Department of Energy
Oak Ridge Operations
Paducah Site Office
P.O. Box 1410
Paducah, KY 42001

May 5, 1999

Mr. Carl R. Froede Jr., P. G.
United States Environmental Protection Agency
Region IV
DOE Remedial Section
Federal Facilities Branch
Waste Management Division
61 Forsyth Street
Atlanta, Georgia 30303

Mr. Michael V. Welch, P.E.
Manager
Hazardous Waste Branch
Kentucky Department for Environmental Protection
14 Reilly Road, Frankfort Office Park
Frankfort, Kentucky 40601

Dear Mr. Froede and Mr. Welch:

WASTE AREA GROUPING 6 (C-400 AREA) REMEDIAL INVESTIGATION REPORT (DOE/OR/07-1727&D2), PADUCAH GASEOUS DIFFUSION PLANT, PADUCAH, KENTUCKY

Enclosed for your approval is the subject document along with the Comment Response Summary for comments received on the D1 version of the Waste Area Grouping (WAG) 6 Remedial Investigation (RI) Report. As you are aware, once this document is approved, the WAG 6 RI will be incorporated into the Groundwater Operable Unit (GWOU) Feasibility Study (FS), which is due for submittal June 18, 2000. In addition to incorporation into the GWOU FS, the WAG 6 data will also be incorporated into the other operable units as appropriate. Consistent with the Federal Facilities Agreement, we request that you provide notification of your approval of the WAG 6 D2 RI Report by June 10, 1999. If you have any questions or require additional information, please call David W. Dollins at (502) 441-6819.

Sincerely,

Jimmie C. Hodges

Jimmie C. Hodges, Site Manager
Paducah Site Office

Enclosure

cc w/enclosure:
S. Hampson, KDEP/Frankfort
G. T. Mullins, KDEP/Frankfort
T. M. Taylor, KDEP/Frankfort
J. A. Volpe, KDEP/Frankfort

COMMENT RESPONSE SUMMARY

for Review Comments from
The United States Environmental Protection Agency
and the
Commonwealth of Kentucky Department of Environmental Protection

for the
August 1998

Remedial Investigation Report for Waste Area Grouping 6 at the Paducah Gaseous Diffusion Plant Paducah, Kentucky DOE/OR/07-1727&D1

Prepared by
CH2M HILL, Inc.
Paducah, Kentucky
under General Order 18B-99345C

for the
U.S. Department of Energy
Office of Environmental Management

Environmental Management Activities at the
PADUCAH GASEOUS DIFFUSION PLANT
Paducah, Kentucky 42002
managed by
BECHTEL JACOBS COMPANY LLC
for the
U.S. DEPARTMENT OF ENERGY
Under contract DE-AC05-98OR22700

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Comment No.	Section/Page/Para.	State Comment	Response
1	General	Given the amount of TCE present in UCRS soil at SWMU 11, it is likely that DNAPL exists beneath the southeast corner of the C-400 Building. DNAPL may also be present beneath the southwest corner of the building. Samples collected from borings 400-015 and 400-142 would tend to support this assumption. It will be necessary to further characterize these two areas in order to support a full evaluation of remedial alternatives. Further characterization could be undertaken as a part of the Treatability Study for WAG 6. A discussion of additional characterization as a part of the Feasibility Study should be included in the D2 WAG 6 RI Report.	We agree that a considerable amount of TCE exists both at the southeast and southwest corners of the C-400 Building. However, the DOE and project team are comfortable that sufficient data exist to put bounds and develop sensitivities on the areas and volumes of material that would require treatment in a remedial action situation. To that end, we propose to do no further characterization at this time. We do, however, suggest that we should look at the implementation of remedial design borings during the design phase following the Record of Decision to assist in isolating the area to be treated and thus conserve resources for treatment.

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2	General	Waste Area Grouping 6 represents a source of contamination that is contributing to risks above 1 x 10^{-6} to current industrial workers on-site, as well as current off-site receptors. The modeling used by DOE (MEPAS) does not indicate that future concentrations of radionuclides migrating within the TCE plume will be above a level of concern for several hundred years. Technetium-99 was not modeled as it is currently present in off-site groundwater above a level of concern. We have serious reservations about the tendency to rely on modeled predictions which assume that the fate and transport of each contaminant present is independent of the presence of other chemicals in the soil and aquifer.	Comment noted. Please see responses to specific comments for additional discussion about modeling concerns. DOE recognizes that MEPAS modeling results are screening level. In addition please recognize that DOE did not prepare the model in order to declare that monitoring was not needed at WAG 6 or in the groundwater plumes. Furthermore, the modeling was not intended to show that contaminants were not migrating from source areas at WAG 6. In fact, existing offsite monitoring shows that TCE and Tc-99 are migrating from the site in concentrations of concern. Currently, since modeling and monitoring are the only means available for determining what is leaving or may leave the site, we must model. The DOE recognizes that migration characteristics of a contaminant may be impacted by a co-contaminant(s) present in the source area. However, modeling to integrate all possible contaminant combinations is very expensive, and would provide results that are very uncertain. Therefore, DOE believes that such modeling would be of little benefit in this RI Report.

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Comment No.	Section/Page/Para.	State Comment	Response
3	General	Include a table that contains the ground surface or floor surface elevations for all sampling locations.	Agreed. Appendix F in Volume 2 of this report presents the surveyed elevations for all WAG 6 sampling locations.
4	General	Include a figure that depicts the location of all buried utility lines and building drains, past and present.	Agreed. A figure depicting the location of all buried utility lines and building drainage systems in the vicinity of WAG 6 has been compiled from available data and added to Section 3 of Volume 1.
5	General	For completeness it is suggested that this chapter include a table listing the metals and radioisotope PRGs similar to Tables 4.1 and 4.2 which list the metals background values and radioactive-isotope background values respectively.	Agreed. A new table (Table 4.2) presenting the PRGs for selected metals and radioisotopes has been added to Section 4.

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Comment No.	Section/Page/Para.	State Comment	Response
6	General	The lack of documentation of the source of Technetium-99 leaves unresolved a significant issue that may be necessary for remediation.	Agreed. The DOE concurs that additional characterization is needed of the Tc-99 source area. The DOE has identified the North-South Diversion Ditch to be a source of the Tc-99 contamination. The limited sampling results that are available from the Phase II Investigation provide information supporting the N-S Ditch being the source. We further believe that additional characterization is needed to identify it as the source and to identify the additional contaminants that may be present and which must be handled as part of a remedial action. To that end, we are evaluating and reprioritizing the resources available to us this fiscal year to determine whether we can perform a limited number of borings this calendar year. After prioritization, if the resources are not available, we commit to attempting to obtain additional resources to perform these additional borings. With the inclusion of the limited number of borings discussed above, an additional drilling program may be needed as part of the remedial design to focus resources based on the remedial technology chosen for implementation. This information will be incorporated into the Groundwater Operable Unit Feasibility Study.

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Comment No.	Section/Page/Para.	State Comment	Response
1	Section 2.3; Page 2-2; 2nd para	Using radioactivity meters to scan for twice background can be problematic when working in close proximity to the cylinder yards. A new method has recently been employed at the PGDP in which soil samples are encased in lead prior to performing gamma scans.	Comment noted. The new sampling procedure using a sodium iodide detector and lead-shielded samples was employed during the WAG 27 RI fieldwork (Spring 1998).
2	Section 2.4; Page 2-4; 2nd para	This paragraph indicates that 12 groundwater samples were collected from piezometers for volatile organic analysis. Please indicate whether these piezometers were of PVC or stainless steel construction. PVC wells might adversely affect VOC results.	All piezometers were constructed using schedule 40 PVC. Construction details are contained in Section 2.5, Piezometer and Monitoring Well Installation, and Sampling. The piezometers were not originally planned to be sampled for groundwater. However, to collect additional groundwater data, a field decision was made near the end of the project to collect a round of UCRS water samples from the piezometers. The potential effect on the VOC content of the groundwater collected from monitoring wells constructed of PVC is minimal and will not affect risk management.
3	Section 2.8.5.3; Page 2-17	Lines 3 through 5 state that sample results "...judged to be significantly impacted were assigned an assessment flag." Please clarify what is meant by "significantly impacted."	Any VOA sample in which the holding time exceeded fourteen days was considered "significantly impacted" and assigned a BL-T data assessment flag. This clarification has been added to the text in Section 2.8.5.3.

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Comment No.	Section/Page/Para.	State Comment	Response
4	Section 4.1.1; Page 4-2	Lines 2 through 5 state that certain known laboratory contaminants were "...determined to represent laboratory contamination and not site contamination." Please explain how these compounds were eliminated from further consideration as possible site contaminants. Was their elimination based upon a comparison of blank and sample results or were they simply eliminated because there are known lab contaminants?	Laboratory contaminants were identified using protocol set forth in the U.S. EPA's National Functional Guidelines for Organic Compounds. This protocol is based on a comparison of field or method blanks to environmental results. Compounds identified as laboratory contaminants were assigned an "In-Lab" assessment qualifier in the database and were removed from consideration in Section 4, Nature and Extent of Contamination. A statement will be added to the text in Section 2.8.5.3, Final Review, that clarifies this process.
5	Section 4.2.8.2; Page 4-26	Lines 15 and 16 state that the majority of subsurface samples collected from beneath the SWMU 26 pipeline were collected from no deeper than 15-feet bgs. However, lines 21-22 on the previous page state that subsurface samples were collected from a depth of 48.5-feet bgs. These two statements appear to contradict each other. Please clarify.	Agreed. Subsurface samples were collected beneath the SWMU 26, C-401 Transfer Line at depths of up to 48.5 feet below ground surface (bgs). Most of the samples that were collected along the pipeline were from a depth of less than 15 feet bgs. However, at selected locations in Sector 8, samples were collected down to a depth of 48.5 feet bgs to help determine the nature, extent, and origin of contaminants that might be present at depth. The text on page 4-25, lines 21-22 has been changed to read "...(collected from a depth of up to 48.5 ft bgs)...".

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Comment No.	Section/Page/Para.	State Comment	Response
6	Section 4.3.3; Page 4-37; 2nd para	Line 18 lists 1.82 pCi/L as the maximum Tc-99 activity from boring 400-041. Table 4.65 lists this result as 1.88 pCi/L. Which figure is correct?	Agreed. The correct value for the Tc-99 concentration in groundwater at a depth of 120-feet bgs in boring 400-041 is 1.88 pCi/L. The numerical value in the text on page 4-37 has been corrected from 1.82 pCi/L to 1.88 pCi/L.
7	Figure 4.9	Volatile organic compounds were detected at high concentrations within this sector. Please revise the map so that points where VOC contamination exists can be easily identified.	Agreed. Figure 4.9 has been revised to show which boring locations contained VOA contaminants.
8	Figure 4.10c	The panel at the top of this figure shows a large area of contamination (i.e., blue and green) located just south of the C-400 Building. There does not appear to be enough sample density in this area to justify including the blue contoured region in the figure. Please explain how this data was contoured.	Agreed. The series of maps included in Figures 4.10a, 4.10b, and 4.10c were intended to graphically depict the approximate location of the contaminant plume at Sectors 4 and 5 as it appears at different depths below the ground surface. Unfortunately, the perspective used to illustrate the plume location at depth is misleading. This apparent shift in the actual location of the plume has been corrected so that plume placement as depicted on the depth slices now corresponds to contaminant concentrations reported from boring locations. Revisions of Figures 4.10a, 4.10b, and 4.10c are included in the D2 report.
9	Figure 4.11a	In this figure, the soil sample collected at boring 400-200 from 30-feet bgs contained 2,759,000 ppb TCE. The top panel in Figure 4.10c gives no indication that such high levels of TCE exist in the vicinity of 400-200. Please explain and revise Figure 4.10c as necessary.	Agreed. Figure 4.10c has been revised to reflect the levels of TCE reported from boring 400-200. Please also see response to Comment #8 above.

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Comment No.	Section/Page/Para.	State Comment	Response
10	Figure 4.11b	In this figure, the soil sample collected at boring 400-015 from 24-feet bgs contained 168,200 ppb TCE. The top panel in Figure 4.10c gives no indication that such high levels of TCE exist in the vicinity of 400-015. Please explain and revise Figure 4.10c as necessary.	Agreed. Figure 4.10c has been revised to reflect the levels of TCE reported from boring 400-015. Please also see response to Comment #8 above.
11	Figure 4.12	This map does not indicate the presence of any TCE contamination in the vicinity of boring 400-195 or boring 400-178. However, Figure 4.10c shows high levels of TCE in this area. Explain and revise the figures as necessary.	Agreed. Figure 4.10c has been revised accordingly. Please also see response to Comment #8 above.
12	Figure 4.39	TCE concentrations for RGA groundwater at boring 400-034 are not listed below 60-feet. Include the RGA groundwater concentrations on the figure. Also, the inset map at the bottom of this figure is somewhat misleading. Several boring locations have been adjusted so that all borings fall along a straight line. The figure makes it appear as if numerous McNairy borings were drilled beneath the C-400 building. Please revise this figure.	Agreed. TCE concentrations for the RGA groundwater at boring 400-034 have been posted on Figure 4.39. Also, the inset map showing the line of section has been revised to show the actual spatial relations of the wells and how these individual borings were *projected* into the cross section.

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Comment No.	Section/Page/Para.	State Comment	Response
13	Section 2.2; Page 2-1	It is unclear as to how the soil gas sampling was utilized in the Remedial Investigation (RI) of WAG 6. It appears that the sampling was focused along utility bed corridors, but that problem with the integrity of the sampling equipment prevented obtaining reliable results from a number of samples. Discuss how the results of this sampling were used in the RI. Appendix D is incorrectly referenced in the text as containing a discussion of the sampling problems.	A discussion of the soil gas sampling effort during the WAG 6 project, as well as the problems encountered, can be found in Volume 2, Appendix D, pages D-1 through D-4, of the RI. For the WAG 6 RI, soil gas sampling was conducted within and adjacent to the utility corridors in order to collect real time screening data that would help focus the soil and groundwater sampling effort. Unfortunately, there were technical problems associated with the soil gas sampling effort that caused the reliability of the screening data to be questioned. However, due to the high density of soil samples which were being collected in conjunction with the soil gas sampling and the associated analyses at the on-site Close Support Lab, it was determined that real time definitive data were already available at most of the soil gas sampling locations. Therefore, adequate coverage for characterization was available even if the soil gas screening data were invalid. As a result, due to the problems in the collection of soil gas screening data, the results of the soil gas survey were not used to draw any conclusions concerning the nature and extent of contamination or to make any risk-related decisions during the WAG 6 project.

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Comment No.	Section/Page/Para.	State Comment	Response
14	Section 2.4	Provide discussion whether these groundwater samples were filtered prior to analysis. For risk assessment purposes, analytical data from unfiltered samples are required.	Agreed. Both filtered and unfiltered groundwater sample data were used in the WAG 6 RI. The following text will be added to Section 2.4, Borehole Groundwater Samples, to clearly define the use of filtered and unfiltered sample data: "**Filtered and Unfiltered Groundwater Sampling Rationale.** Groundwater samples collected during the WAG 6 RI were submitted for laboratory analyses in both a filtered and unfiltered condition. This was accomplished by collecting a sufficient volume of groundwater at each sampling point to divide the sample into separate aliquots for analyses. As discussed in Section 4, Nature and Extent of Contamination, for metals the filtered results were primarily used to preclude biased-high results that are inherent to groundwater that percolates through clay-rich soils. Results from both the filtered and unfiltered samples for metals were assessed in the baseline risk assessment as discussed in the Section 6 summary and in Vol. 3a."

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Comment No.	Section/Page/Para.	State Comment	Response
15	Section 2.5; Section 4.3	According to the text in this section, the analytical data from groundwater samples used in the risk assessment is based on filtered samples. However, in Volume 3a (Section 1.6.1.4, page 1-171), the RI states "In this BHHRA, all analyte concentrations in water came from and analyses of unfiltered or total samples". Please clarify and correct these conflicting statements. The calculation of risk from exposure to groundwater must be based on the total metals present (unfiltered samples), according to guidance from the United States Environmental Protection Agency (USEPA 1998).	The discussion of filtered versus unfiltered groundwater results in section 4.3, Groundwater, is specific to the Nature and Extent section of the RI report. In keeping with the procedures in the regulatory agency-approved *Methods for Conducting Human Health Risk Assessment and Risk Evaluations at the Paducah Gaseous Diffusion Plant*, results from unfiltered groundwater samples were used when characterizing the risk reported in the main part of the risk assessment, and the results from filtered groundwater samples were used when examining the uncertainties inherent in unfiltered samples (i.e., separate assessment run). As noted in the aforementioned document, this approach is consistent with all EPA guidance.

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Comment No.	Section/Page/Para.	State Comment	Response
16	Section 2.7	When the sump was sampled, was consideration given toward the potential for preferential settling of contaminants of potential concern (COPCs) in the waste liquid? The description of the sampling method used indicated that it is appropriate for sampling a relatively homogenous waste liquid. However, heavy or insoluble contaminants, if present, may not have been adequately characterized through this method.	Internal characterization of the C-403 Neutralization Tank was not part of the original scope of the WAG 6 RI. Indeed, the tank was believed to be dry at the start of the field investigation. However, during the field effort liquid was observed in the tank and a field decision was made to collect a sample of the liquid for analyses. As discussed in Section 2, Field Investigation, a grab sample was collected using a disposable bailer. Additional sampling has been conducted at the tank based on the results of this initial analyses. Please also see response to Comment No. 30.

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Comment No.	Section/Page/Para.	State Comment	Response
17	Section 4.1.1; Page 4-1	Numerous inorganic elements in the background data set for soil and groundwater exceed a risk-based level of concern, some by several orders of magnitude (e.g., thallium in groundwater). Screening COPCs against background when some background levels are elevated will underestimate the risks present. Regardless of whether the contaminants are related to the site or are naturally occurring "ambient" concentrations, the exposures are to the total contaminant mass present. The estimation of risk should reflect the total risk present, and ambient, or background risk should be considered in the risk management process.	As discussed in the introductory material in Section. 4, Nature and Extent of Contamination, the data were screened against background data to develop a list of analytes that deserved additional attention in the discussion of the nature and extent of contamination. This screening is totally unrelated to the approach followed in the baseline risk assessment. In the baseline risk assessment, a background screen is included per the regulatory agency-approved *Methods for Conducting Human Health Risk Assessment and Risk Evaluations at the Paducah Gaseous Diffusion Plant.* However, to address the issue of high background concentrations for some metals, additional discussions of the risk that may be caused by exposure to soils containing metals at the background concentrations are included in the uncertainty section of the risk assessment. Hence, all information necessary to make appropriate risk management decisions is present in the baseline risk assessment.

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Comment No.	Section/Page/Para.	State Comment	Response
18	Section 4.2.4.2; Page 4-14	Please explain why the sample quantitation limit (SQL) was 20 times greater than the PGDP background value for antimony in soils. We would expect the SQL to be near or below the background value reported in Table 4.1 (0.21 mg/kg).	Agreed. As you expected, a review of the BG data shows that in most cases the SQLs are lower than, or equal to, BG. The exception is antimony. However, the laboratory Instrument Detection Limit for antimony was low enough to capture the antimony analytical results. These results were used to evaluate Nature and Extent, Fate and Transport, and Risk from exposure to antimony.
19	Section 4.3.2; Page 4-35	Although no trend in the inorganic analyses suggests that the C-400 Building was the source of the widespread metals contamination found in groundwater below WAG 6, the building was used for metal-plating, and numerous elevated detections were found associated with waste storage areas and transfer conduits. The activities within the C-400 Building and surrounding areas have obviously impacted surface and subsurface soils and should be considered as a significant contributor to the contamination found in the underlying groundwater resource. The acidic soils found over WAG 6 would tend to facilitate the mobility of many inorganic compounds through soils to groundwater.	Comment noted. The limiting factors controlling metals migration in subsurface soils are discussed in Section 5, Fate and Transport, Subsection 5.3.3, Metals. As a further note, pH is one of the transport parameters used in the MEPAS model.
20	Figure 4.16	The mapped sample locations and the analytical data do not appear to agree. The sample locations also do not agree with other maps of Sector 5. Please clarify this discrepancy.	Agreed. During the final plotting of this figure for the D1 report, the electronic layer containing the data boxes was inadvertently shifted to the right in relation to the base figure. This shift has been corrected and the revision of Figure 4.16 is presented in the D2 as requested.

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Comment No.	Section/Page/Para.	State Comment	Response
21	Section 5.2.2.1; Page 5-5	Additional explanation of the justification and rationale behind the estimation of the groundwater recharge rate from precipitation is needed. It is unclear how the estimate (8% of total rainfall) was determined. It appears that the estimate is based on average rainfall, which does not account for the variation often seen in annual precipitation levels. A conservative estimate, which represents an upper-bound annual rainfall amount, would ultimately indicate the potential upper-bound migration, rather than the central tendency.	The recharge rate was derived from the 1992 Geotrans modeling simulations that accounted for the physical conditions of the PDGP facility. Since the facility is covered with industrial structures including pavement, buildings, and product storage areas, a recharge rate of 8% is a very realistic estimation of the total rainfall available for recharge. For a comparable site in an area with much lower industrial usage, a published ratio of recharge to annual rainfall of 12% has been reported. A difference of 4% in total recharge for the PGDP facility would appear justified by the high industrial land usage. It should be noted that this recharge rate was provided to give general information concerning the water balance at the PGDP and was not used in the MEPAS modeling conducted for this RI. The water balance for MEPAS is computed using long-term meteorologic data (including monthly estimates of precipitation, potential evapotranspiration, snowmelt, temperature, and runoff) as well as WAG 6 site information and so does account for variation in precipitation.

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Comment No.	Section/Page/Para.	State Comment	Response
22	Section 5.3.3; Page 5-12	a) Chromium should also be considered to be one of the metals used at the C-400 Building, based on the analytical data from sampling the residual waste within the Technetium-99 Storage Tank (SWMU 47). Widespread chromium detections in surface soils, subsurface soils, and groundwater support this assertion. b) "Generally reported literature values" for metals are not relevant to the PGDP site, or the WAG 6 RI.	a) Chromium has been added to the text of the first bullet listed under Abundant Metals on page 5-12. This will provide consistency with the source description of SWMU 47 provided under Section 5.2.1, Sector 6 (SWMU 47). b) The published values for metals are relevant and may be useful to future decision-making by risk managers. The suggested use of published data should be noted in the text.
23	Section 5.4.1.2; Page 5-16	Please provide the method for the estimation of the advection velocity.	Agreed. The advection (seepage) velocity,v = ki/n; and the variables are defined as k (the hydraulic conductivity), i (the hydraulic gradient), and n (the effective porosity).
24	Section 5.5; Page 5-20; line 19	a) Please identify the criteria used to identify "analyte concentrations that did not greatly exceed a screening level".	a) Agreed. The following sentence will be added to the text for clarification: "Analyte concentrations that did not greatly exceed a screening level were determined by site experts based on the range of observed contaminant levels and the closeness of the screening level to the sample quantification level".
		b) It is unclear how the concentration (source) term for each sector used in the model was determined. It appears that all detections plus one-half the value of non-detections were averaged. The source term	b) Agreed. A reference will be added in the text indicating that the procedures used to define each source term are detailed in Table 5.8 (Sector 1), 5.11 (Sector 2), 5.14 (Sector 3),

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Comment No.	Section/Page/Para.	State Comment	Response
24	Cont.	should be based on the 95% UCL or the maximum. Please explain the procedure used for this process.	5.17 (Sector 4), 5.20 (Sector 5), 5.23 (Sector 6), 5.26 (Sector 7), and 5.29 (Sector 8). The revised text will further state that the procedures used to characterize the contaminant levels for each source term are dependent upon the distribution of data. Default to either the maximum observed concentration or the 95% UCL is appropriate where the data distribution is inadequate to define a source term. In most cases, the WAG 6 data are sufficient, in combination with knowledge of site processes, to model a source term. The maximum observed concentration was used when data were insufficient to define the source term.
		c) The RI states "Modelers identified RGA sources for two sectors: 5 and 7.". Please explain what is meant by "RGA sources". It would appear that several other sectors are sources of contamination to the RGA (e.g., Sector 2 (SWMU 40), Sector 8 (SMWU 26)).	c) Agreed. "RGA sources" refers to sources of undissolved contaminant within the lower Continental Deposits (primary host formation of the Regional Gravel Aquifer). You are correct that other sectors contain sources within the topsoil and upper Continental Deposits (host formation of the Upper Continental Recharge System) - these are the MEPAS sources defined as Surface Soil and Subsurface Soil. The text will be revised to clarify the sources being discussed.

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Comment No.	Section/Page/Para.	State Comment	Response
24	Cont.	d) How does the modeling account for the effect of the presence of highly acidic soils on the rate of migration of COPCs through soils?	d) MEPAS accounts for soil pH. The pH of the soils is one of the input parameters used to select the K_d values for inorganics. See Table 5.6 for the pH values used in the WAG 6 model. (The soils are not highly acidic.)
25	Figure 5.3	The Division will not accept the "2X" background approach to screen potential chemicals of concern. This approach, although supported by Region 4 USEPA, is not scientifically based. It is a "rule of thumb" which attempts to accommodate the typical CERCLA site with a limited degree of background sampling. The approach that KYDEP supports is one in which chemicals of concern are screened against health-based preliminary remediation goals (PRGs) for residential use. Contaminants which are not related to site activities yet exist above health-based levels are accounted for in the estimate of pathway and total risk. Risks above the de minimus which can be attributed to "background" are discussed in the risk characterization portion of the risk assessment. The nature of the site, potential for exposure, and characteristics of the contaminants (e.g., fate and transport) and presence of other site-related contaminants will dictate if risk management is required.	Agreed. It would not be appropriate to use the 2X background rule in risk assessments at PGDP where we have developed an approved set of background values for soil. In keeping with this conclusion, this approach was not used in the baseline risk assessment. The risk assessment uses only those screening criteria approved in *Methods for Conducting Human Health Risk Assessment and Risk Evaluations at the Paducah Gaseous Diffusion Plant*. However, the 2X background screen was used in the fate and transport section of the WAG 6 RI report (i.e., Section 5) in order to identify those contaminants in soil which deserve further attention in the fate and transport discussion, and not to define COCs. Text will be added to clarify the intent of the screening steps outlined in Figure 5.3.

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Comment No.	Section/Page/Para.	State Comment	Response
26	Figures and Tables	Many of the references cited in support of information found in several figures and tables (e.g., Table 5.1, Physical and Chemical Properties of COPCs at WAG 6; Table 5.2, List of Distribution Coefficients; Table 5.3, Radioactive Half-lives, etc) are not listed in the references found in Section 8.	Agreed. The references cited in the text have been added to Section 8.
27	Table 5.4	The biodegradation half-life estimates for PAH compounds in this table represent the lowest estimate (maximum biodegradation rate) in the range published in Howard et. al. (1991). There is no reason to believe that site conditions at WAG 6 will support either the minimum or maximum biodegradation rates. A reasonable compromise is using half-life data for PAHs which represent the average of the range of estimated half-lives. The chlorinated hydrocarbons are correctly assumed to resist biodegradation as they migrate from WAG 6 through the RGA, as confirmed through previous monitoring data.	Comment noted. The table is presented for general reference and to provide information for Risk Management Personnel and was not used for calculating quantitative results of PAH biodegradation at WAG 6.
28	Figure 3.6	Building C-410 and the C-402 Lime House should be identified. The north-south diversion ditch should be included as SWMU-98. Expand the label of SWMU 40 to include the phrase "C-403 Neutralization Tank", SWMU 47 to include "Tc-99 Storage Tank", SWMU 203 to include "Waste Discard Sump", and SWMU 11 to include "TCE Leak Site".	Agreed. Figure 3.6 has been revised to include designations for Building C-410 and for the C-402 Lime House. Also, SWMU labels have expanded as requested and the north-south diversion ditch (SWMU 59) has been delineated on the map.

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Comment No.	Section/Page/Para.	State Comment	Response
29	Section 4.2.1.2; Page 4-5	Figure 5.2 indicates that the water table at WAG 6 is less than 40-feet bgs. Explain how the soil sample from boring 400-020 taken at a depth of 44-48 feet could be at the base of the UCRSs vadose zone.	The UCRS water level in Figure 5.2 was approximated from several water level measurements in borings or monitoring wells. The figure has been revised using water level elevations (42-45' bgs) as determined from the potentiometric map in Figure 3.18.
30	Section 4.2.2.1; Page 4-7	Explain the source of Technetium-99 in the area of the C-403 Neutralization Tank when water entered the tank from an adjacent water line break during the WAG 6 investigation. Table 4-11 provides radiation data for samples from this sector; however, activities of radionuclides in the UCRS adjacent to C-403 cannot account for the levels of radionuclides in the tank subsequent to the water line break. Indicate the location of the water line break on Figure 4.4 and provide data for any soil samples taken from the area or adjacent areas. Explain the decrease in activity from 43,750 pCi/L to 4430 pCi/L from November 1997 to January 1998. Did the volume of water increase in the tank? Explain loss of activity since decay cannot be the cause of the decrease in activity?	Agreed. The location of the broken water line in the area of the C-403 Tank is now shown on Figure 4.4, and soil samples that were collected from the area around the C-403 Tank during a post-WAG 6 supplemental work scope have been included as an addendum to Appendix J. The high Tc-99 activities of up to 43,750 pCi/L represent historical sampling of the tank contents. The scope of the WAG 6 investigation did not include the internal characterization of the C-403 Tank. However, based on stratified sampling of the contents of the tank in July 1998, the levels of Tc-99 and TCE were found to increase significantly with depth. This suggests that the source for the TCE and Tc-99 is the layer of bricks and interstial pore water within these bricks that line the base of the tank.

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Comment No.	Section/Page/Para.	State Comment	Response
31	Section 4.4.4; Page 4-9	The last paragraph reports results for water samples. Since this section deals with surface and subsurface soils, this paragraph appears out of place. Furthermore, no sampling locations and no procedure for handling samples is provided with the data. Explain the information provided in this last paragraph.	Agreed. The comment correctly notes that the water radioactivity was reported within the soils evaluation section. The paragraph containing the water radioactivity results has been moved to the subsection immediately following and is now the last paragraph before Section 4.2.3, Sector 3. The water samples discussed in the subject paragraph were collected from six borings located around the perimeter of the C-403 Neutralization Tank. These locations have been added to Figure 3.6 as an inset map. A description of this additional sampling effort has been added to the Sector 2 text on page 3-13: "Six additional soil borings were drilled in the UCRS to a depth of 10-30 feet bgs in April 1998 to determine if a release had or was occurring from the C-403 tank". The drilling and sampling of the six borings was conducted using the same field operations procedures described in Section 2, Field Investigation.

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Comment No.	Section/Page/Para.	State Comment	Response
32	Section 4.2.6.2; Page 4-22	Technetium-99 activities do not appear excessively elevated and the uranium appears to be naturally occurring and not depleted. Explain the data and include the activity of Technetium-99 and uranium isotopes.	Agreed. The activities for these samples were described as "high" based on a comparison with BG. Admittedly, it is a subjective judgment as to whether an activity that is four or twenty times higher than background should be described as "high". The text on page 4-22 in the Radionuclides section has been revised to simply indicate that radioisotopes in the 047-002 soil sample from 4.5-feet bgs were detected at activities that exceeded background.
33	Section 4.3; Page 4-30	Indicate whether the exclusion of metals also applies to radionuclides.	In Section 4, both filtered and unfiltered radionuclide results were considered in assessing the nature and extent of radionuclide constituents detected at WAG 6.
34	Section 4.3.1; Page 4-33	Identify the Sector(s) associated with sample locations 400-009 and 400-018. Tables 4.4 through 4.50: Samples of sludge should be identified as sludge and not listed as "soil".	Agreed. Sample locations 400-009 and 400-018 are assigned to Sector 5. Appendix A provides a list of each sampling station and its associated sector for the WAG 6 RI. Agreed. Sludge samples were not differentiated from soil samples within the unique sample identifier used during the WAG 6 RI. Tables 4.4 through 4.50 have been revised to clearly indicate sludge samples by placing the word "Sludge" in column 1, Sample Type, where appropriate.

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Comment No.	Section/Page/Para.	State Comment	Response
35	Section 5.2.2; Page 5-5	Line 7 states that the UCRS is not perennially saturated where as line 29 states that the saturated zone is the UCRS; resolve this conflict.	The text on line 7 refers to one of the MEPAS modeling (leachability analysis) assumptions. The text on line 29 refers to one of the assumptions made by Geotrans (1992) to simulate the water balance at the PGDP. Different models require different types of assumptions, and although they may appear to be limiting, the modeling results afford the technology to evaluate several physical processes simultaneously and to help predict future tends in fate & transport analyses.
36	Section 5.3.4; Page 5-13; lines 34 and 35; 2nd para	The text indicates that decay chains, etc. are provided in Table 5.3. Either include decay chains in Table 5.3 or modify statement.	Agreed. The sentence has been revised to state that "the decay products and half-lives" are presented in Table 5.3.
37	Section 5.3.4; Page 5-14; last para	Include the background activities for the radionuclides mentioned. Describe the calculations and any conversion factors that are alluded to in the text.	Agreed. The background activities available for radionuclides at the PGDP are provided in Table 4.1 of the report. The reference statement concerning radioactive conversion calculations is given as general information only. The calculations were not performed as part of the WAG 6 RI work scope and would not add significant value to the report.

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Comment No.	Section/Page/Para.	State Comment	Response
38	Section 5.4.1.1; Page 5-16; line 2	The velocity of infiltrating water should be based on the effective porosity which can be very closely approximated by the field capacity, especially in the fine grained soils like those of the UCRS.	The velocity of infiltrating water was conservatively estimated using a water filled porosity because of the theory that preferential flow paths have developed in the upper 20 feet of material, material known to have been borrowed during the construction of PGDP. Underground utilities and other structures also increase the rate at which water infiltrates. A published value for specific yield (effective porosity) of 0.2 can be used.
39	Section 5.4.1.1; page 5-15; lines 10-11	The Division does not concur with the assessment that the dominant driving force in the UCRS is diffusion. Investigations of the UCRS groundwater flow system and investigations of the structure of the loess (C. Petersen, Masters thesis, University of Kentucky, 1996) indicate that the loess can have an abundance of macropores and vertical fractures that facilitate the rapid vertical transport of groundwater.	At the PGDP fluvial sediments comprise the bulk of the UCRS strata, and neither vertical fractures nor macropores have been typically described from the samples studied. Macropores and fractures can, in many rock types, enhance the physical process that drives contaminant transport and probably plays some role in the overall dispersion of contamination from the UCRS to the RGA.
40	Section 5.5; Page 5-17	Supply the results of the calibration and verification runs for the MEPAS model.	Because the MEPAS model does not utilize potential past source terms, it is not possible to calibrate the model to existing conditions. In fact, the goal of the MEPAS model is to estimate potential future concentrations of contaminants in groundwater at the exposure points given the current source terms at WAG 6.

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Comment No.	Section/Page/Para.	State Comment	Response
41	Section 5.5.4; Page 5-23	Lines 7 and 8 state that cis-1,2-DCE and trans-1,2-DCE could not be modeled because they are absent from the MEPAS database. Both of these contaminants were detected in Sector 4 at levels above established residential PRGs. In particular, trans-1,2-DCE was detected at a maximum level of 1200 µg/L. The residential PRG for this compound is 4 µg/L. These compounds should not be discounted as contributors to off-site risk and therefore should be modeled.	The WAG 6 risk assessment accounts for cis-1,2-DCE and trans-1,2-DCE in Sector 4. However, the MEPAS model was unable to model future contaminant levels. Because we expect the source to deplete over time, the current risk posed by these volatile organics provides a boundary to the problem.
42	Section 5.5; Page 5-18; lines 24 through 30	The source of Technetium-99 has not been identified. Therefore, how can the statement be made that the activity of Technetium-99 is declining? Provide data documenting that the activity of Technetium-99 is decreasing at the source.	Agreed. A plot of measured Tc-99 activity for well MW-66 (completed in the Northwest Plume near the PGDP security fence) will be added to the RI Report to document the trend of declining levels over time. Because the Northwest Plume originates from the C-400 technetium source, the dissolved phase trends reflect the change in the remaining source mass.
43	Section 5.5; Page 5-18; 3rd & 4th para	The following two statements: "...modeling is not required for assessing current or future levels of contaminant exposure originating from the DNAPL zone." and "...modeling is unnecessary for assessing current or future levels of contaminant exposure originating from the Technetium-99 source," are contradicted by the modeling described in Sections 5.5.1 through 5.5.8. Revise the text to eliminate this apparent contradiction.	Agreed. The text will be revised. The modeling in Sections 5.5.1 through 5.5.8 is required to assess the need for remedial action in each of the independent sectors. However, it remains true that empirical data are sufficient to demonstrate, without modeling, that the cumulative impact of contamination in the shallow soils (upper Continental Deposits) and aquifer (lower Continental Deposits) requires a remedial action.

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Comment No.	Section/Page/Para.	State Comment	Response
44	Table 5.6	Include references for bulk density, total porosity, and field capacity.	The table documents the calculation of bulk density (no other reference is applicable). There has been no measurement of field capacity of PGDP soils. The value is based on MEPAS guidance, which provides estimates of field capacity based on soil texture, and the professional judgment of site hydrogeologists (a reference to the MEPAS guidance will be added). A reference will be included for total porosity (WAG 6 measurements).
45	Volume 3a; Section 1.2.2; Page 1-15	The comparison to background procedure outlined in this section differs from the methodology outlined in Volume 1 (Figure 5.3). Our (KYDEP) recommendations for screening contaminants were outlined in Specific Comment #15.	Comment noted. Please recognize that the recommendations in Specific Comment #15 do not match the procedure contained in the approved *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant*. As agreed when that document was prepared, a screen against background is to be performed as part of the risk assessment, and the uncertainties inherent in this screen are to be discussed. This is the procedure followed in the WAG 6 Baseline Risk Assessment.

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Comment No.	Section/Page/Para.	State Comment	Response
46	Volume 3a; Section 1.2.3.2; Page 1-22	In addition to several deficiencies noted within these comments, the groundwater model does not take into account the presence of multiple contaminants and the associated potential enhancement of migration through the UCRS and the RGA. Based on the historical success of modeled predictions at PGDP, we (KYDEP) recommend that remedial decisions should not be based on modeled predictions. Continuous monitoring of the groundwater plumes originating from WAG 6 is necessary to track the migration of contaminants. This monitoring program must start near (downgradient) of WAG 6 and consist of sampling points within the Northwest and Northeast Plumes, with the distance between the sampling points sufficient to approximate the location of migrating contaminants. It is our concern that off-site concentrations above health-based levels of concern will, because the models predicted that the WAG 6 contribution is insignificant, be attributed to "upgradient" or "other" sources which will remain unknown and not addressed until the groundwater integrator unit is considered. Meanwhile, impacts to the RGA and to potential off-site receptors will continue unabated.	Agreed. DOE recognizes that the MEPAS modeling results are screening level results at best. In addition, the DOE did not prepare the model in order to declare that monitoring was not needed at WAG 6 or that contaminants were not migrating from sources in WAG 6 leading to concentrations of contaminants at the points of exposure that are of concern. Additionally, DOE recognizes in Sect. 5 of Vol. I and in Vol. 3a that the TCE and Tc-99 concentrations at WAG 6 are such that modeling was not needed to show if a problem may exist, since empirical evidence shows that a problem does exist. DOE also recognizes that migration characteristics of a contaminant may be impacted by co-contaminants present in a source. Unfortunately, modeling to integrate all possible combinations of co-contaminants is very expensive and leads to results that are very uncertain (i.e., consider propagation of error). Therefore, DOE believes such modeling would be of little net benefit in the RI report.
47	Volume 3a; Section 1.3.1.7; Page 1-35	Please correct the sentence describing the respective percentages of the surface area of Sector 6 that is covered by concrete, gravel and grass. The total, as written, is 155%.	Agreed. The correct proportions are 10% covered by concrete, 0% covered by asphalt, 65% covered by gravel, and 25% covered by grass. The appropriate change has been made in the D2 revision of the RI report.

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Comment No.	Section/Page/Para.	State Comment	Response
48	Volume 3a; Page 1-44	The residential scenario should also include the consumption of wild game, since the proximity of wildlife habitat would be near the residential area. In addition, the recreational visitor will come in contact with surface soils; incidental ingestion, inhalation of volatiles and particulates from soils, dermal, and external (radioactive) exposures under this scenario should be evaluated.	If the consumption of wild game is of concern to the decision makers, then the risk from consumption of game can be combined with the risk from the other rural residential exposure routes. Note that, as discussed in the baseline human health risk assessment, the individual assumed to harvest wild animals at the PGDP is, in fact, a local resident. It is noted that a recreational user may be exposed to contaminants in the soil through incidental ingestion, dermal contact, inhalation of particles and vapors, and direct irradiation; however, because a flat open area such as WAG 6 could contain little of interest that would prolong exposure, the doses expected would be minimal. Also, please be aware that the exposure assessment and its results presented in the WAG 6 baseline human health risk assessment are consistent with the regulatory agency-approved *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant.*
49	Volume 3a; Section 1.3.2.3; Page 1-45	a) The evaluation of contact with groundwater-filled ponds by residents was deferred to when the groundwater operable unit is considered as a whole. The area downgradient of WAG 6 and within the contaminated plume migrating off-site appears to contain numerous ponds and surface water sources.	a) As noted in the cited material, the decision to defer the evaluation is consistent with the regulatory agency-approved *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant.* In addition, current

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49	Cont.	It is not apparent whether current impacts from WAG 6 and other contaminated soils and groundwater to distant surface water bodies have been evaluated by sampling; this potential exposure pathway has been assumed to be insignificant based on fate and transport modeling. The model should be verified by sampling before the significance of the pathway is discounted. If the investigation of this potential exposure route is deferred as intended, current uncontrolled exposures will continue to take place perhaps at or above levels of concern. The surface water bodies potentially impacted by PGDP in general and WAG 6 in particular should be evaluated and appropriate risk management procedures initiated, if required, to prevent additional exposures.	groundwater controls restrict or prevent use of contaminated groundwater at PGDP; therefore, uncontrolled exposures are not occurring.
		b) Consumption of livestock products were not evaluated for the future resident due to the industrial nature of the WAG 6 area and the fact that if livestock production occurs in the area, it will be far into the future, making the current contaminant levels meaningless. For volatile organic compounds in soils, this may be true. However, the radioactive compounds will not appreciably degrade for thousands of years. Inorganic compounds also will not appreciably degrade. Additionally, the groundwater is currently	b) Please recognize that the WAG 6, as it currently stands, is not suitable for livestock production. Although the area is rather large, a significant portion of the surface area is currently covered by buildings, gravel, concrete, or asphalt. In addition, not quantifying the risk through the livestock and livestock products consumption exposure routes at a source unit like WAG 6 is consistent with the regulatory agency-approved *Methods for Conducting Risk Assessments and Risk Evaluations at the*

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Comment No.	Section/Page/Para.	State Comment	Response
49	Cont.	contaminated with TCE and radioactive compounds to the degree that the water used will remain contaminated at high levels far into the future. Thus, it appears the persistence of the waste present in WAG 6 will remain after the industrial use of this site is finished, requiring an evaluation of potential consumption of livestock products.	*Paducah Gaseous Diffusion Plant*. Finally, please note that the uncertainty inherent in not quantifying the livestock and livestock product consumption exposure routes is discussed in the uncertainty section of the risk assessment; therefore, the pertinent information concerning these routes of exposure is available for consideration by risk managers.
50	Volume 3a; Section 1.4; Page 1-51	The toxicity equivalent factors (TEFs) for two furan congeners listed in Exhibit 1.21 are incorrectly noted in the Region 4 guidance (1995) cited in this section. According to USEPA's *Interim Procedures for Estimating Risks Associated Exposures to Mixtures of Chlorinated Dibenzo-p-Dioxins and –Dibenzofurans (CDDs and CDFs) and 1989 Update, EPA/625/3-89/016, March, 1989)* which was used as the source for the Region 4 guidance, the TEF for 1,2,3,7,8-Pentachloro-p-dibenzofuran (1,2,3,7,8-PeCDF) is actually 0.05, and the TEF for 2,3,4,7,8,-PeCDF is 0.5.	Comment noted. Because the TEFs listed here are those which we are required to use per the approved *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant*, they cannot be changed based on this comment alone. This change will need to be discussed by DOE, EPA, and the Commonwealth. In any event, dioxins and furans are not COCs in WAG 6.

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Comment No.	Section/Page/Para.	State Comment	Response
51	Volume 3a; Table 1.62	Numerous COCs in this table are not listed with all of the appropriate toxicity criteria. In Kentucky, unless data indicates otherwise, route-to-route extrapolation from oral slope factors to inhalation slope factors are used to evaluate the toxicity associated with the inhalation of carcinogenic chemicals. Table 1.62 should be updated to reflect the following criteria, and the risk calculations should also reflect these changes. *Table attached at the end of this document.*	The COCs are listed with the toxicity criteria which were correct and appropriate at the time the document was produced (i.e., Spring 1998). Also, as noted in the approved *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant*, DOE recognizes the preference of the Commonwealth for extrapolation from oral toxicity criteria to inhalation toxicity criteria. To address this preference, DOE agreed to examine the potential impact of such extrapolation as an uncertainty to the risk assessment. This was done in the WAG 6 risk assessment and demonstrates that the increases in the level of risk are insignificant given the risks from other exposure routes. Note, Table 1.62 will not be updated with the extrapolated criteria because this would invalidate the agreements made in the approved *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant.*
52	Volume 3a; Table 1.63	Several toxicity values listed in Table 1.63 are not in keeping with values recognized as appropriate by KYDEP, or are missing. Please add the following values to Table 1.63 and incorporate them into the assessment of risk from exposure to WAG 6 contamination. *Table attached at the end of this document.*	Please see response to Comment #51.

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Comment No.	Section/Page/Para.	State Comment	Response
53	Volume 3a; Section 1.4.6; Page 1-126	This section should be updated to reflect the modifications to Tables 1.62 and 1.63 outlined in the previous comments.	Please see response to Comment #51.
54	Volume 3a; Section 1.75; Pager 1-188	The dermal absorption rates recommended by KYDEP are based on the range of values seen in various peer-reviewed studies. Numerous references to dermal absorption can be found in the toxicological profiles published by the Agency for Toxic Substance and Disease Registry (ATSDR), Washington D.C. Most dermal absorption studies evaluate the degree of absorption of a single contaminant; exposures in the "field" are likely to consist of exposure to multiple contaminants simultaneously, which may increase the degree of absorption over that seen in the laboratory.	Agreed.

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Comment No.	Section/Page/Para.	State Comment	Response
55	Volume 3a; Section 2.1.2.1; Page 2-3	Chemicals of potential concern should be removed from consideration only if they are below a No Observed Effects Level (NOEL) for the most sensitive ecological receptor. Screening against background is inappropriate. Likewise, the sample quantitation limits should be below or equal to the NOEL for the most sensitive ecological receptor that could potentially be present.	The procedure contained in the approved *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant* includes screening contaminant concentrations against background as part of the risk assessment. This is the procedure followed in the WAG 6 baseline risk assessment. The purpose is to focus the assessment on site-related contaminants. The sample quantitation limits used for the project were those of standard EPA analytical methods and are as presented in the work plan for WAG 6. The sample quantitation limits were approved by the regulatory agencies prior to initiating work.

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Comment No.	Section/Page/Para.	State Comment	Response
56	Volume 3a; Section 2.6; Page 2-41	As mentioned in the assessment, although current use of the WAG 6 does not provide significant habitat for ecological receptors due to the industrial nature of the site, current concentrations are present at sufficient levels to cause adverse impacts to ecological receptors. As long as the site remains active, the potential for significant impact is minimized. Future use of the site (i.e. abandonment) could result in more attractive habitat and increased impacts to ecological receptors. Off-site impacts to surface water resources have not been evaluated. It is likely that the WAG 6 contribution to the contamination found in the RGA and McNairy Formation is several miles off-site, and is causing significant impacts (e.g., Ohio River). These impacts should be assessed.	Agreed. A future use of the site which results in higher quality habitat would lead to greater use by ecological receptors. This is the scenario addressed in the assessment as the current industrial nature of the site precludes it from being a significant area for wildlife. Potential off-site impacts to surface water resources are beyond the scope of the WAG 6 RI. Potential impacts to ecological endpoints in off-site aquatic habitats will be assessed as part of the Surface Water OU.

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Comment No.	Section/Page/Para.	EPA Comment	Response
1	General	The report addresses all radionuclides that have the potential to be COCs and important contributors to risk.	Comment noted.
2	General	The characterization of the contaminants appears to be complete except that greater care is needed in distinguishing between background levels of radionuclides in the environment and elevated levels of radionuclides in the environment attributed to the operation of the facility. For many of the sectors, radionuclides are reported as being present above background, when in fact they appear to be present within the expected variability of background.	Screening of the radionuclide data discussed in the WAG 6 RI Report was accomplished by comparing data collected during the WAG 6 RI field investigation with background values derived from historical data that are representative of naturally occurring conditions and concentrations in the surface soil, subsurface soil, and groundwater at PGDP. The background values used for comparison with the WAG 6 data were obtained from the following reports: 1) *Baseline Risk Assessment and Technical Investigation Report for the Northwest Dissolved Phase Plume, Paducah Gaseous Diffusion Plant (DOE.OR.07-1286&D1), July 1994* and 2) *Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky (DOE/OR/07-1586&D2), June 1997.* Please recognize that DOE has agreed to utilize background concentrations that were developed as parts of other projects and to identify potential contamination when these values are exceeded.

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Comment No.	Section/Page/Para.	EPA Comment	Response
3	General	The radiological risk characterization appears to be complete and in accordance with EPA guidance and standards of good practice. However, the regulatory level (1E-6, background, or PRGs) selected for screening is in some cases confusing. Summary tables that include the limiting concentrations that correspond to 1E-6, any ARARs, the variability in background, and the minimum detectable concentration should be provided.	Comment noted. Summary tables containing ARARs and 1E-6 values are contained in the Risk Section (Volume 3) of the RI. These values were used to screen the data to assess impacts to human health and the environment. Minimum Detectable Concentrations (MDCs) for radionuclides have not been routinely requested from the contract analytical laboratory in the past, and were not provided for the WAG 6 project. However, MDCs have been added as a requirement for future projects to be conducted at the PGDP. Due to the fact that background values used in the WAG 6 report are set as the 95% upper tolerance bound, consideration of the variability of background concentrations would not be appropriate. A table of Preliminary Remediation Goals (PRGs), Table 4.2, has been added to the Section 4 of Volume 1 for comparative purposes.
4	General	DOE does not provide any information to support their source term release rates. Their current assumptions lead to dilution/attenuation factors of about 9 orders of magnitude, which appears highly unrealistic. A more detailed discussion of this issue is provided in Appendix B.	The following discussion demonstrates that the WAG 6 RI MEPAS model is reasonably approximating dissolved contaminant concentrations. As in the U.S. EPA model effort, Sector 7 technetium levels are used for the derivation. In the following discussion, both English and metric units are used, depending upon the units of coefficients. Derivation of dissolved Tc-99 activity in the source term

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Comment No.	Section/Page/Para.	EPA Comment	Response
4	Cont.		For Sector 7, the Tc-99 activity of the soil is modeled as 3.16 pCi/g. The K_d for Tc-99 used in the MEPAS model of WAG 6 is 20 ml/g. Thus, the derived Tc-99 activity dissolved in the source zone water should be 1.58×10^{-1} pCi/ml or 1.58×10^{2} pCi/L (derived by dividing 3.16 pCi/g by 20 ml/g). Redistribution of Tc-99 activity in the unsaturated zone The modeled source extends to a depth of 34 ft. The unsaturated zone is 49 ft thick. Thus, 15 ft (457.2 cm) of unsaturated zone is present below the source zone in which the Tc-99 activity will be reduced. The unsaturated zone has a bulk density of 1.86 g/cm^3. Assuming a 1 cm^2 area vertical flow cell, a soil mass of 850.4 g exists between the base of the source zone and the top of the aquifer. The K_d for Tc-99 of 20 ml/g defines the amount of Tc-99 that will remain in the dissolved phase after partitioning to the soil in the flow of water downward to the aquifer. The resulting dissolved phase Tc-99 activity is 9.29 pCi/L. (1.58×10^{2} pCi/L divided by 20 l/kg x 0.8504 kg). Dilution of Tc-99 activity in the aquifer

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Comment No.	Section/Page/Para.	EPA Comment	Response
4	Cont.		To assess the effect of dilution, consider the input of a 1 ft^2 area at the top of the aquifer below the source zone. From the conceptual model for WAG 6 (page 5-5 of the RI report), net groundwater recharge is 8% of 50.28 in/yr (rainfall is 4.19 in/month). This equates to a daily net recharge of 0.011 in/day (4.02 in/yr divided by 365.25 days/yr). However, only 93% (0.010 in/day) of the groundwater recharge enters the aquifer. This equates to 8.53×10^{-4} ft/day per unit area which is equal to 8.53×10^{-4} ft^3/day. The aquifer has an effective porosity of 0.3, a hydraulic conductivity of 1,500 ft/day, and a gradient of 0.0004. The Darcy velocity of the aquifer is 2 ft/day. With an aquifer thickness of 45 ft, the amount of aquifer water flowing beneath the source zone unit area is 27 ft^3/day (2 ft/day flow rate x 0.3 x 45 ft thickness x 1 ft width). Thus, the dilution factor is 8.53×10^{-4} ft^3/day divided by 27 ft^3/day (3.2×10^{-5}). The Tc-99 activity in the aquifer immediately below the source zone is 9.29 pCi/L multiplied by 3.2×10^{-5} (2.97×10^{-4} pCi/L). <u>Assessment of Dispersion in the Aquifer</u> The modeled dispersion of Tc-99 activity in the aquifer can be derived by an iterative trial and

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Comment No.	Section/Page/Para.	EPA Comment	Response
4	Cont.		error procedure using the given modeled Tc-99 activity at the security fence (distance = 1,005 m/ 3,297 ft) and at the DOE property boundary (distance = 1,680 m/5,512 ft). The modeled Tc-99 activities are 5.35 x 10^{-6} pCi/L at the security fence and 3.37 x 10^{-6} pCi/L at the DOE property boundary. For the iteration, we will use the size of your model cell (15 m). This iterative analysis determines that the Tc-99 activity is depleted by 1/0.9898 for each 15 m of the flow path between the security fence and the DOE property boundary (refer to Attachment 1). The reduction factor of 1/0.9898 is an approximation of the modeled dispersion. <u>Comparison of estimates of Tc-99 activity in the aquifer at the source zone derived from K_d and dilution functions versus dispersion</u> Using the dispersion estimate and the modeled Tc-99 activity at the security fence, the estimated Tc-99 activity in the aquifer at the source zone is 1.06 x10^{-5} pCi/L. This estimate is one order of magnitude less than the estimate derived from the source zone and represents a negligible error. There is some error in the approximations of the model processes.

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Comment No.	Section/Page/Para.	EPA Comment	Response
	SPECIFIC COMMENTS ON VOLUME I		
1	Page 2-3, line 27	This sentence refers to free release criteria pertaining to the radionuclide content of subsurface samples. Is this statement referring to contamination levels that are below concern from a radiation protection perspective for radiation workers, for transport of samples, or does it refer to clearance criteria for soil contaminated with radioactivity? Whichever the case, reference should be made to that section of the report that addresses free release criteria. This comment also applies to other sections of the report, such as page 2-7, line 31.	Agreed. The purpose of the referenced screening was to ensure that radioactive contaminated material and supplies that were used to collect environmental samples were not released off-site. All tools and equipment that were used to collect samples of environmental media were considered to be contaminated until a Health and Safety staff member scanned the items for the presence of radioactivity. The results of the radiological screening survey were compared to DOE established limits to determine if the material was acceptable for unrestricted or "free release" from the site, or if the equipment and material required decontamination to remove radiation contamination before being allowed off-site. Paducah Operations Work Instruction P202, Appendix A in the *Radiation Protection Program Manual* for WAG 6, contains a table listing the Free Release Criteria Values. Reference to these documents will be added to Section 2 of the RI report.
2	Section 2.8 (pages 2-8 to 2-10)	This section describes the analytical methods, DQOs, QA, data verification and data management used on the project and is consistent with EPA guidance and standards of good practice.	Comment noted.

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Comment No.	Section/Page/Para.	EPA Comment	Response
3	Page 2-9, lines 28-42	This section refers to the radiological procedures used in the program. The procedures are consistent with EPA guidance and standards of good practice.	Comment noted.
4	Table 2.8	Table 2.8 refers to a detection limit of 10 pCi/L gross alpha and 20 pCi/L gross beta for liquid samples, and 12 pCi/L gross alpha for solid samples. Reference should be made to sections of the report or procedures that establish why this lower limit of detection is acceptable. For example, is the specified detection limit sufficiently sensitive to ensure that the MCLs or the 15 mrem/yr dose limit for contaminated soil are not exceeded? Clearly these detection limits are not sufficient to detect contaminants in the environment that are associated with a lifetime risk of 1E-6. This subject requires some discussion.	The radioactivity detection limits listed in Table 2.8 of the RI are for the Close Support Laboratory (CSL) and were established based on the type of instruments used and the radiological scanning procedure that was followed. The methods for calculating the MDCs for the CSL are contained in the document titled *"WAG 6 Quality Assurance Project Plan -CSL"*. The CSL detection limits were set so that they would be below the screening levels outlined in Section 10.1.1, Characterization Strategy, of the approved WAG 6 Work Plan. These screening levels were used to determine which environmental samples would be shipped to an off-site laboratory for selected isotopic analyses.
5	Table 4.2	This table defines discrete values for background contamination. What is the variability associated with these values? In addition, there appears to be a need to demonstrate that twice background is a defensible approach for screening in light of the variability of natural background for these radionuclides.	The source for the background values contained in Table 4.2 are: 1) *Baseline Risk Assessment and Technical Investigation Report for the Northwest Dissolved Phase Plume, Paducah Gaseous Diffusion Plant (DOE/OR/07-1286&DF1, July 1994* and 2) *Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky (DOE/OR/07-1586&D2) June 1997*. Because the background values used in the

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5	Cont.		WAG 6 report are defined as the 95% upper tolerance bound, consideration of the variability of background concentrations would not be appropriate, and the "twice background argument" would not be viable.
		a) Section 4.1.1 refers to the Screening process used to identify COCs. Table 4.2, referred to in Section 4.1.1, presents the background radionuclide concentrations used to assess whether the contaminants identified in WAG 6 are above natural background or above ubiquitous levels of radionuclides in the environment due to fallout. Inspection of Table 4.2 reveals that, except for Pb-210 and Tc-99, the values appear reasonable. In the case of Pb-210, the table indicates N/A (Not Available). The levels of Pb-210 in soil should be comparable to those of U-238 and Ra-226, Eisenbud (1997)[1] cites work that shows that the Pb-210 concentrations in soil is about twice that of U-238, and rainwater contains about 1 to 10 pCi/L of Pb-210. Later in the report, Pb-210 is reported as an important COC and contributor to risk associated with the site. This appears to be an artifact associated with not considering Pb-210 as part of natural background.	a) Agreed. The information concerning Pb-210 contained in this comment will be added to the uncertainty discussion in Vol. 3a, to the observations made in Vol. 3a, and in Sect. 6 of Vol. 1. It is agreed that excess cancer risk associated with Pb-210 may not be real; however, the final decision in that regard will need to be made by the appropriate risk managers.
		b) The Tc-99 level or 2.5 pCi/L does not seem to be appropriate (i.e., it should be zero) since it is not	b) The background value for Tc-99 was drawn from a regulatory agency-approved report

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5	Cont.	normally present in soil. (See Section 1.4.3.8 of Volume 3 of the report, which explains why Tc-99 is not naturally present in the environment.)	entitled *Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1586&D2) *June 1997*. In that document, the background concentrations of Tc-99 in surface soil is reported as being 2.8 pCi/g. (This value is a 95% upper tolerance bound.) Generally, the range given for Tc-99 in surface soil across the A and B horizons and three soil types was 0 to 3.1 pCi/g (15 samples total), and the mean concentrations were 0.151 and 0.395 pCi/g for the A and B horizons, respectively, across three soil types. Hence, the value used for Tc-99 background is correct.
		c) Np-237 is reported as present in natural background at 0.1 pCi/g. Please cite the basis for this value.	c) The background value for Np-237 was drawn from a regulatory agency-approved report entitled *Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1586&D2) *June 1997*. In that document, the background concentration of Np-237 in surface soil is reported as being 0.1 pCi/g.

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Comment No.	Section/Page/Para.	EPA Comment	Response
6	Table 4.6	Table 4.6 presents the isotopes detected in Sector 1. It appears that all radionuclides are at the background level except for Np-237, where the background level is reported as zero. However, Table 4.2 reports that Np-237 is present in background surficial soils at 0.1 pCi/g. It is not apparent that any radionuclide contamination is present in the Section 1 analysis above background. Table 4.6 does not include the values for Tc-99. If any radionuclide is expected to be present it would be Tc-99. Some discussion of this matter is needed.	Table 4.6 provides concentrations of radioisotopes in subsurface soil. The background concentration for Np-237 in the subsurface is 0. (See *Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-1586&D2) *June1997*. There were no detections of Tc-99 at concentrations above background levels from UCRS soils at Sector 1. The general lack of elevated radionuclide activity, including Tc-99, below the thick concrete floor of the C-400 building is not unexpected.

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Comment No.	Section/Page/Para.	EPA Comment	Response
7	Table 4.12, 4.17, and the other summary level Upper Continental Recharge System (UCRS) soil tables	Table 4.12 indicates that uranium, thorium, and Tc-99 are present in soil above background. However, it is not apparent whether these levels are above the levels corresponding to ARARs, 1E-6, or 1E-4. It is not until the reader reviews other chapters that the significance (or lack thereof) of the measured values becomes apparent. These tables should include the limiting concentrations that correspond to 1E-6, 1E-4, any ARARs, the variability in background, and the minimum detectable concentration. This comment applies to all the summary level tables. It appears that the site related radionuclide concentrations in soil at most sectors are relatively low, often close to background, and within the 1E-4 risk range. The main exception to this observation is Sector 8, where the Tc-99 and uranium levels are clearly of concern. This observation is obscured by the enormous amount of information provided. It should be mentioned in the Executive Summary.	It was the intent of the Nature and Extent section (Section 4) to document the distribution and occurrence of all the constituents that may represent possible contamination at the site. For this reason, only limited screening of the data set was preformed. However, as discussed in Section 4.1.1, Screening Process, emphasis was placed on those contaminants that were identified as most likely to be drivers for remedial actions. Additional screens of the data set against risk-based parameters were performed as part of the Baseline Risk Assessment, which is contained in Volume 3 of the report. It is during the BRA process that the constituent concentrations are compared to HI and ELCR values for various scenarios to assess impact to human health and the environment. However, for comparative purposes, a comprehensive list of risk-based Preliminary Remediation Goals (PRGs) has now been included in Section 4 as Table 4.2. Inclusion of this table in the Nature and Extent section should allow the reader to assess the relative significance of the quantitative results that are reported in this section.

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Comment No.	Section/Page/Para.	EPA Comment	Response
8	Page 4-30, line 38	This line states that the peak Tc-99 concentration observed in the upper portion of the Regional Groundwater Aquifer (RGA) during the Site Investigation (SI) was 177 pCi/L. It should be pointed out that this is well below the MCL for Tc-99. Reference is also made to high levels of Tc-99 (i.e., 1200 and 1735 pCi/L). Again these concentrations should be placed into perspective with respect to the MCLs.	Agreed. The significance of these historical detections of TCE and Tc-99 will be placed in perspective by adding text to the discussion that compares the reported values to risk-based PRGs.
9	Page 4-36,line 8	This line refers to Bi-212, Pb-210 and Pb-214 detected above screening levels. These are likely naturally occurring. Some discussion regarding this issue is needed.	Agreed. The text has been revised to state that the three referenced isotopes were each detected in only one sample. Natural groundwater typically contains trace amounts of Bi and Pb, and it is probable that the reported constituents are naturally occurring. However, there is no site specific background data at PGDP for the specific isotopes that were identified. For this reason, and because the risk from these isotopes is evaluated in the BRA, a decision to report the occurrences of these isotopes without additional comment appears appropriate.

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Comment No.	Section/Page/Para.	EPA Comment	Response
10	Page 4-37, line 7	This section identifies a long list of radionuclides detected above screening levels (as described in Section 4.1). Many of these are naturally occurring and appear to be present at naturally occurring levels. The screening criteria provided in Section 4.1 need to be revisited with regard to the natural levels of uranium decay series radionuclides and K-40 in soil and water.	Agreed. Many of the identified radionuclides referenced are likely present at levels which are naturally occurring. Unfortunately, no site-specific background data on these radionuclides are available at the PGDP to support this assumption. Therefore, the distribution and concentration of these radioactive isotopes is reported without further comment. The potential impact due to exposure to these isotopes has been evaluated as part of the BRA.
11	Table 4.50	The radionuclide concentrations in RGA/McNairy soil all appear to be within background levels. By adding additional columns to the table, giving the variability of background, the MDCs, and the 1E-4 to 1E-6 levels, all the reported concentrations could be quickly placed into perspective.	Agreed. Many of the radionuclide concentrations identified within the RGA/McNairy soil are likely within the range of background concentrations for naturally occurring isotopes. Unfortunately, background data for many of the identified constituents are not available for the PGDP. The goals and objectives of the Nature and Extent section was to document the distribution and occurrence of all the constituents that may represent possible contamination at the site. For this reason only limited screening of the data set was preformed. However, for comparative purposes, a table containing a comprehensive list of risk-based PRGs has now been included in Section 4 (Table 4.2). This table will help the reader to place the reported concentrations in perspective with regards to potential health-based risk.

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Comment No.	Section/Page/Para.	EPA Comment	Response
12	Tables 4.55, 4.60, 4.65, and 4.66	The radionuclide concentration in water could be placed into better perspective by comparing the values to the MCLs.	Agreed. However, Maximum Contaminant Levels (MCLs) are not available for most of the radionuclides contained in the referenced tables and would be of limited value. Therefore, for comparative purposes, a table containing a comprehensive list of calculated risk-based PRGs has now been included in Section 4 (Table 4.2). This table will help the reader to place the reported concentrations in perspective with regards to potential health-based risk.

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Comment No.	Section/Page/Para.	EPA Comment	Response
13	Section 5.2 General Comment	It is not apparent, according to the conceptual site model, whether the origin of the contaminants in the aquifers down gradient from the site (see Figure 5.1) are from WAG 6 sources or from other onsite sources. Some discussion is needed of the results of this study within the context of the overall site.	Agreed. Figure 5.1 is a schematic site conceptual model. One of the primary functions of this figure was to illustrate the migration pathway for contaminants derived from the WAG 6 SWMUs. Additional labeling of the figure with respect to the location of WAG 6 and to identify the contaminated plume as originating from sources at WAG 6 have been placed on the figure. Additionally, the following text has been added to Section 5.2, Conceptual Site Model: "As illustrated in Figure 5.1, extensive areas of soil surrounding WAG 6 have been impacted by releases of high concentrations of TCE and lower concentrations of other contaminants into the shallow subsurface UCRS soil. Due to the DNAPL characteristics of the TCE, the dominant dispersal pattern through the vadose soil to the top of the RGA is gravity driven. Within the RGA, where spill volumes were sufficiently large, vertical DNAPL migration has penetrated to the base of the RGA. Lateral transport of dissolved phase contaminants within the RGA follows groundwater flow paths established by the regional groundwater gradient. Releases of TCE at WAG 6 are the source for the downgradient, off-site Northwest Plume and may be related to the smaller Northeast Plume."

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Comment No.	Section/Page/Para.	EPA Comment	Response
14	Section 5.3.4	This section provides an overview of the radionuclides that may be present at the site based on process knowledge. The section indicates that it is unlikely that the longer lived progeny of the U-238 series are present because the site only processed uranium, which was separated from the ore. As such, Th-230 and Ra-226 and their progeny are not expected to be seen at the site. The results of the sampling and analysis program confirm this because Ra-226 does not appear to be present above natural background. Nevertheless, the report identifies Pb-210 as a COC and an important contributor to risk. This appears to be an incorrect conclusion.	Agreed. The occurrence of Pb-210 in natural soils and groundwater has been added to the uncertainty discussion in the Risk section of Volume 3 of the RI. See associated responses to EPA comments #5a and #19.
15	Page 5-14, line 42	This section states that "Due to the very long half-lives of U-238 and U-235, relatively little daughter activity is produced until periods of time approaching the half life have expired. Once the half life has expired, most of the uranium activity is due to U-238". These statements are incorrect and reflect a lack of understanding of basic health physics principles. The presence of any progeny is a function of the half life of the progeny not the parent. For example, the short-lived, immediate progeny of U-238, i.e., Th-234 T1/2=24.1 days; and Pa-234 T1/2=1.7 months, are almost always present along with U-238 in equilibrium. Within a few half lives of the progeny, the progeny approach full equilibrium of the parent; i.e., they approach the same concentration of the parent, given the branching fraction.	The referenced statements have been removed from the text and replaced with: "Radioisotopes such as U-235 and U-238 decay over relatively long time periods and produce daughter products. However, because the presence of any daughter product is a function of the half-life of the progeny, the parent and progeny can approach equilibrium within a few half-lives of the progeny"

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16	Figure 5.3	The figure indicates that radionuclides that exceeded 2 times background or the PRGs were modeled. The PRGs are usually set at the ARARs or at a concentration that falls within the risk range. PRGs for radionuclides are not presented in the report. In addition, it appears that all analyses key into a lifetime risk of 1E-6. Finally, the background levels provided in Section 4, appear to require correction (i.e., the Pb-210 problem). There appear to be some problems with the screening process that need to be resolved. For radionuclides, it appears that only U-238 and Tc-99 in Section 8 are above the PRGs.	The screening summarized in Figure 5.3 was used only to pare the list of contaminants for fate and transport modeling (the PRGs are keyed to a 10^{-6} risk level). This is not the screening procedure used in the quantitative risk assessment.
17	Page 5-23, line 16	This line discusses plutonium contamination in the soils at Sector 4. Inspection of Table 4.22 indicated that there is no plutonium present above 0.2 pCi/g. This is well below any concentration that would be considered a PRG. As a rule of thumb, any concentration of Pu-239 in soil below a few pCi/g could not result in a lifetime risk in excess of 1E-4. In addition, given that all the reported values are at 0.2 pCi/g, is 0.2 pCi/g the MDC? Table 2.8 addresses MDCs but does not provide the MDC for specific radionuclides. a) This section reveals that there are some problems with the screening process. Much more attention must be given to background and the variability in background, the difference between PRGs and screening at 1E-6, the ARARs, and minimum detectable concentrations for radionuclides. In	As a conservative measure in screening contaminants for fate and transport modeling, a plutonium source was modeled at the level of quantification in the absence of a background value or PRG. a) The screening process for the quantitative risk assessment is that outlined in *Methods for Conducting Human Health Risk Assessment and Risk Evaluations at the Paducah Gaseous Diffusion Plant.*

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Comment No.	Section/Page/Para.	EPA Comment	Response
17	Cont.	general, it appears that only Sector 8 contains radionuclide contamination in soils that requires modeling because the concentrations are clearly above PRGs. According to the tables in Section 4, all other sectors have insignificant levels of radionuclides, well below possible PRGs. If the authors of the report are using 1E-6 as a PRG, that would explain some of the conclusions. If the authors are using 1E-6 levels as the basis for decision making, this should be made clear, and reference to PRGs deleted. It should be noted that using 1E-6 as a decision point for radionuclides is problematical because natural background and ubiquitous manmade levels of radionuclides in the environment are above or comparable to the levels corresponding to a risk of 1E-6.	
18	Table 5.31	As a check on the MEPAS modeling, the Tc-99 results were reviewed for Sector 8. According to Table 5.31, the peak Tc-99 concentration in groundwater at the fencepost is 1.14E-3 pCi/L and occurs at year 2213. The starting point for this calculation is the concentration of Tc-99 in subsurface soil in Sector 8, which is given in Table 4.42 as an average of 1281 pCi/g with a max of 4840 pCi/g. Since the Kd of Tc-99 is about 0.1 (i.e., it moves at about the same velocity as the groundwater), it can be assumed that the Tc-99 concentration in the soil pore water in Sector 8 is about 1000 pCi/ml or 1E6 pCi/L. This means that between the source and the fencepost, which appears to be about 1 mile, the Tc-99 is diluted by about a factor	See response to EPA General Comment # 4. The source term concentrations used for the MEPAS modeling of Sector 8 contaminants are provided in Table 5.29 and differ from the concentrations provided in Table 4.42 that were used in your calculations. A source concentration of 265 pCi/g Tc-99 was input to MEPAS, as it was the maximum detected in UCRS soils (the higher values listed in Table 4.42 represent concentrations in sludge). The MEPAS model selected a K_d value of 20 ml/g, based on the soil properties of the UCRS. Using these values, the Tc-99 activity in the water released from the

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18	Cont.	of 1E9 and takes 2000 years to travel the 1 mile. This is an extremely large dilution factor. A discussion is needed explaining conceptually why it is reasonable to expect such a large dilution factor between the source and the fencepost. a) It is also unclear how the existing plume concentrations have been factored into the modeling analysis. Do the models assume that the modeled results are superimposed on the preexisting plume?	source into the vadose zone is 1.325×10^{4} pCi/L. Additional dilution occurs upon entry into the saturated zone. If an approximate dilution factor of 3.2×10^{-5} is applied within the RGA (see Comment # 4), dilution within the aquifer would reduce the Tc-99 activity to 4.2×10^{-1} pCi/L, which is approximately 2 orders of magnitude greater than the result (1.14×10^{-3} pCi/L). The approximations provided above have a high degree of uncertainty. It also is recognized that there are uncertainties in the input parameters used in MEPAS that can lead to results that differ by orders of magnitude. For this reason, the model is used just as a screening tool, not to provide quantitative data for input to the risk assessment. The mathematical formulations used by MEPAS can be found in the Battelle document *MEPAS: Multimedia Environmental Pollutant Assessment System Formulations*. This reference will be added to the document. In addition, the K_d values used in the MEPAS model will be added to Table 5.6 for clarification.

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Comment No.	Section/Page/Para.	EPA Comment	Response
19	Section 6	The risk assessment appears to be comprehensive in that it addresses all the radionuclides of concern, a broad range of current and future use scenarios, and the important exposure pathways. However, Page 6-4, line 8 concluded that exposure to Pb-210 is a major contributor to risk from the site. For the reasons discussed above, the Pb-210 present at the site is likely a natural background and not due to the operation of the facility.	Agreed. The information concerning Pb-210 will be included in the revised risk assessment so that the information is available for consideration by risk managers; a reference to the information will be inserted in Section 6 of the RI report.
20	Section 7	The conclusion section should indicate that, except for Sector 8, the observed radionuclide concentrations are either within the normal range of natural background or well within the MCLs or potential PRGs.	Disagree. A comparison of the radionuclide data to the PRGs in Table 4.2 indicates several radionuclides were present in WAG 6 at concentrations greater than the MCL or PRGs.
21	Volume 3a-Baseline Risk Assessment for Radionuclides	Given schedule and resource limitations, it was not possible to perform a separate detailed review of the BRA. However, a cursory review was performed of the radiological portions of Volume 3, the Baseline Risk Assessment.	Comment noted.
	REVIEWER TWO COMMENTS		

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22	General	The BRA presents a comprehensive analysis of all plausible scenarios and pathways for both present and future use of the site, both on and offsite. All potentially significant radionuclides are addressed. MEPAS was used as the dose and risk assessment model. Previous reviews of MEPAS have revealed that it is an excellent multi-media model for performing offsite dose and risk assessments for both toxic chemicals and radionuclides.	Comment noted.
23	Page 1-115, line 21	Line 21 attributes the elevated risk of lung cancer from smoking to the alpha emitters in tobacco. It is more likely that the chemical carcinogens present in tobacco smoke are primarily responsible for the cancer risks associated with smoking.	Agreed. The sentence "In addition, the cancer incidence in smokers may be directly attributed to the naturally occurring alpha emitter, polonium-210, in common tobacco products" will be modified to "In addition, the cancer incidence in smokers may be attributed, in part, to the naturally occurring alpha emitter, polonium-210, in common tobacco products."
24	Page 1-116, line 16	The statement is made that stochastic effects are related to dose and acute effects are not related to dose. This statement is incorrect. The severity of a stochastic effect is unrelated to dose, but the probability of a stochastic effect is related to dose. The severity of nonstochastic effects are related to dose above the same threshold.	Agreed. The appropriate revisions will be made.
	GENERAL COMMENTS ON GROUNDWATER		

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	General	The greatest concerns we have identified, with respect to DOE's prediction of the fate and transport of radionuclides in groundwater, are associated with DOE's failure to provide relevant information with respect to their contaminant source terms. The information that is usually necessary to describe the source term can be divided into four general areas and include 1) data availability; 2) conceptual model; 3) mathematical model, and 4) verification of results.	Comment noted.
25	Data Collection	Although we performed only relatively cursory review of the available data, it appears that DOE has collected a reasonable amount of data from which the dimensions of the source terms and existing contaminant plumes can be roughly delineated. As noted below, however, data associated with contaminant partitioning and release rates appear to be almost non existent.	Comment noted.

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26	Conceptual Model	DOE's conceptual model for explaining the mechanisms by which radionuclides are mobilized and transported is restricted to a very brief discussion of page 5-19, and indicates that the sources were modeled as depleting over time and degrading within the environment. To evaluate the adequacy of their approach, DOE needs to present the means by which the radionuclides are depleted. For example, on p. 5-7, the text indicates that the distribution coefficient (K_d) is useful in determining retardation, but that K_d does not relate the total metal concentration in the solid to a dissolved concentration. DOE is correct in asserting that the K_d concept is not very accurate in predicting the partitioning between the soil and the water phase, but the fact remains that it is commonly used for this purpose. DOE needs to explain how they explain how they have arrived at pore-water concentrations of radionuclides since apparently they have not used the K_d concept.	Agreed. Although asserting that the K_d concept is not very accurate, the WAG 6 RI uses K_d values in the model to derive pore-water concentrations. Text will be added to clarify that K_d values were used.

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27	Mathematical Model	The most comprehensive discussion pertaining to the mathematical model is found on pages 5-18 and 5-19. The presentation shows that DOE is predicting the migration of contaminants in groundwater by one-dimensional advective and three-dimensional dispersive equations that account for sorption and radioactive decay. This discussion does not, however, present the mathematical formulations for the source-leaching term, which are necessary for a technical adequacy review. Another concern with the mathematical model used to support the RI is that the authors of MEPAS only intended MEPAS to be used as a screening level tool, as is clearly indicated in the code's User's Manuals. This fact is also acknowledged on page 5-19 of the Paducah RI. Therefore, it is not clear how DOE is justifying the use of a tool designed to provide qualitative estimates to support a quantitative risk assessment.	For the WAG 6 model, the RI uses the MEPAS model source-term release module, relying upon K_d values, to derive pore-water concentrations. The MEPAS model is only being used in a qualitative manner to support the risk assessment.

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28	Model Verification	It is difficult to see that DOE has done anything to verify that their modeling results are providing reasonable approximations of the actual field conditions. As will be shown below in our independent modeling section, the most critical aspects of their fate and transport analyses are the assumptions regarding radionuclide release rates from the source term. At a minimum, DOE should support their release rates with leaching studies that are performed with actual site media (i.e., soil and groundwater), and under prevailing geochemical conditions (e.g., Eh, pH). Although DOE indicates that they do not use K_d to predict the concentrations of radionuclides in groundwater, it is difficult to see how they could support a more sophisticated approach since even the most basic data (i.e., K_ds) for the radionuclides have not been measured at the site. Furthermore, if they did use a more defensible means for deriving radionuclide pore-water concentrations, the same methodology should have been used to predict rates of transport. The K_d approach that they use to predict transport rates has many of the same limitations that are associated with predicting pore-water concentrations. The facilitative transport associated with plutonium in Sector 4 suggests that, at least in some cases, the current conceptual model describing transport may not adequately predict radionuclide migration rates and concentrations.	Agreed. Leaching studies with PGDP soils are unavailable for reference. In the absence of the data, the WAG 6 RI has defaulted to K_d values to approximate pore-water contaminant levels derived from the sources. Additional text will be added to the report to discuss the source-release mechanisms. Please also see response to Comment # 4.

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	COMPUTER MODEL VERIFICATION		
	MODFLOW/ SURFACT Modeling	As a reality check on the DOE modeling results, and to illustrate the importance of the contaminant source term assumptions, we performed an independent modeling analysis. Since DOE does not provide any information on the pore-water concentrations of radionuclides reaching the water table, we used our analysis to back out intermediate concentrations along the flow path in order to assess whether DOE's leaching rates and concentrations appear reasonable. Our analysis consists of three major steps as identified below: • Assess how much dilution could potentially occur in the saturated zone as radionuclides travel from the contaminant source to the DOE property boundary. • Use potential dilution rates calculated for the saturated zone, in conjunction with DOE's predictions of Tc-99 concentrations at the DOE property boundary, to determine concentrations of Tc-99 reaching the water table. • Use DOE's assumed contaminant source concentrations in conjunction with estimates of radionuclide concentrations reaching the water table to assess the appropriateness of dilution/attenuation rates that DOE is taking credit for in the unsaturated zone. *Computer Code Selection* - The computer codes that	As shown in our response to EPA General Comment #4, the results obtained by MEPAS are reasonable approximations. An explanation of how source leaching terms are derived by MEPAS is too extensive to include in the RI report, as the formulas used depend on the location of the source and the contaminant type. However, a reference to the Battelle document "MEPAS: Multimedia Environmental Pollutant Assessment System Formulations" will be added to direct the reader to the needed information.

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	Cont.	were selected for the analysis are MODFLOW, for the flow aspects of the analysis, and SURFACT for the transport simulations. MODFLOW was developed by the US Geological Survey, and SURFACT was developed by HydroGeoLogic Inc. *Model Setup* - The model domain is shown in Figure 1, and consists of an area of 6000 by 3000 feet. Constant head boundaries were imposed on the up and downgradient edges of the model in order to impose a hydraulic gradient identical to that used by DOE (i.e., 0.0004). The grid spacing was uniformly set to 15 m, and the domain was divided into 5 layers (i.e., top layer is 5 feet thick, remaining layers are each 10 feet thick). This discretization results in a total of 400,000 nodes. As in Sector 7, the source term dimensions are 290 ft by 195 ft and are set 3300 feet from the security fence and 5500 feet from the DOE property boundary. The source concentration was set to a unit concentration of 1.0, and was assumed to be constant and non decaying. The aquifer properties were also assigned to those used by DOE as identified in DOE's Table 5.6. The hydraulic conductivity (i.e., 1500 ft/day) was assumed to be homogeneous and isotropic. The effective porosity was set to 0.3, and the aquifer thickness was assigned a value of 45 feet (Table 5.6). Contaminant transport properties were also assigned values used by the DOE and include 50, 5, and 0.1 ft. for longitudinal, transverse and vertical	

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	Cont.	dispersivities, respectively; and a distribution coefficient (K_d) of 0.1 L/kg, which DOE assumed was appropriate for Tc-99. *Saturated Zone Dilution* - The results from the modeling are shown in Figures 1, 2, and 3 Figure 1 depicts the steady-state relative concentrations of the areal plume. It should be kept in mind that these concentrations are relative to a unit concentration of 1.0. Therefore, dilution rates are only applicable after the radionuclides have reached the water table. Insofar, as the model does not simulate leaching within the partially saturated zone. Figures 2 and 3 show that relative dilution rates at the fence line and DOE property, respectively. These graphs indicate that the saturated zone could be responsible for reducing radionuclide concentrations by approximately a factor of four. *Concentration of Tc-99 Reaching the Water Table* - To estimate the Tc-99 concentrations that MEPAS would have predicted to reach the water table we have used DOE's model predictions of Tc-99 concentrations at the fence line and DOE property boundary, in conjunction with our knowledge of potential dilution rates in the saturated zone. For the Sector 7 source term, DOE currently predicts that Tc-99 concentrations at the fence line and DOE property boundary will be 5.35×10^{-6} pCi/L, and 3.37×10^{-6} pCi/L, respectively (Table 5.28). Our modeling results,	

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	Cont.	presented above, have shown that dilution in the saturated zone will only decrease contaminant concentrations by a factor of 4. Therefore, DOE must be assuming that concentrations of Tc-99 reaching the water table from the partially saturated zone are approximately 1.685×10^{-6} pCi/L (i.e., 3.37×10^{-6} divided by 0.2). *Leaching Concentrations* - To assess whether DOE's assumed concentration of Tc-99 (i.e., 1.685×10^{-5} pCi/L) reaching the water table is reasonable, we have used Tc-99 concentration data from Sector 7. The initial source concentration presented in Table 5.26 indicates a Tc-99 concentration in the soil of 3.16 pCi/g. As mentioned above, DOE does not discuss their means for deriving pore-water concentrations. This approach, albeit with a high-degree of uncertainty, results in a port water concentration of 3.16×10^{-4} pCi/L for Tc-99, as shown below: $Conc_{Water} = Conc_{Soil}/K_d$ $Conc_{Water} = 3.16$ pCi/gr (1000 gr/kg)(1/0.1 L/kg) $Conc_{Water} - 3.16 \times 10^{-4}$ pCi/L This calculation indicates that the processes DOE has assumed are occurring in the unsaturated zone, in conjunction with the initial mixing of the radionuclides introduced to the groundwater, reduces the pore-water concentrations of Tc-99 from 3.16×10^{4} pCi/L to 1.685×10^{-05} pCi/L or by approximately nine orders of magnitude.	

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	Cont.	*Conclusions* - At face value, a concentration reduction due to dilution/attenuation in the immediate vicinity of the source on nine orders of magnitude appears unrealistically high. However, since DOE has not provided a discussion of the source-release mechanisms it is not possible to identify specific assumptions that seem unreasonable. Perhaps this subject matter can be incorporated within the revised report?	