MODERATE.

Aromatic/Polyaromatic Hydrocarbons

Among the aromatics, benzene presents the greatest potential threat to human health due to its known potential to cause leukemia. Related alkyl benzene compounds have the potential to cause central nervous system narcosis. However, the alkylbenzenes tend to be relatively non-toxic except at high concentrations during acute exposures. ~~Thus the hydrocarbons identified above as TICs are not likely to be of serious concern.~~

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Pyridines are a special group of compounds, that are fat soluble and tend to penetrate the intact corneal epithelium, then rapidly reaches the iris and causes iritis. This causes leakage of proteins and leukocytes if sufficient concentrations develop.

Polyaromatic compounds such as the chlorinated biphenyls, phenanthrene and anthracene were identified as COCs and the risk was quantified. However, additional compounds, could increase the risk for adverse effects, such as skin chloracne. However, these compounds require a certain molecular shape and if present, induce the hepatic enzyme, arylhydrocarbon hydroxylase which correlates highly with chloracne. These agents are capable of initiating other adverse skin reactions and considered to be skin carcinogens. They may be considered as co-carcinogens. They could increase the impact on risk.

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CONCLUSION: THE IMPACT ON SITE RISK FROM AROMATIC/POLYAROMATIC
HYDROCARBONS IS PROBABLY MODERATE.

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Carboxylic Acids

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Carboxylic acids are soluble forms of compounds that are easily conjugated by the liver enzymes and are rapidly removed from tissue due to their high solubility as conjugated polar compounds. Toxicity of these compounds is generally unknown: however, due to their high solubility and rapid removal from the body, effects would appear to be minimal.

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CONCLUSION: IMPACT ON RISK FROM CARBOXYLIC ACIDS IS PROBABLY BE LOW.

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Esters

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Esters are chemical compounds that are formed when an organic radical group (R) replaces the hydrogen atom in an organic acid. Generally these compounds are found in the plastics industry either as resins, as plasticizers or as solvents for lacquers. Generally, esters of organic acids tend to be of low toxicity; although there are exceptions. The more saturated the compound, the more likely it will be harmless. Higher levels of double bonds in these molecules tend to increase the ability for skin irritation.

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Esters used as plasticizers, with the exception of certain phosphate esters, are usually physiologically inert. In those instances from exposure to acrylates, methacrylates, crotonates and vinyl and allyl esters are the source of exposure, toxicity demonstrated by conjunctivitis, upper respiratory irritation and pulmonary edema may occur.

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Tributyl phosphate (TBP) ester has found use as a solvent in the uranium extraction process. Its harmful effects are limited to the respiratory system, the skin and eyes. There do not appear to be any chronic manifestations of exposure. As with most acute toxins, removal of the source will allow reverse of the symptoms. The ACGIH established an air level of 1300 mg/m³ TBP as immediately dangerous to life.

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As a rule, mammalian metabolic systems have broads classes of esterase enzymes present in the liver and kidney to hydrolyze the linkages of foreign compounds. They are rapid in their action and remove such materials from the body quickly through increased solubility.

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20 CONCLUSION: THE IMPACT TO RISK FROM THESE ESTERS IS PROBABLY LOW. 1

Furans 3

Furans cause irritation of the eyes and upper respiratory system. Nausea, dizziness, and headaches are symptoms of exposure above 200 parts per million. In experimental animals, liver and kidney damage have been caused by furan exposures. Carcinogenicity in furans is assumed and although furans are a significant compound class with respect to risk, the relatively few TICs in this class that were reported would indicate that the impact on total risk is low. 4
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20 CONCLUSION: THE IMPACT ON RISK IS PROBABLY LOW FROM THESE FURANS. 10

Dimethyl Sulfide 12

The impact from this compound is unknown. Toxicity data is lacking and precludes an evaluation of any possible toxic effects. 13
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CONCLUSION: THE IMPACT TO RISK IS UNKNOWN. 16

Unknown Organic Compounds 18

There are a number of unidentified unknowns present in the LIST OF TICs; their impact on risk cannot be evaluated. 19
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CONCLUSION: THE IMPACT ON RISK IS UNKNOWN. 22

E.6.3.2.3 Overall Impact of TICs on Risk 24

The overall impact on risk from these compounds is low. This is due to the fact that these materials appear to be relatively non-toxic, and because the potential for exposure is minimal, are primarily from the lower horizons of pit material. Although there is risk of hazard from the exposure to the eyes and skin, this appears to be minimal because the source material has a very low level concentration in the pit materials. The volume of soil required for ingestion to produce an adverse effect from these levels of materials would be in excess of a few kilograms (2-3 pounds or more) and is highly unlikely. Any possible risk, would likely be occupational, considering its likely that a construction or remedial worker, digging in the soil, would be exposed to the sub-surface soil TICs. pit media. 25
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20, 24 These materials may be present due to the various reasons stated ~~previously above, from residuals~~
~~blown over from crop farms~~ and/or present due to existing biological (plants, insects, microbes)
 products present naturally in the soils. This would tend to reduce the expectation that these materials
 would be toxic, except under fairly large exposure conditions. Although plant alkaloids can be toxic,
 there are few only at very small amounts and it would require the receptor to consume inordinately
 large volumes of pit material to reach toxic levels.

Under chronic conditions of exposure, a positive impact on risk always exists. The primary potential
 of such materials is to irritate the mucous membranes of the eyes and the respiratory tract. Given
 their presence in the pit materials, the impact is minimal, if at all.

The variability of these TIC compounds suggest residues from many biological activities, not likely
 associated with the site process activity. Together with the very low ppb levels, it reaffirms our belief
 that the presence of these tentatively identified compounds, at levels estimated, are unlikely to
 negatively impact human health and site risk.

20 The question of the degree of impact is a professional judgment: the certainty of its lack of impact on
 risk is fairly high. ~~The low concentrations and the low potential for an exposure, effects of these~~
~~TICs, if present, and their bioavailability, would be non-existent to very low. The impact on the~~
~~overall site risk is very low.~~ **Given the low concentrations and locations of TICs, and the lack of**
complete exposure pathways, the degree of impact on total baseline risk is considered to be
minimal.

TABLE E.6-4
LIST OF TICS BY CLASS*

ALCOHOL/GLYCOL

- 3-methyl-2-butanol(13000)
- 4-butanediol-diacetate(370)
- 2-butoxyethanol(28)
- 2-cyclohexanemethanol(78)
- dodecylcyclohexanol(14000)
- 2-propyl-1-heptanol(47)
- tetrahydropyran-2,3-diol(4900)
- 2,4-dimethyl pentanol(31)
- tetracontanol(5800)
- undecen-1-ol(34)

ALDEHYDE/KETONE

- 1-(3-ethyloziranyl)-7-ethanone(680)
- 2-ethoxy-1,2-diphenyl ethanone(160)
- butanal(140)
- 3-methyl-2-butanone(13mg/kg)
- 6-acetyloxy-2-hexanone(22mg/kg)
- dihydroxy-2-hexanone(450)
- 5-methyl-3-hexen-2-one(660)
- 3h-naphtha-2,1-b-pyran-3-one(2700)
- 2h-pyran-2,3-diol-tetrahydrodiacetate(5180)

ALIPHATICS

- bicyclononane(61)
- 1,4-dimethylcyclooctane(32)
- bicycloheptane(220)
- azabicyclohexane(190)
- decyl-cyclohexane(2400)
- eicosyl-cyclopentane(2300)
- 1-methyl-1,4-cyclohexadiene(30)
- 1-methyl-3-(1-methylethyl)-cyclopentane(55)
- cyclopropane(4700)
- hexatriacontane(910)
- tetra-1,3-dioxalane(410)
- 2-methyl-6-propyldodecane(200)
- 2-methyl-4,5-nonadiene(61)
- 2-methyl-1-propene(45)
- 4-methyloctane(190)
- spirodecane(1000)
- tetradecane(590)
- tricyclodecane(140)
- 1,3,6-trioxocane(39)
- tri-tetracontane(240)

AMINO/NITRO COMPOUNDS

- 2,4-pentadiene nitrile(45)
- 2-methyl-1-nitropropane(20)
- 1,4-dibutyl-tetrazine(2300)

AROMATIC/POLYAROMATIC

- cyclohexyloxy-benzene(2500)
- 1-choloromethyl-isobenzene(25)
- Isoquinolinium(6400)
- decahydronaphthalene(150)
- dibenzothiophene(1500)
- 5h-indeno-1,2-pyridine(41mg/kg)
- pentachlorobiphenyl(6.8mg/kg)
- tetrachlorobiphenyl(2.0mg/kg)
- benzanthracene(22mg/kg)
- cyclopentaphenanthrene(3000)
- methylphenanthrene(15mg/kg)

CARBOXYLIC ACIDS

- 2,4-dinitrobenzeneacetic acid(4000)
- hexanedioic acid(16mg/kg)
- 1-phenyl-cyclopropane-carboxylic acid(57)
- 2-methylpentanoic acid(6600)
- octadecanoic acid(4400)

ESTERS (of the following acids)

- tributylphosphoric acid(7700)
- hexanedioic acid(12.0mg/kg)

FURANS

- tetrahydrofuran(14)
- 2-propylfuran(1200)

SULFUR COMPOUNDS

- dimethyl sulfide(40)

UNKNOWN

C₆ THROUGH C₃₀

* All concentrations are reported in µg/kg, unless otherwise noted. These concentrations are considered to be relatively low (ppb range), as compared to the detected analytes on the target analyte list.

5795

APPENDIX E.7

000095

child were considered applicable for consideration with current access controls. The receptors considered applicable if access controls were removed are the trespassing youth, off-property RME resident farmer and child, and off-property user of meat and dairy products (an individual that would ingest meat and dairy products from livestock grazed on-site). With access controls, the exposure pathway contributing the greatest risk is external exposure of the groundskeeper to radiological constituents in buried pit materials. Under current land use without access controls the principle exposure pathways from the current source term are biotransfer of chemical CPCs into meat and milk products. The receptor with the greatest risk for current land use, current source term is the off-property user of meat and milk products from cows grazed on site with a total carcinogenic risks of 2×10^{-3} . The primary contributors to this risk are total PCBs and ^{238}U ^{238}U in the surface soil and ^{137}Cs ^{137}Cs ^{137}Cs in surface water as a result of their biotransfer to meat and milk products. The Hazard Indices for all these receptors are acceptable (less than 1) except for the off-property user of meat and milk products with a hazard index of 2.9. Antimony and cadmium in surface soils are the systemic toxins most significantly contributing to total cancer risk.

26

Tables E.7-3 and E.7-4 contain a summary of risks associated with current land use and future source term. Assumptions were made for the future source term regarding the configuration of the operable unit that would result in higher exposure to stored waste materials. The receptors given in Tables E.7-3 and E.7-4 include the trespassing youth and Great Miami River User (i.e., an individual that uses the river as a source of domestic water and for recreational purposes). A number of other receptors were also identified as relevant under current land use, future source term. These receptors include the off-property farmer and child, and off-property user of meat and milk products. The cancer risks and hazard indices are not dependent upon on-site land uses, and therefore, are applicable under the current and future land use scenarios. The cancer risks and hazard indices are presented under future land use, future source term evaluation.

Cancer risks for the current land use, future source term range from 3×10^{-7} for the Great Miami River User to 2×10^{-3} for the off-property RME farmer. The pathway contributing the majority of risk is ingestion of groundwater by the off-property RME farmer with uranium isotopes the primary contributors to total cancer risk. Total hazard indices range from 0.004 (Great Miami River User) to 90 for the off-property child. Groundwater was the pathway contributing the majority to the total hazard index for this receptor. Other exposure pathways

TABLE E.7-1

**INCREMENTAL LIFETIME CANCER RISK SUMMARY
CURRENT LAND USE, CURRENT SOURCE TERM ^a**

Media	Groundskeeper	Off-property Farmer	Off-property Young Child	Trespassing Youth	Off-property User of Meat and Milk Products
Air					
Radiocarcinogenic Risk	6E-06	3E-06	2E-07	7E-07	NA
Chemical Carcinogenic Risk	1E-08	2E-07	8E-08	2E-09	NA
Total ^b :	6E-06	3E-06	2E-07	7E-07	NA
Surface Soil					
Radiocarcinogenic Risk	8E-05	NA	NA	3E-05	5E-04
Chemical Carcinogenic Risk	1E-05	NA	NA	9E-06	9E-04
Total ^b :	9E-05	NA	NA	4E-05	1E-03
Buried Pit Material					
Radiocarcinogenic Risk	5E-05	NA	NA	2E-05	NA
Chemical Carcinogenic Risk	NA	NA	NA	NA	NA
Total ^b :	5E-05	NA	NA	2E-05	NA
On-property Surface Water					
Radiocarcinogenic Risk	NA	NA	NA	NA	2E-04
Chemical Carcinogenic Risk	NA	NA	NA	NA	6E-06
Total ^b :	NA	NA	NA	NA	2E-04
Sum All Media					
Radiocarcinogenic Risk	1E-04	3E-06	2E-07	5E-05	7E-04
Chemical Carcinogenic Risk	1E-05	2E-07	8E-08	9E-06	9E-04
Total ^b :	1E-04	3E-06	2E-07	5E-05	2E-03

NA - Not applicable. Exposure route not evaluated for receptor.

^a This table includes values that have been rounded to one significant figure. Therefore, the total number may be higher or lower than the sum would result from adding the values in the table, due to rounding. Refer to Attachment E.IV for specific values.

^b Radiocarcinogenic and chemocarcinogenic risks are not truly additive. A total is provided for reference only.

TABLE E.7-3

INCREMENTAL LIFETIME CANCER RISK SUMMARY
CURRENT LAND USE, FUTURE SOURCE TERM ^a

Medium	Trespassing Youth	Great Miami River User
Air		
Radiocarcinogenic Risk	8E-05	NA
Chemical Carcinogenic Risk	4E-05	NA
Total ^b :	1E-04	NA
Surface Soil		
Radiocarcinogenic Risk	1E-04	NA
Chemical Carcinogenic Risk	7E-05	NA
Total ^b :	2E-04	NA
Buried Pit Material		
Radiocarcinogenic Risk	7E-06	NA
Chemical Carcinogenic Risk	NA	NA
Total ^b :	7E-06	NA
Paddys Run Surface Water		
Radiocarcinogenic Risk	7E-08	NA
Chemical Carcinogenic Risk	6E-08	NA
Total ^b :	1E-07	NA
Paddys Run Sediment		
Radiocarcinogenic Risk	4E-06	NA
Chemical Carcinogenic Risk	9E-06	NA
Total ^b :	1E-05	NA
Great Miami River		
Surface Water		
Radiocarcinogenic Risk	NA	3E-07
Chemical Carcinogenic Risk	NA	3E-08
Total ^b :	NA	3E-07
All Media		
Radiocarcinogenic Risk	2E-04	3E-07
Chemical Carcinogenic Risk	1E-04	3E-08
Total ^b :	3E-04	3E-07

NA - Not Applicable. Exposure route not evaluated for this receptor.

^a This table includes values that have been rounded to one significant figure. Therefore, the total number may be higher or lower than the sum that would result from adding the values in the table, due to rounding. Refer to Attachment E.IV for specific values.

^b Radiocarcinogenic risk and chemocarcinogenic risk are not truly additive.

A total is provided for reference only.

TABLE E.7-5

INCREMENTAL LIFETIME CANCER RISK SUMMARY
FUTURE LAND USE (GOVERNMENT RESERVE)
FUTURE SOURCE TERM ^a

Medium	On-property Groundskeeper	Expanded Trespasser
Air		
Radiocarcinogenic Risk	7E-04	1E-04
Chemical Carcinogenic Risk	2E-04	6E-05
Total ^b :	9E-04	2E-04
Surface Soil/Exposed Pit Material		
Radiocarcinogenic Risk	4E-04	3E-04
Chemical Carcinogenic Risk	2E-04	2E-04
Total ^b :	7E-04	5E-04
Buried Pit Material		
Radiocarcinogenic Risk	5E-05	3E-05
Chemical Carcinogenic Risk	NA	NA
Total ^b :	5E-05	3E-05
Paddys Run Surface Water		
Radiocarcinogenic Risk	NA	7E-08
Chemical Carcinogenic Risk	NA	6E-08
Total ^b :	NA	1E-07
Paddys Run Sediment		
Radiocarcinogenic Risk	NA	4E-06
Chemical Carcinogenic Risk	NA	9E-06
Total ^b :	NA	1E-05
All Media		
Radiocarcinogenic Risk	1E-03	4E-04
Chemical Carcinogenic Risk	4E-04	3E-04
Total ^b :	2E-03	7E-04

NA - Not Applicable. Exposure route not evaluated for this receptor.

^a This table includes values that have been rounded to one significant figure. Therefore, the total number may be higher or lower than the sum that would result from adding the value in the table, due to rounding. Refer to Attachment E.IV for specific values.

^b Radiocarcinogenic risk and chemocarcinogenic risk are not truly additive. A total is provided for reference only.

**TABLE E.7-7
INCREMENTAL LIFETIME CANCER RISK SUMMARY
FUTURE LAND USE (AGRICULTURAL USE)
FUTURE SOURCE TERM ^a**

Media	On-property RME Farmer ^c						Off-property User of Meat and Milk Products	
	On-property RME Farmer ^c	(User of Perched GW)	On-property CT Farmer	On-property Young Child	Off-property Farmer	Off-property Young Child	Homebuilder	
Air								
Radiocarcinogenic Risk	5E-03	5E-03	4E-04	9E-05	2E-04	4E-06	1E-04	1E-05
Chemical Carcinogenic Risk	5E-03	5E-03	3E-04	1E-03	3E-04	7E-05	4E-05	8E-04
Total ^b :	1E-02	1E-02	7E-04	1E-03	5E-04	8E-05	2E-04	8E-04
Exposed Waste Pit Materials								
Radiocarcinogenic Risk	2E-02	2E-02	2E-03	2E-03	NA	NA	7E-05	NA
Chemical Carcinogenic Risk	9E-03	9E-03	6E-04	4E-03	NA	NA	2E-04	NA
Total ^b :	3E-02	3E-02	3E-03	6E-03	NA	NA	2E-04	NA
Surface Soil								
Radiocarcinogenic Risk	7E-04	7E-04	4E-05	1E-04	NA	NA	NA	5E-04
Chemical Carcinogenic Risk	1E-03	1E-03	6E-05	5E-04	NA	NA	NA	9E-04
Total ^b :	2E-03	2E-03	1E-04	6E-04	NA	NA	NA	1E-03
Buried Pit Material								
Radiocarcinogenic Risk	1E-03	1E-03	2E-04	2E-07	NA	NA	7E-09	NA
Chemical Carcinogenic Risk	NA	NA	NA	NA	NA	NA	NA	NA
Total ^b :	1E-03	1E-03	2E-04	2E-07	NA	NA	7E-09	NA
On-property Surface Water								
Radiocarcinogenic Risk	3E-04	3E-04	1E-05	4E-05	NA	NA	NA	3E-04
Chemical Carcinogenic Risk	6E-06	6E-06	4E-07	1E-06	NA	NA	NA	6E-06
Total ^b :	3E-04	3E-04	1E-05	4E-05	NA	NA	NA	3E-04
Groundwater								
Radiocarcinogenic Risk	2E-02	5E-01 b	2E-03	1E-03	2E-03	9E-05	NA	NA
Chemical Carcinogenic Risk	4E-02	9E-01 b	3E-03	9E-03	0E+00	0E+00	NA	NA
Total ^b :	6E-02	1E+00 b	4E-03	1E-02	2E-03	9E-05	NA	NA
All Media								
Radiocarcinogenic Risk	5E-02	5E-01 b	4E-03	3E-03	2E-03	1E-04	2E-04	8E-04
Chemical Carcinogenic Risk	5E-02	9E-01 b	4E-03	1E-02	3E-04	7E-05	2E-04	2E-03
Total ^b :	1E-01	1E+00 b	8E-03	2E-02	2E-03	2E-04	4E-04	2E-03

NA - Not applicable. Exposure route not evaluated for receptor.

^a This table includes values that have been rounded to one significant figure. Therefore, the total number may be higher or lower than the sum that would result from adding the values in the table, due to rounding. Refer to Attachment E.IV for specific values.

^b Radiocarcinogenic and chemocarcinogenic risks are not truly additive. A total is provided for reference only.

^c Risks calculated and total summed based on the use of the 1-hit equation for calculating risks from higher doses (EPA 1989a), therefore, total risks will not exceed 1.0.

TABLE E.7-9
INCREMENTAL LIFETIME CANCER RISKS FOR SOIL PATHWAYS
RME RESIDENT FARMER
NATURAL BACKGROUND CONCENTRATIONS

Radionuclide	0"-6" UCL Background Soil Concentration ^a (pCi/g)	Background Risk	Cancer Risks Operable Unit 1 ^c
Cs-137 + 1 dtr	4.4 x 10 ⁻¹	4 x 10 ⁻⁵	4 x 10 ⁻⁴
Ra-226 + 8 dtrs	1.2 x 10 ⁰	3 x 10 ⁻⁴	1 x 10 ⁻²
Th-230	1.5 x 10 ⁰	1 x 10 ⁻⁷	1 x 10 ⁻⁴
Th-232 + 10 dtrs	1.1 x 10 ⁰	4 x 10 ⁻⁴	2 x 10 ⁻²
U-234	1.0 x 10 ⁰	3 x 10 ⁻⁷	3 x 10 ⁻⁵
U-235 + 1 dtr	8.8 x 10 ⁻²	9 x 10 ⁻⁷	4 x 10 ⁻⁴
U-238 + 2 dtrs	1.1 x 10 ⁰	2 x 10 ⁻⁶	1 x 10 ⁻³
K-40 ^d	1.7 x 10 ¹	1 x 10 ^{-3d}	NA
Total Risk	--	7 x 10^{-4d}	4 x 10⁻²

Chemical	0"-6" UCL Background Soil Concentration ^b (mg/kg)	Background Risk	Cancer Risks Operable Unit 1
Arsenic	6.0 x 10 ⁰	2 x 10 ⁻⁴	1 x 10 ⁻²
Beryllium ^c	6.0 x 10 ⁻¹	2 x 10 ⁻⁴	1 x 10 ⁻³
Total Risk	--	4 x 10⁻⁴	1 x 10⁻²

^aRadionuclide UCL background concentrations in soil (0"-6") are obtained from Attachment E.I, Table E.I-5.

^bChemical UCL background concentrations in soil (0"-6") are obtained from Attachment E.I, Table E.I-4.

^cUCL was not calculated; frequency of detection was 1/30.

^dThe background risk for K-40 was not included in total background risk because K-40 was not selected as a CPC for this operable unit. Including it in the total risk from background could bias decisions if the total background risk were compared directly with the total site-related risks calculated in this report. It is included here because it is a ubiquitous component of background.

^eTotal cancer risks for Operable Unit 1 include risk to background concentrations of CPCs.