Colorado Department of Health

Comments

FINAL DRAFT

PHASE 1 RFI/RI WORK PLAN

ROCKY FLATS PLANT

WALNUT CREEK PRIORITY DRAINAGE

(Operable Unit No. 6)

APRIL 1991

General Comment: All figures in Section 2 and Section 7 should incorporate the surface geological contacts depicted on Figure 1-5. Overlaying the geology facilitates the Division's understanding of site characteristics and investigation plans and objectives. The following figures should be updated: Figures 2-2, 2-7, 2-10, 2-11, 2-12, 7-1, 7-2, 7-3, 7-4, 7-5 and 7-6.

Executive Summary: In the first paragraph, page ES-1, it is stated that "the presence or absence of contamination at (IHSSs)" will be investigated. Although the IHSSs constitute the focus of the investigation, the effort cannot be limited to these discrete units if contiguous or upstream contamination is suspected. For example, the work plan properly provides for the investigation of stream drainages between the A and B Series ponds. It must also provide, more fully, for the investigation of stream channels from contaminate release points to the unit (i.e. Old Outfall). The specific comments will expound on overlooked issues. The summary, however, should acknowledge that the investigation will be thorough and not limited merely to designated IHSSs.

In the fourth paragraph, page ES-2, the requirements of the Field Sampling Plan, i. e. screening activities, sampling of soils etc. are described. Characterization of the IHSSs and associated areas or drainages will not be complete, nor adequate, if the vadose zone is ignored. The importance of the vadose zone is discussed beginning in the last paragraph of page 2-8 of "Volume 1, Interim

Final RCRA Facility Investigation Guidance, Development of an RFI Work Plan and General Considerations for RCRA Facility Investigations", May 1989 (EPA 530/SW-89-031). The FSP should be amended to provide for vadose zone monitoring and sampling where the Conceptual Models anticipate ground water contamination.

Section 1.0: In the first paragraph it states that the FSP is presented to assess the "nature and extent" of contamination of the IHSSs. As presented in this document, the FSP is essentially a screening survey. Much more will be necessary to define nature and extent of contamination. Extent, for example, cannot be fully determined from one or two down gradient monitoring wells. As written, the general public might assume, incorrectly, that the current version of the FSP will be comprehensive. Although an RFI work plan may need to be performed in stages, it should be the intent of the plan to be as comprehensive as practical to expedite remediation. The introduction should acknowledge that a staged approach is envisioned and the FSP should clearly describe the possible stages of the investigation, and alternatives, in a decision-tree.

Relative to foregoing observations, the Division is concerned that IAG, Statement of Work, Table 5 is perceived as meeting the screening and sampling requirements necessary to define nature and extent of contamination. However, the SOW specifically states that "The FSP shall incorporate the sampling objectives of Table 5, and shall anticipate investigations beyond the work specified in this Attachment" (SOW, page 25, Section VI.B). Please propose an FSP that will reasonably define nature and extent and diminish the need for additional stages.

The reference to the "RFI Guidance" should be 1989a not 1989b. Please correct.

Section 1.3.3.1: The discussion on topography, page 1-4, is very weak. Both the gentler eastward slopes and topographic dissection play an important role in the exposure or subcropping of bedrock at, and in the vicinity of, Rocky Flats. Topographic relief, although seemingly inconsequential, may increase the potential for contamination of stratigraphically lower units (like the Laramie Formation). The Division believes that the interrelationship of geologic structure and topography have not been fully considered in the determination of potentially contaminated strata. An insightful discussion, not merely acknowledgement of regional slope and the general elevation, should help foster a better understanding of site geology and associated contamination.

Section 1.3.3.2: The location of the Broomfield Diversion Ditch, page 1-7, should be shown and identified on Figure 1-2.

Section 1.3.6: On page 1-10, "deeper bedrock sandstones under confined conditions" are discussed. Are these the mappable

sandstones of the Arapahoe Formation or the Laramie/Fox Hills Formations?

It is stated in this section that geologic interpretations are based on information from Hurr (1976) and the Geologic Characterization Report (EG&G, 1990e). The Hurr report was aimed at the **hydrology** of Rocky Flats. The geology sections of that report were not the main emphasis; they merely suggest the general geologic setting or context of his work. Consequently, it would be better to extract more definitive geologic information from Weimer, 1973 (referenced in Hurr) and comparable **geologic** studies. This is not merely a matter of preference or bias but of substance.

Section 1.3.6.1: On page 1-10, "pediment drainages in the top of the bedrock" are discussed. A bedrock surface "structure" map is needed to depict the drainages. The data of Table 2-1 should be mapped pending additional data from RFI activities. It is difficult to see a conceptually adequate FSP without the concept this map would provide.

Section 1.3.6.2: On page 1-16, "younger terrace deposits including the Verdos..." are discussed. However, occurrences of Verdos Alluvium are absent from Figure 1-5. If the Verdos is absent within the Walnut Creek Operating Unit please state in the text.

The section also describes the Verdos, Slocum and Louviers alluvial deposits as "terrace" alluvium. Figure 1-6 shows the Louviers, but not the Slocum, as Terrace alluvium. Which is correct? Also, the legend to Figure 1-5 shows the Terrace alluvium; is this solely the Louviers alluvium. Please modify Figures 1-5, 1-6 and the narrative to establish consistency and clarity.

Section 1.3.6.3: This narrative states that sandstones of the upper Arapahoe Formation were deposited by meandering streams. It is the Division's understanding that the upper portion of the Arapahoe Formation, at RFP, was eroded prior to the deposition of the Rocky Flats Alluvium. Reference to the upper Arapahoe should include a statement that the section has been eroded. Also, please state the basis for the interpretation that the "claystones represent overbank deposits". Why are they predominant?

The Division is still under the impression that it is distinctly possible that all of the Arapahoe Formation beneath RFP was removed by erosion. The basis of the interpretation that it is present, or partially present, **must be clearly set forth** since RFP has shown reluctance in releasing the Geologic Characterization report.

On this issue, the statement is made that the Arapahoe Formation, beneath the Rocky Flats Plant, contains more clay and silt than typical to the formation and is similar to the Laramie Formation. Perhaps **it is** the Laramie Formation! The Division wishes to know the basis for RFP geologic correlations; a low and possibly rolling

dip, topographic relief, and a possible deltaic environment exposed along McCaslin Blvd suggest that the Laramie is at a shallow depth beneath RFP. For example, if the McCaslin Blvd exposures are lower Arapahoe sediments deposited by braided streams, as the narrative suggests, where are the sands typical of braided deposits? To say that the lower Arapahoe was the result of braided streams then state that it contains more clay and silt than typical must be supported by causes for the variation. Note, Figure 1-4 depicts these lenticular sandstones as being continuous.

Section 1.3.6.4: This discussion should be subdivided. The upper Laramie is more than a "thick upper claystone unit" and should not be lumped with the lower Laramie/Fox Hills aquifer. The depositional setting may be better described than "continental" as borrowed from Hurr, 1976. Again, we refer to Weimer, 1973 and comparable studies for more detailed geologic information.

The Division also takes exception to Hurr's description of a greater than 700 feet thick claystone with very low hydraulic conductivity. Unless these claystones are prodelta muds there is, in all likelihood, laterally contemporaneous silts and sands that may transmit contaminants laterally and possibly, through interconnection, downward.

The Division believes that the need for deeper stratigraphic tests are indicated and warranted to define the subsurface formations, the depositional environments that define them, and the potential impacts on contaminate transport and fate. Limited outcrop exposures are just that, "limited".

Figure 2-1: On Figure 2-1 a discontinuous stream segment is shown between the Existing Radioactive Ambient Air Monitoring Program Locations S-3 and S-4. If this stream segment connects to North Walnut Creek via a culvert, please show the trace of the culvert. This is important due to the potential for leakage of contaminants from culverts into ground water. (Note: if any contaminate releases occurred on this stream segment, both the stream and culvert will need to be investigated.)

Section 2.1: On page 2-7, North and South Walnut Creek are referred to as intermittent streams; however, Figures 2-1 and 2-2 use a perennial symbol to depict the streams. Figure 2-2 shows a short dotted segment with the legend indicating it to be an intermittent stream. The narrative and maps are inconsistent; are North and South Walnut Creek intermittent or perennial? Please clarify this inconsistency and properly indicate the streams on the maps.

The second paragraph, page 2-8, discusses the A-1 Bypass. Whether flow is through a culvert or open channel, please show and identify this structure on Figure 2-1.

Also relative to this second paragraph and Figure 2-1, does the unnamed drainage situated southwest of Pond A-1 flow into the pond or is it diverted to Pond A-3 via the A-1 Bypass? If flow is through a culvert, please show the trace of the culvert. Again, this information is important due to the potential for contaminant leakage.

Section 2.2.2: The co-solvation, if any, of contaminants (page 2-9), as they affect individual or collective transport into environmental media, should be discussed. Screening and sampling programs should reflect a basic model of how contaminants may move and to which environmental media. This should help focus the FSP.

The point(s) of discharge into North Walnut Creek of laundry wastewater from the northern production facilities and from process liquid waste, cooling tower blowdown, etc. (page 2-9) must be disclosed. This information is critical in the Division's review of FSP adequacy. Just as contaminants in the vadose zone feed groundwater, contaminants upstream can feed the detention ponds.

The pathway of spray evaporation (page 2-9) and potential contamination of soil in the vicinity of each pond where spraying was employed must be screened. Specifically and historically, where was this spraying practiced; over the pond or on the ground?

On page 2-11, first paragraph, pumping of water from Pond B-2 to Pond A-2 is discussed. Please indicate on the appropriate figure(s) the route of the pipeline. This is of interest due to the potential for leakage from the pipeline and resulting contamination.

Also the route of the B-5 to A-4 transfer line, third paragraph, should be disclosed.

Section 2.2.5: On page 2-19, third paragraph, reference is made to well B208489 on Figure 2-2. Well B208289 is shown on Figure 2-2 while B208489 is shown on Figure 2-1. Table 2-1 data indicate a depth to bedrock of less than one foot for well B208289. Which is correct? Please amend.

Are the lenticular sandstone bodies sufficiently correlated as to identify the No. 4 Sandstone as the bedrock beneath the fill? If so, the Division should be supplied with the cross sections demonstrating this knowledge. Figure 2-6 is inadequate, it is schematic and does not verify correlation. Please submit a cross section that will allow a true assessment of the geologic setting and thus FSP adequacy.

The discussion of the No. 4 sandstone, page 2-22, suggests that this specific sandstone is present "immediately beneath" the A-Series ponds. Figure 2-6 shows it immediately beneath ponds A-3 and A-4. However, given the narrow stratigraphic range of the

numbered Arapahoe sandstones, it is possible that the No. 3 or No. 5 may be "immediately beneath" ponds A-1 and A-2. This is not inconsequential; the entire transport and fate of contaminants, and a reasonable model, are affected. These considerations must be reconciled within the FSP and/or the interpretation of results from the FSP.

The relationship of the sandstones to a bedrock surface map would be a worthy endeavor. (See comments to Section 1.3.6.1.) Subcroppings, even of a cursory nature, would aid the investigation. The potential for transport from alluvium into a sandstone unit, then back into alluvium or colluvium, must be considered.

SECTION 2.3.4: On page 2-25, third paragraph, vertical distribution of plutonium in pond sediment is discussed. This data should be presented to support the proposed sediment sampling plan.

Section 2.3.5: On page 2-31, it is stated that the Arapahoe Formation is present beneath the B-Series ponds. Have the numbered Arapahoe sandstones cropped out or are they present at greater depth, i.e. what is the geologic setting? To say that the Arapahoe Formation is present says little.

Section 2.4.2: On page 2-35, the Pond Area Spray Field is discussed. The managers for OU-7, Present Landfill, are planning to incorporate the pond and this spray field into OU-7. How is this change being coordinated between OUs.

Screening surveys or sampling of the South Spray Field should extend to Walnut Creek, and downstream, given the fact that runoff from the surface was prevalent (see page 2-36, first paragraph).

The Division's inspectors have reported that spraying has been conducted on the north bank of the pond in addition to the area known as the Pond Area Spray Field. Why has this spray area not been defined as an IHSS nor included in the FSP? Will this issue be addressed in OU-7? If not, where?

Section 2.4.5: On page 2-42, second paragraph, the extent of the Rocky Flats Alluvium relative to the North & South Spray Fields is discussed. Overlaying the geologic contacts of Figure 1-5 would better illustrate this information. Please add the contacts to Figure 2-10.

Also, please amend the text to clarify that all, not merely the western half of IHSS 167.3, is underlain by the Rocky Flats Alluvium. As the text is structured, it is easily misconstrued that only the western halves of IHSSs 167.1 and 167.3 are underlain by the alluvium. The value of showing the geologic contours on Figure 2-10 is apparent.

Section 2.6.5: The statement on page 2-45, third paragraph, regarding the "aquifer near the trenches" should be amended. The term "near" suggests that the alluvium is present laterally; in this geologic setting it could only be upgradient, and therefore not affected by contaminants. However, referring to Figure 1-5, the trenches apparently were excavated within the alluvium. This changes the potential effect upon the aquifer from a "doubtful" to a "probable". Please amend the text and acknowledge the above observations.

Section 2.7.2: On page 2-47, reference is made to sludge drying beds visible in a 1964 aerial photograph. This statement suggests that the drying beds are no longer operating. Please comment on the status of these beds and demonstrate why they should not be handled as an IHSS.

Section 2.7.5: The description of the Arapahoe #1 Sandstone on page 2-47 is incomplete. Although it is 3.5 feet thick there is no indication of its depth below the surface either in narrative or cross-sectional format. Table 2-1 does not provide such information. This information is needed to support FSP adequacy.

Section 2.8.2: In the fourth paragraph of page 2-49, the removal of soil from an "area of about 200 square feet" is discussed. If the specific sites of soil removal are known, they should be shown on Figure 2-11. Any and all other known soil removal sites for this and other IHSSs should be mapped. Additionally, the depths, if known, to which soils were excavated should be reported.

Section 2.8.5: In the fourth paragraph, page 2-52, the draft geologic characterization report (EG&G 1990e) is referenced. Please utilize the report to depict the geologic framework of the IHSS. For example, the thickness of the Rocky Flats Alluvium could, and should, be mapped or cross-sectioned and presented in this workplan. The IAG mandated sampling and monitoring requirements do not preclude the potential for more appropriate investigation measures. The requested information will allow a better analysis of FSP adequacy.

Figure 2-13: The legend for this figure shows "Concentrations of Soil Samples In d/m/gm" These are plutonium concentrations in soil samples. Please amend the legend to read "Plutonium Concentrations in Soil Samples In d/m/gm". Please also see comments to Section 2.9.4.

After reviewing Figures 1-2 and 1-5 the course of McKay Ditch relative to this figure is unclear. Figure 1-2 shows the ditch running through the northern end of the PSZ; however, Figure 1-5 shows it passing north of the Present Landfill. This figure, 2-13, shows it comparable to Figure 1-2. Which figures are correct? Please amend the maps as necessary.

Section 2.9.4: This section, page 2-60, contains three different formats for stating disintegrations per minute per gram data. Please use a consistent format within this section and throughout the workplan. Workplans are public documents, they should inform rather than confuse the reader.

Section 2.11: The following comment is applicable to all of the conceptual models. The potential sources of contamination , i. e. Air Pathway, Surface Water Pathway etc. represent current and future sources of secondary contamination. However, the models must include identification of the initial contamination sources, i. e. buildings, processes, etc., the point(s) of release, the suspected chemicals or radionuclides, and the pathways into the environment. To discuss only the pathways from the affected environment into other environmental media or to receptors diminishes the potential for an effective FSP.

The discussion of pathways should summarize what is known about rates of migration. The discussion of receptors should include types, sensitivities, time of exposure, concentrations, and numbers for the receptor populations. The conceptual models presented are in some instances flawed or incomplete, and in most cases, not fully developed. The following comments to Section 2.11 reflect the findings of the Division.

Section 2.11.1: On page 2-63, regarding the Air Pathway, the streams between the ponds are contaminated and they are dry when water is not being discharged. Consequently, contaminated particles would be available to the air pathway. The conceptual model must reflect these observations. In addition to on-site workers and animals, the air pathway must include off-site receptors as part of the exposed populations.

Section 2.11.2: See comment to Section 2.11.1.

Section 2.11.6: Regarding the "Groundwater Pathway" on page 2-67, the statement that ground water is not a pathway because the IHSS is located on a slope is not valid. Recharge of ground water occurs on slopes as well as flat ground. With a depth to ground water of only three feet, it must be considered a potential pathway and appropriate planning should be reflected in the FSP.

Section 2.11.7: Regarding the "Surface Waters and Air Pathways" on page 2-67, it has not been indicated in Section 2.8 that soils from the entire IHSS have been removed nor is there any discussion of a covering; therefore, neither of the pathways can be ruled out. In fact, soil from two small hot spots were apparently never removed (see page 2-50). The FSP must reflect these issues.

Section 2.11.8: See comment to Section 2.11.7. Some areas of the unit may not have been covered with fill.

Section 2.11.9: Regarding the "Groundwater Pathway" on page 2-68, the geology discussion on page 2-62 indicates that no monitoring wells have been completed beneath the unit. Until sufficient data are collected to demonstrate otherwise, the ground water pathway cannot be ruled out. Consequently, the FSP must reflect this issue.

Section 3.0 - General Comment: Tables 3-1, 3-2, and 3-3 appear, with some exceptions, to be comprehensive site-wide lists of potential chemical specific ARARs. The Target Analyte List and Target Compound List (Table 7-9) appear to represent subset lists appropriate to OU-6. If this is DOE's intent, please indicate it in the text. The Division could then ascertain the thought process that DOE and EG&G are using to screen the various standards and chemicals.

The workplan should clearly and specifically state that RCRA Health Based Standards are potential ARARs even though numerical standards typically have not been established, to date.

Section 3.1: Colorado Water Quality Control Commission ground water standards for the Rocky Flats area became effective on April 30, 1991. The ground water standards are now potential ARARs and no longer TBCs. Please revise the text to reflect this change.

Section 3.11.5.C.4 (5 CCR 1002-8), which is the "Basic Standards for Ground Water," states "Whenever the current detection level (PQL) for a pollutant is higher (less stringent) than a standard listed in Subsection 2 or 3 above [radioactive, Table A, and Table B constituents], the detection level shall be used as the performance standard in regulating specific activities. The detection levels (PQL's) identified in Tables A and B shall apply, unless and until they are modified as the result of a subsequent rulemaking hearing." Therefore, in contrast to the surface water regulations, the Division has identified several constituents in Table 3-1 (Groundwater Quality Standards) of the text that currently have the standard, instead of the less stringent detection limit, listed as the potential ARAR. This can be changed in the ARAR tables.

Table 3-1: The section of the CCR that became effective April 30, 1991 (Section 3.12.0; 5 CCR 1002-8) includes a "Table 6" that outlines the new radionuclide standards that will be applied to all ground water that is hydraulically connected to Walnut and Woman Creeks. Please replace the radionuclide standards that currently appear in Table 3-1 of the text with these new standards:

Gross Alpha	7 pCi/l
Gross Beta	5 pCi/l
Plutonium	.05 pCi/l
Americium	.05 pCi/l
Tritium	500 pCi/l

Uranium	5 pCi/l

Please add the following standards that are missing from the "Tables A and B - Statewide" column:

Benzene	5 ug/l
Chloroform	100 ug/l
2,4,6 Trichlorophenol	10 ug/l
Benzidine	50 ug/l
Dieldrin	10 ug/l
Pentachlorophenol	200 ug/l

Please replace the following standards with the detection limits in the "Tables A and B - Statewide" column:

bis (2-Chloroethyl) ether	10 ug/l
Chlorodane	10 ug/l
DDT	10 ug/l
Dieldrin	10 ug/l
Dioxin	3 ug/l
Heptachlor	100 ng/l
Heptachlor Epoxide	100 ng/l
Hexachlorobenzene	10 ug/l
Nitrobenzene	10 ug/l
PCB's	500 ng/l

In addition, the values for Atrazine and Dichlorobenzidine presented in Table 3-1 could not be located in Tables A or B. Please remove them from the table.

A standard of 10 ug/l appears in Table 1 (Human Health), but was omitted from Table 3-1. Please add this value to Table 3-1. In addition, standards are promulgated in Table 1 for Lindane, 2,4-D, and 2,4,5-TP Silvex. Please include these chemicals and their standards in Table 3-1.

A standard of 0.2 ug/l for Endrin, 100 ug/l for Methoxychlor, and 5 ug/l for Toxaphene appear in RCRA subpart F regulations, but were omitted from Table 3-1. Please add these values to Table 3-1. In addition, standards are promulgated in RCRA Subpart F for Lindane, 2,4-D, and 2,4,5-TP Silvex. Please include these chemicals and their standards in Table 3-1.

Standards for Boron and Lithium appear in Table 3 (Agricultural Standards) but have been omitted from Table 3-1. Please include these chemicals and their standards in Table 3-1.

Standards for Diphenylhydrazine 1,2 and Ethylene Dibromide are promulgated in Table A (Carcinogenic Organic Chemicals) but have been omitted from Table 3-1. Please include these chemicals and their standards in Table 3-1.

Standards for Aldicarb, Carbofuran, 2,4-D, Ethylene Glycol, Pentachlorobenzene, 1,2,4,5 Tetrachlorobenzene, and 2,4,5-TP are promulgated in Table B (Non-carcinogenic Organic Chemicals) but have been omitted from Table 3-1. Please include these chemicals and their standards in Table 3-1.

Section 3.2: This section, page 3-2, indicates that ARARs will be derived from federal and state regulations including " Colorado Department of Health (CDH) surface water standards for Woman Creek and Walnut Creek (5 CCR 1002-8, Section 3.8.29, Final Rule Effective March 30, 1990) - applied to surface water". The Division finds that the domestic water supply standards listed in TABLES I, II and III of "The Basic Standards and Methodologies for Surface Water 3.1.0 (5 CCR 1002-8)" must also be listed as potential ARARs. Section 3.8.29 specifically provides that "water supply standards are met at the point of discharge" and the action "will provide an extra layer of protection of downstream water supplies from the two reservoirs, each of which (Great Western and Standley) are already classified as domestic water supplies". For example, a standard for Fecal Coliform has been established for Domestic Water Supply where no such standard applies to warm water biota. Please amend Table 3-3 to include the Domestic Water Supply standards.

The last paragraph of Section 3.8.29 states that "For the organic pollutants contained in Tables A and B, the practical quantitation limits (PQLs) listed as "detection levels" are to be used as the compliance thresholds". The Division finds, in Table 3-3, that the "Standard(s)" rather than the "Detection Levels" were listed as potential ARARs. Please amend the two "Table A & B" columns of Table 3-3.

Section 3.8.29 also states that "For any organic pollutants listed in Table A or B, the Commission intends that these standards be applied in accordance with PQLs determined appropriate by the Colorado Department of Health laboratory". Please determine the applicable PQLs.

Table 3.3: The following chemicals are identified in Tables A, B and C of "The Basic Standards and Methodologies for Surface Water 3.1.0 (5 CCR 1002-8)" but are absent from Table 3-3. Where these intentionally omitted? If so, provide the rationale. If inadvertently omitted, please list.

TABLE A:

1,2 Diphenylhydrazine

TABLE B:

Aldicarb
Carbofuran

Dichlorophenoxyacetic Acid (2,4-D)
Pentachlorobenzene
Tetrachlorobenzene 1,2,4,5
Trichlorophenoxypropionic Acid (2,4,5-TP)

TABLE C:

Benzene
BHC Hexachlorocyclohexane
Chloro-4 Methyl-3 Phenol
Chlorophenol 2
Chlorpyrifos
Demeton
Dichloropropene
Dimethylphenol 2,4
Dinitrotoluene
Diphenylhydrazine 1,2
Guthion
Malathion
Mirex
Parathion
Phenol

The following additional errors and omissions have been found in the standards of Table 3-3. Typically the errors represent unit conversion errors. Some of the errors listed may be moot due to the application of the Section 3.8.29 requirements that "detection levels" be listed as possible ARARs. (See the comments to Section 3.2, second paragraph, above.)

Table 3-3 contains thirteen (13) columns in which numerical standards are identified beginning with the column for Tables A & B. To simplify these comments, errors and omissions will be identified in respect to a column number, page number and the compound. For example, under the Statewide Standards, Table C, Acute column, page 3-24, Chlordane should be 2.4 ug/l not ng/l. The "Acute" column is the number 2 column. The 13th column is for Walnut Creek.

The standards for Fecal Coliform, Ammonia, Sulfur, Boron and Chlorine (not just Chloride) should be listed in columns 10 and 11, page 3-19, as derived from the Stream Segment Table.

A Chloroform standard, Tot THM, is listed in columns 1 and 7, page 3-21. This standard is not listed in either Table A or Table B. Please state where this standard is documented. Please explain the acronym THM in the footnotes to Table 3-3.

Trichlorophenol 2,4,6, 1.2 ug/l, was omitted from column 11 of page 3-21.

The standard for tetrachloroethane, 0.8 ug/l, was omitted from column 11 of page 3-22. Note that 1,1,2,2 Tetrachlorethane, 170 ng/l, was included in column 11 of page 3-21.

The standard for Acrylonitrile, page 3-23, column 11, should be 58 ng/l not 58 mg/l.

To repeat, the standard for Chlordane, column 2, page 3-24 should be 2.4 ug/l not ng/l.

The standard for Hexachlorobutadiene, column 11, page 3-25, should be 0.45 ug/l not 0.45 ng/l.

The standard for Hexachloroethane, column 2, page 3-25 should be 980 ug/l (or .98 mg/l) not 0.98 ug/l.

The standards for Toxaphene, columns 3 and 4, page 3-26, belong in columns 2 and 3 respectively.

Section 4.1.4: The last sentence of this section states "It is important to recognize that additional phases of investigation and risk assessment may be required at some IHSSs." DOE must recognize that further phases are not scheduled in the IAG and that the Final ROD date is set. Failure to meet the ROD delivery date will likely result in stipulated penalties being assessed against DOE.

To the extent practical, the objectives outlined on page 4-3 should be met through implementation of a comprehensive work plan rather than being deferred to later phases (stages). Any unavoidable "staged" investigations should be clearly described in a decision-tree within the context of the IAG schedule.

Table 4-1: Regarding the Data Need "Characterize and Delineate Contaminate Sources" plumes are considered by the Division to be secondary sources resulting from unplanned releases from a unit, improper disposal of a substance, or physical relocation of contaminated material. The investigation must, to the fullest extent possible, determine the initial source or waste management practice that resulted in a plume. Plume development may then be better ascertained.

The reliance on a soil gas survey to identify plumes is of concern. The table suggests that boreholes or wells will be used if plumes are identified (presumably from soil gas). The Division believes that boreholes or wells may be appropriate even if soil gas results are negative. Please clarify this issue; are no wells to be drilled if all soil gas results are negative? The Division will not support this position. We also question reliance on IAG, SOW, Table 5, minimums. The Division will support minimums only when it is apparent that a more comprehensive sampling and analysis effort is unwarranted.

Regarding characterization of radiative materials at the Old Outfall, page 4-7, infilling of the site may render negative results on field screens. Please refer to the comments on Section 7.2.3 and amend this table as needed.

Section 4.2.4: This section clearly demonstrates the lack of understanding of the RFI/RI process. Although Table 5 of the IAG Statement of Work specifies the minimum quantities, the IAG also specifies that RFP "anticipate" investigative needs. Phase I data (there is only one IAG Phase for this OU) evaluation is not a discrete IAG step that focuses a subsequent round of RFI activities requiring approval of the additional steps. It is **in this workplan** that subsequent steps should be defined by a decision tree. In other words, if we (RFP) find "A", we will next do "Y", but if we find "B", we'll next do "Z". It is through this approach that RFP must "anticipate" data needs beyond the minimums specified in Table 5. The Division will not concur with workplan approval until these details are included!

Section 5.3: Regarding the last sentence of the first paragraph of this section, see the comment to Section 4.2.4.

Section 5.3.2: Is it an objective of this work plan to collect, and report, background surface and sediment samples (page 5-3) or are these samples to be incorporated with the ongoing "Background Geochemical Characterization Report"? Please clarify.

Section 5.5.1: In the first paragraph of page 5-5, it is indicated that geologic data will be used to characterize the stratigraphy. Since the proposed drilling of the Old Outfall (section 5.3.3) is limited to collecting soil samples two feet below the original (buried) surface, it is difficult to envision an adequate characterization of the underlying stratigraphy. Please specify how this will be accomplished; if necessary amend the FSP to achieve this objective.

In the third paragraph, it is stated that surface water and sediment sampling will be used to characterize the ponds. Characterization must include groundwater beneath the ponds; however, the few proposed wells appear to be inadequate for this purpose. Please specify how a full and complete characterization will be accomplished or amend the FSP.

Section 5.7: On page 5-12, a discussion of "Detailed Analysis of Remedial Alternatives" is introduced. Although data may be insufficient to determine alternatives, the workplan should be expansive enough to fully characterize the IHSSs. A reoccurring theme appears to be the intent of RFP to defer data collection to later phases. This is not an acceptable management alternative. To the extent resources are responsibly used, the design and implementation of this work plan should reflect full IHSS characterizations as soon as possible to expedite corrective

action.

Section 7.1.3: Please explain the basis for modification of IAG sampling and analytical activities listed on pages 7-3 through 7-6. If a result of an EPA and DOE scoping meeting held March 15, 1991, please state. Also explain how reducing grid sizes, i. e. collecting fewer data, will lead to a better evaluation of the IHSSs (See paragraph 1, page 7-3).

The Division understands that grid patterns were discussed and reductions considered in the March 15, 1991 meeting. The IAG SOW and the work plans are not specific on the type of grid to be used. Reductions in both block-centered and mesh-centered grids result in greater reductions in the number of samples or sites than may be anticipated. For example, under theoretical conditions, changing a block-centered grid from 50-foot to 100-foot results in a 75% sample reduction. Changing a mesh-centered grid from 50-foot to 100-foot depends on the size of the area being investigated, but range from a 55% sample decrease for a 100' x 100' area versus a 70% decrease for a 500'x 500' area. Regardless of the grid type used, significant losses in sample coverage may result. The Division understands that 30-50% grid reductions were proposed at the March 15, 1991 meeting. Does this equate to reductions in the number of samples/sites or to the grid spacing? This issue and the proposed impacts must be clarified.

The following comment is relative to Item 10, page 7-5, and the proposed 150-foot grid for surface and subsurface sampling. The IAG requires a 50-foot grid for sampling and a 25-foot grid for radiation screening. Is it the intent of RFP to maintain the 25-foot grid for screening or use a 150-foot grid for both screening and sampling? (See the comments to Section 7.2.4, below.)

Section 7.2: The screening and sampling requirements, including any proposed modifications, should be included and discussed in the appropriate Investigation Program subsections. The sampling rationale, particularly for proposed modifications, should be documented. How the Investigation Program will achieve all of the objectives listed in Section 7.1.1, in a timely manner, should be discussed.

Section 7.2.1: Will the radiation survey, Step 1, page 7-6, be conducted on the same 25-foot grid shown on Figure 7-1 as "Proposed Surface Sampling Locations"? If so, please reference Figure 7-1 and amend the legend to specify that the radiation survey and the sampling will occur at the same site.

Relative to Step 3, a proposed well is shown on Figure 7-1 in contradiction to the narrative which states that it will be located after the completion of Step 2. If the well location is an initial site pending the completion of Step 2 activities, please specify or remove the well spot from Figure 7-1.

Regarding "Step 3 - Monitoring Wells" on page 7-6, the Division believes that the groundwater monitoring wells should be sampled for longer than one year.

Section 7.2.2: Relative to Step 1, page 7-8, it is appropriate that the surface water monitoring report be submitted with the workplan. The Division wishes to review the document in conjunction with its review of the workplan. Please submit along with the revised workplan.

Relative to the collection of sediment samples, paragraph 3, page 7-11, the IAG calls for analysis of HSL volatiles and semi-volatiles etc. How does this FSP address these requirements?

Relative to the list of sediment samples (page 7-11), Building 118 is not depicted on Figure 7-4. Please show the building's location.

Also relative to the list, until the point(s) of discharge into North Walnut Creek are disclosed it is impossible to determine the adequacy of the sediment sampling sites. (See Section 2.2.2).

Regarding "Step 3 - Monitoring Wells" on page 7-16, the Division believes that the groundwater monitoring wells should be sampled for longer than one year.

Figure 7-4: The figure shows two proposed sediment sampling sites on a branch of the unnamed tributary to North Walnut Creek adjacent to OU-7. Please specify their inclusion on this map and there purpose. Also justify why additional sites, under the requirements of the new sitewide SOPs, are not proposed on the downstream length of the unnamed tributary. (There are no guarantees that older data are reliable unless they have been validated.)

Section 7.2.3: Table 5 in the IAG Statement of Work specifies that a radiation and soil sampling survey be performed at the Old Outfall. The IAG does not reflect the fact that fill dirt, up to 10 feet thick, has been placed at the site. Consequently, it is the Division's recommendation that the radiation survey (Step 1) and the "surface" soil samples (of Step 2) be restricted to only those areas of the IHSS, if any, where fill has not been placed. If fill areas cannot be readily delineated, it will be necessary to extend surface screening and sampling activities into known "fill" areas. (The soil borings proposed in the last paragraph of Step 2 should be adequate for this workplan activity.)

The Division is also concerned about releases from the Old Outfall into North Walnut Creek during the active phase of the IHSS. The sediment sampling sites proposed for North Walnut Creek should provide initial information on plutonium releases from the unit. Pending these results, the culvert that connects the Old Outfall to the creek may require investigation to determine if leakage has

contaminated the groundwater beneath the culvert.

Section 7.2.4: This section, page 7-18, fails to provide for a radiation survey. The IAG, Statement of Work, Table 5 (page 50 of 56) specifically states that a radiation survey be conducted on a 25-foot grid for IHSS 156.2. The work plan (see Table 7-4) does not provide for a radiation survey on any grid spacing. Although the Division recognizes that the soil in this area has been moved twice and any original surface contamination may have become mixed and/or covered, radiation screening on a narrow grid may detect radiation. A grid of 150', as proposed for surface samples and borings, would be less likely to detect radiation given the history of the IHSS. The 25-foot grid specified in the IAG should be adopted unless the adequacy of a wider grid can be verified.

Although specified in IAG, SOW, Table 5, the collection of surface scrapings of undisturbed soil (it has been disturbed twice) and borings into undisturbed soil beneath the soil piles is inadequate. The mixing and burying of contaminated soil necessitates that the soil piles themselves be sampled and analyzed. Failure to fully investigate the piles would result in an inadequate characterization of extent and nature of contamination.

The modification of grid size from 50 to 150-foot is of concern. Figure 7-1 shows 14 "Proposed Boring and Surface Sampling Locations" (Note that Table 7-4 states there will be 12 sites). In respect to a mesh-centered grid, this means approximately 84% fewer sample points. By comparison, a 75-foot grid would be approximately 49% fewer sample points than that provided by the original 50-foot grid. The Division believes that a 84% reduction in sample points is too great. The Division recommends that reductions be limited to the 30-50% range.

Regarding "Step 3 - Monitoring Wells" on page 7-21, the Division believes that the groundwater monitoring wells should be sampled for longer than one year.

Section 7.2.5: Regarding Step 2, page 7-21, the Division is of the understanding that the PSZ was not present when the Triangle Area was operational. Since the fence area is potentially contaminated, special security provisions should be made to allow cleared entry into the area and to conduct full radiation and soil gas surveys. Soil cores (Step 3) should also be collected within the fence area.

The modification of the grid size from 50 to 100-foot is noted. Since drums were stored at the site, the potential exists for single drum releases that may not be detectable even with a tighter grid. Rather than suggest a tighter pattern, the Division recommends that darkened or discolored soils, even in areas where soils have been removed, be surveyed as an added approach to complement a 100-foot grid. Air photos and other remote sensing techniques should be considered in searching for such soils.

Regarding Step 3, page 7-23, only two soil cores would be taken with the proposed 100-foot grid; this is not adequate. Since the 1 in 25 soil-core to soil-gas sample ratio is based on a 50-foot grid, the relative coverage afforded by the tighter grid should be maintained.

Regarding "Step 4 - Monitoring Wells" on page 7-28, the Division believes that the groundwater monitoring wells should be sampled for longer than one year.

Section 7.2.7: Step 2, page 7-28, provides for two stream sediment samples relative to the North Area Spray Field (Figure 7-4). An additional sediment sample is needed downstream of the South Area Spray Field to complement site SED-06 and to determine potential contamination upstream, closer to, the south spray field. The Division believes that the sample sites should be placed close to the point where the streams would initially receive contaminates. Consequently, the proposed sample point nearest the North Area Spray Field should be moved up stream near surface water sampling station SW-96. The complement to SED-06, likewise, should be placed close to the runoff point from the surface into the stream.

Since the proposed sample sites are specific to the FSP for the spray fields and not North Walnut Creek, they should be shown on Figure 7-6, not Figure 7-4. If necessary extend the map coverage of Figure 7-6 to the east to allow their inclusion. (Please see the comment to Figure 7-4.)

Regarding "Step 3 - Monitoring Wells" on page 7-30, the Division believes that the groundwater monitoring wells should be sampled for longer than one year.

Section 7.2.8: The modification of grid size from 50 to 200-foot, Step 2, page 7-30, is noted. Since area spraying was conducted at the site a less stringent grid pattern is reasonable; however, Figure 7-3 indicates that this will result in only six sites. The Division recommends a 100-foot grid as an initial investigative approach to provide for additional sites.

Section 7.3.1: Regarding sample designations on page 7-30, how will non-sampled sites, i.e. grided radiation survey stations, be designated for future reference? Will radiation stations of the grids be surveyed prior to or following the investigation?

Section 8.0: The following comments on the Baseline Health Risk Assessment Plan are applicable to both the OU-5 and OU-6 workplans sections. (The Division's comments to the OU-5 workplan refer to the following comments.)

There appear to be inconsistencies in the use of terminology with regard to "chemicals of concern" versus "contaminants of concern". As chemicals are only a subset of "contaminants of concern " (i. e.

metals or radionuclides) this latter phrase is more appropriate (See reworded section, attached)

For consistency and clarity, the Division suggests that the tasks of the Baseline Health Risk Assessment be identified numerically, comparable to Section 9.0.

The "Background Geochemical Characterization Report" referenced on page 8-2, the Division believes, ignored the potential for wind dispersal of contaminants to the west of the plant. Some of the data from ground surface samples may, therefore, represent contamination. Until this issue is resolved the subject report should not be relied on as background data.

Section 8.1: In the first sentence of the second paragraph of this section, please remove the phrase "... confirm the presence or absence of contamination at OU6 and ..." The Baseline Risk Assessment does not confirm contamination. It assesses the risk of contamination that has already been confirmed.

Section 8.2: The IAG, in Section VII.D.1.a states that when selecting indicator chemicals, "DOE shall also consider the additive or synergistic effect of risks, to the extent possible." Known synergistic effects should be considered in selecting the final list of contaminants of concern. Please add to the second bulleted item as shown on the reworded section (attached).

Section 8.3: Several items need to be added to either Section 8.3.1 or Section 8.3.2 based on Section VII.D.1.b of the IAG and should be included as part of any exposure assessment discussion. The items are: an estimate of the current number of people at the exposure point, a characterization of the sensitive and exposed populations, a consideration of present and future use, and a consideration of current and maximum reasonable use scenarios.

Section 8.3.2: The second sentence in the first paragraph of this section seems to contradict text on the previous page. One of the bullets on the previous page states that one of the criteria for choosing chemicals of concern is their concentrations relative to background levels. However, this sentence in Section 8.3.2 says that only sites where the chemicals of concern are significantly above background levels will be considered sources of chemical release. Please clarify this apparent contradiction.

Section 9.0: A revised Environmental Evaluation section indicated by EG&G to be forthcoming at the time of Workplan delivery (April 6, 1991) was not received in a timely manner. The Division understands that the EEs for OU-5 and OU-6 will be highly comparable; therefore, the following comments developed from the OU-5 EE should be addressed. The Division will respond to the revised OU-6 EE section, at a later date, if site specific concerns warrant a separate response.

General Comments to the Revised EE of OU-5 (June, 1991):

1) The process of selecting a sampling plan for any site needs to take all questions and data needs into consideration. In selecting the aquatic sampling locations, physical, chemical (radionuclides included), and biological data needs should be considered concurrently.

2) The sampling stations selected and the data to be generated for OU 5 need to be evaluated further. Basic transport considerations would dictate some reconsideration or modifications as to where chemical and flow rate measurements can be located for better tracking of surface and sub-surface loads. The development of conceptual and more definitive models of the system as well as the identification of causal relationships depend on the ability to relate the data over time and space. Therefore, as was indicated in the June 25, 1991 meeting on Environmental Evaluations at RFP, Jeb Love of the Rocky Flats Program Unit will present the State's preferred approach, applying it to the Woman Creek basin at the next EE meeting. He will also give examples of interpretations and potential uses of the information in the decision making process.

3) A fundamental issue when examining data is the uncertainties in the data and the interpretations along the way. The methodology for quantifying the uncertainties in the EE should be included in the Workplan. This effort should be integrated with the selection of the models to be used. The methodology for quantifying the uncertainties is not presently in the final version of this EE.

4) An Approach for Selecting and Using Indicator Species to Monitor Ecological Effects Resulting From Chemical Changes in Soil and Water, by Reagan, D.P. and C.L. is cited as the framework for examining the food web and other exercises that will be carried out during the implementation of this workplan. Please provide the State (specifically Jeb Love) a copy of this reference for our information and review.

5) The workplan should ~~state~~ DOE will be building a reference collection of benthic organisms as part of the EE work.

6) Part of an EE is a Use Attainment Assessment (UAA) of the aquatic uses in Woman Creek. The methodology for this assessment should be spelled out in an SOP (see CDH comments to the Ecology SOP's). The intent is to determine the limitations in the use and the factors contributing to the limitations. The factors can be tonics, flow, nutrients, etc.

7) Any aquatic station where biology and chemistry data are collected need to include flow measurements. Without flow measurement, evaluation of habitat suitability and loading to the system can not be determined. This is particularly critical for habitat and fate and transport assessments.

Section 9.1.2.1: Screening data against the EPA National Ambient Criteria Documents should be done for organics, inorganics, radionuclides, as well as heavy metals. Please revise this discussion in the text to indicate that this important task will be done for all of these classes of compounds.

Section 9.1.2.2: The screening process for selection of COC's should be done before the conclusions on page 13 and 60 (radionuclide examination of tissue) are drawn. Conclusions should be drawn from the data when presented. Until the review of existing data is complete, with attendant agreement on the conclusions and gaps in the information, conclusions are inappropriate.

Plutonium and Americium have such a significance to this site, obtaining body burden data in selected organisms is paramount.

Section 9.2.1.3: Regarding item 2, page 9-25, how will reference areas be determined, or proven, to be unaffected by windblown radionuclides or chemical contaminants? Upstream areas have potentially been affected by diurnal winds at RFP.

Section 9.2.3.5: Regarding the last paragraph, page 9-32, a SOP must be referenced, or established, for the collection of "flora from a measured area".

Figure 9-4: Specific dates are needed in line with the approval of Ecology SOPs.

Figure 9-6: In the revised EE submitted to the Division on June 7, 1991, please make sure that Figure 9-6 includes all of the sampling locations for aquatic biota that are included in OU 1, OU 2, and OU 5. The Division suggests that the sampling locations be color coded to match their association with the different OU's. A comparison of the equivalent figures in the revised EE's for OU 1 and OU 2 showed that some of the sampling locations are duplicated and some of the locations overlap areas that are being covered in another OU. By presenting all of the sampling locations in different colors on all of the maps, confusion by reviewers and readers can be substantially reduced. In addition, it would give the reviewers more confidence that a comprehensive, but not duplicating, sampling plan is proposed for the entire Woman Creek drainage which includes portions of OU 1, OU 2, and OU 5.

Review and Comment

Quality Assurance Addendum (QAA 5.1)
Woman Creek Priority Drainage - OU 5 RFI/RI
March, 1991

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Specific Comments:

Introduction and Scope: The date of the workplan referred to is April not February, 1991

REWORDED

8.0
BASELINE HEALTH RISK ASSESSMENT PLAN

8.1 OVERVIEW

A baseline health risk assessment will be prepared for Operable Unit Number 6 (OU6) as part of the Phase I RCRA Facility Investigation (RFI)/Remedial Investigation (RI) report. Both a human health evaluation and an environmental evaluation will be performed. This section describes the human health risk assessment. The environmental risk assessment is described in Section 9.0 of this work plan.

The purpose of the Phase I baseline risk assessment is to confirm the presence or absence of contamination at OU6 and provide an estimate of potential health risks that may result from releases of hazardous substances from OU6 in the absence of any remedial action. Risks will be calculated for both on-site and off-site exposures to ~~chemicals~~ CONTAMINANTS released and/or transported from the Individual Hazardous Substance Sites (IHSSs) using available data as well as data collected during the Phase I investigation of the unit.

The purpose of the baseline risk assessment is to provide information useful in determining the following, as described in the National Contingency Plan:

- A determination of whether the contaminants of concern identified at the site pose a current or potential risk to human health in the absence of any remedial action
- A determination of whether remedial action is necessary at IHSSs within the unit, and an identification of the exposure pathways needing remediation
- A justification for performing remedial actions

This assessment will follow the guidance provided by the Environmental Protection Agency (EPA). It will also make use of additional information and methods that will facilitate interpretation of the results of the risk assessment. EPA publications that will be consulted when performing the health risk assessment include the following:

- Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). Interim Final. 1989. EPA/540/1-89/002.
- Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA. Interim Final. 1988.
- Superfund Exposure Assessment Manual. 1988. EPA/540/1-88/001.

- Exposure Factors Handbook. 1989. EPA/600/8-89/043.
- Guidance for Data Useability in Risk Assessment. Interim Final. 1990. EPA/540/G-90/008.

These documents constitute the most recent and appropriate EPA guidance on public health risk assessment. It must be emphasized that EPA manuals are guidelines only and that EPA states that considerable professional judgment must be used in their application. This risk assessment will focus on producing a realistic analysis of exposure and health risk.

The risk assessment will be accomplished in five general steps: identification of chemicals of concern, exposure assessment, toxicity assessment, uncertainty analysis, and risk characterization.

A separate risk assessment will be performed on each IHSS to the extent appropriate for the IHSS. Due to the separated locations, varied historical practices, and different contamination profiles, the IHSS should receive individualized treatment. This IHSS-specific analysis will allow the identification of the most important contributors to the risk from the operable unit, and it will permit sufficient attention to be paid to contaminants that may be important at one IHSS but not at another. IHSSs that do not contribute significant risks can then be identified so that efforts may be aimed at further analysis of the significant sources of risk.

8.2 IDENTIFICATION OF ~~CHEMICALS~~ CONTAMINANTS OF CONCERN

~~Chemicals~~ Contaminants of concern ~~are a subset of all the~~ includes chemicals ~~or~~ and other constituents, such as metals or radionuclides, that are identified at the unit. They are the ~~chemicals~~ contaminants that are evaluated in the baseline risk assessment. A two-step process will be used to identify ~~chemicals~~ contaminants of concern. First, an initial list of ~~chemicals~~ contaminants of potential concern are selected on the basis of the following criteria:

- They are identified in one or more samples at the IHSS.
- They are related to activities at the IHSS; they are potentially released from an identified source in the IHSS.
- They are recognized or suspected toxicants or carcinogens.
- They are present in significant concentrations (above background).

~~Chemicals~~ Contaminants of potential concern will be selected following evaluation of available historical and background sampling results and the results of the Phase I field sampling proposed for OU6. Existing background data will be used to help identify ~~chemicals~~ contaminants that are background constituents in the environment and that are therefore not IHSS-related. Background information is expected to be available from ongoing studies including the "Background Geochemical Characterization Report, Rocky Flats Plant." (EG&G 1990b).

Available historical data on chemical and radionuclide concentrations in groundwater, surface water, sediments, soils and air near OU6 will be used in conjunction with the results of the Phase I field sampling program to identify IHSS-related chemicals of concern.

Existing analytical results taken from other sources will be accepted as suitable for risk assessment purposes. The sampling and analytical program for the Phase I investigation of OU6 is described in Section 7.0 of this Work Plan. The sampling program is designed to adequately address all potential exposure pathways (groundwater, surface water, sediments, and soils) to the extent that they can be anticipated. Samples and analytical results obtained as part of the Phase I investigation will be collected and validated according to the Quality Assurance (QA)/Quality Control (QC) procedures described in that section. Only data validated as suitable for risk assessment purposes will be used in the risk assessment.

Tentatively Identified Compounds (TICs) will be evaluated to determine if they should be included in the risk assessment. If there are few of them in comparison to the Target Analyte List (TAL), they are normally omitted in accordance with EPA guidance.

The second step in the identification process will be followed if the number of chemicals of potential concern is high. In that case, the list may be further reduced to focus on the chemicals that pose the greatest risks at the site. Carrying a large number of chemicals through a quantitative risk assessment can be unwieldy, time-consuming, and may obscure the dominant risks at the site. The rationale for selecting a final list of chemicals of concern will be presented in the text and will be based on the following criteria:

- historical information
- concentration and toxicity, KNOWN SYNERGESTIC EFFECTS
- mobility, persistence, and bioaccumulation
- special exposure routes
- treatability
- Applicable or Relevant and Appropriate Requirements (ARARs)
- chemical class
- frequency of detection (hits/sample)
- evaluation of essential nutrients
- concentration relative to background levels (natural or anthropogenic)
- potential for being a laboratory contaminant.

The results of data collection and evaluation and selection of chemicals of concern will be summarized in the text and appropriate tables.

8.3 EXPOSURE ASSESSMENT

The objective of the exposure assessment is to identify human populations (receptors) that might be exposed to chemical releases from the IHSSs and to estimate the temporal variation and magnitude of their exposure. The exposure assessment involves identifying potential receptors, identifying all potential pathways of exposure, estimating exposure point concentrations of chemicals of concern based on monitoring data and modeling results, and estimating the intake of each chemical for each pathway. The results of the exposure assessment are pathway-specific chemical intakes, expressed as mg chemical/kg body weight/day, by potentially exposed receptor populations. Exposure to radioisotopes will be expressed as activity of intake for internal exposure or as activity in environmental media for external exposure.

Conceptual models of the IHSSs will be formulated and refined based on data collected to integrate the components of the exposure assessment and clarify the pathways to be considered.

8.3.1 Potential Receptors

The exposure scenarios that will be developed in the baseline risk assessment may include exposure of potential future receptors to contaminated media within the OU6 as well as exposure of off-site receptors to potentially contaminated groundwater, surface water, and airborne soil particulates. The exact exposure scenarios to be considered will be selected according to policy decisions regarding future use (e.g., residential, recreational, restricted access) of the site that may be made prior to the completion of the risk assessment.

8.3.2 Exposure Pathways

Identification of exposure pathways involves linking the source of chemical release, an environmental transport mechanism, a point of human exposure, and a mechanism of human uptake. Sources of chemical release will be sites within OU6 that contain ~~chemicals~~ contaminants of concern significantly above background levels. Mechanisms of release can include leaching of chemicals from soils into groundwater or surface runoff, airborne transport of contaminated soil particulates, volatilization of organic compounds, or release of radioactive particles. Points of human exposure will be identified during the site characterization. These may include sites within the operating unit as well as off-site locations where contaminants may be transported. Examples of mechanisms of human uptake are dermal contact with contaminated media, inhalation of volatile organics or particulates, and ingestion of soils or water.

Only complete exposure pathways will be evaluated in the risk assessment. If any one of the elements of an exposure pathway (chemical source and release, environmental transport mechanism, exposure

point, or uptake) is missing, the exposure pathway is considered incomplete and will not be addressed in the assessment.

8.3.3 Exposure Point Concentrations

Exposure point concentrations of ~~chemicals~~ CONTAMINANTS of concern will be estimated using analytical results of the sample program described elsewhere in this work plan and available relevant historical data. Release and transport of chemicals in environmental media may be modeled using basic analytical models recommended by EPA or the best model available, as determined by a model performance evaluation. The models will be calibrated to improve performance using site-specific parameters when possible.

Model outputs will be characterized by estimating variance through an uncertainty analysis to the extent required by the overall risk uncertainty analysis. Effort will be made to reduce the variance of model output: the optimal target for model variance is that it be similar to other sources of variability in the risk assessment, including exposure factors and toxicity values.

Concentrations will also be estimated for "average" and "reasonable maximum" exposure conditions at a minimum. When feasible, a goodness-of-fit analysis will be conducted to correctly identify the distribution of the data and the most appropriate measure of central tendency. The reasonable maximum concentration will be the upper 95 percent confidence limit on the appropriate mean or maximum likelihood estimate. In calculating the media concentrations, censored data (data sets with missing values, nondetects, etc.) will be treated by appropriate methods such as those described in Gilbert, 1987 (Statistical methods for environmental pollution monitoring, Van Nostrand Reinhold).

8.3.4 Estimation of Intake

Human intakes of ~~chemicals~~ CONTAMINANTS of concern will be estimated using reasonable estimates of exposure parameters. EPA guidance, site-specific factors, and professional judgment will be applied in establishing exposure assumptions. Using reasonable values permits estimating risks associated with the assumed exposure conditions that do not underestimate actual risk. The estimate of intake is the "intake factor," which may then be mathematically combined with the exposure point concentrations and the critical toxicity values to determine cancer risks and hazard indices.

8.4 TOXICITY ASSESSMENT

The toxicity assessment is conducted to characterize the evidence regarding the potential for a ~~chemical~~ CONTAMINANTS of concern to cause adverse effects in exposed populations and, where possible, to estimate the

relationship between the extent of exposure and the extent of adverse effects (i.e., dose-response relationship). The toxicity assessment evaluates:

- The evidence for toxic effects of the chemical
- The nature of the dose-response relationship
- The level of uncertainty in the dose-response relationship
- The primary target organs or mechanism of action for each compound of concern
- The applicability of the toxicologic data to the identified exposure scenarios

Sources of toxicity factors (cancer slope factors and reference doses) used in assessing health risks due to exposure to organic compounds, metals, and radionuclides include EPA's Integrated Risk Information System (IRIS) and the most current volume of EPA's Health Effects Assessment Summary Tables. Other sources in the public domain, such as the National Research Council's reports on the Biological Effects of Ionizing Radiation, reports IV and V, and EPA's Background Information Document, Draft E/S for Proposed National Emission Standards for Hazardous Air Pollutants (NESHAPS) for Radionuclides, will be consulted as appropriate. New toxicity data and analyses of the health risks of contaminants of concern will be considered as they become available in the literature. No new experimental toxicological data will be developed.

The toxicity assessment will include a discussion of the uncertainties inherent in the development and application of toxicity factors. The text will include a discussion of the EPA weight-of-evidence classification for carcinogens, the conservatism inherent in applying upper 95th percentile cancer slope factors, the uncertainty factors used in deriving reference doses, and other uncertainties involved in predicting human responses.

In addition, those ~~chemicals~~ CONTAMINANTS that present the greatest risk at the site will receive additional toxicological analysis to more fully describe the potential range of appropriate critical toxicity values based on such considerations as mechanism of carcinogenesis, the validity of toxicity endpoints used to derive the reference dose (RfD), or pharmakokinetic information that may provide insight on extrapolation from one species to another.

8.5 QUALITATIVE AND QUANTITATIVE UNCERTAINTY ANALYSIS

Presentation of uncertainties and limitations of the risk analysis is an integral part of the risk assessment process. Usually, uncertainty is discussed after the risk characterization has been completed. However, in this risk assessment, the uncertainty analysis will provide substantial input into the risk characterization process.

Uncertainties exist primarily in the estimation and modeling of exposure point concentrations, the estimation of human exposures, and the use of toxicology data based on animal studies. These uncertainties will be described qualitatively to provide an understanding of the issues. In addition, a detailed quantitative analysis of the uncertainty will be presented to the extent practicable.

Several methods are available for quantitative analysis. The uncertainty analyses will be performed to quantify, to the extent practicable, the sources and magnitude of uncertainty in the baseline risk assessment. Quantitative techniques may include: sensitivity analysis, first-order analysis, or numerical methods such as stratified Monte Carlo sampling. The outputs will be described and interpreted in the text. This will inform the risk manager of the sufficiency of the baseline risk assessment given the level of site characterization at the conclusion of Phase I, the degree of confidence that is appropriate for the risk estimates, and a basis for further remedial activities at the site.

8.6 RISK CHARACTERIZATION

Risk characterization integrates the toxicity factors for the ~~chemicals~~ CONTAMINANTS of concern with the estimated chemical intakes and radiation exposures under the assumed exposure conditions to yield screening-level carcinogenic and noncarcinogenic health risks. The IHSS conceptual model will be consulted again at this point to determine realistic combinations of exposure pathways as well as maximum likelihood/reasonable maximum estimates for those pathways. Risks to receptors associated with different chemicals and exposure routes will be summed across exposure pathways that are likely to occur simultaneously in order to estimate total noncarcinogenic and carcinogenic risk from chemicals and radioisotopes. When toxicants with known mechanism of action or target organ specificity in humans can be identified, their hazards will be segregated and considered separately.

The results of the risk characterization, both average, reasonable maximum, and reasonable minimum exposure conditions as determined by the uncertainty analysis will be summarized in tables and discussed in the text. The risk characterization will therefore be an unbiased estimate of risks upon which risk management decisions may be based. Populations that may be affected by the real or potential risks will be identified to the extent that is possible. These results will be discussed in the context of the output from the uncertainty analysis described above. This information will allow the risk manager to make a more informed decision on a final deterministic cleanup value.