DOE/OR/07-2180&D2/R1
Primary Document

REDLINE VERSION

Site Investigation Report for the Southwest Groundwater Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

CLEARED FOR PUBLIC RELEASE

THIS PAGE INTENTIONALLY LEFT BLANK.

DOI/OR/07-2180&D2/R1
PRIMARY DOCUMENT

Site Investigation Report for the Southwest Groundwater Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Date Issued–June 2007

Deleted: May

Deleted: 6

Prepared for the
U.S. DEPARTMENT OF ENERGY
Office of Environmental Management

Environmental Management Activities at the
Paducah Gaseous Diffusion Plant
Paducah, Kentucky 42001

managed by
Paducah Remediation Services, LLC

for the
U.S. DEPARTMENT OF ENERGY
under contract DE-AC30-06EW05001

05102007

PADUCAH REMEDIATION SERVICES, LLC;
PORTAGE ENVIRONMENTAL, INC.;
SCIENCE APPLICATIONS INTERNATIONAL CORPORATION; and
BECHTEL JACOBS COMPANY LLC

contributed to the preparation of this document and should not
be considered an eligible contractor for its review.

05102007

PREFACE

This *Site Investigation Report for the Southwest Groundwater Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/OR/07-2180&D2/R1, was prepared in accordance with the requirements of the *Federal Facility Agreement for the Paducah Gaseous Diffusion Plant* (FFA). In accordance with Section IV of the FFA, this integrated technical document was developed to satisfy applicable requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA). Please note that the phases of the investigation process are referenced by CERCLA terminology within this document to reduce the potential for confusion.

The Site Investigation was conducted in accordance with the approved *Site Investigation Work Plan for the Southwest Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/OR/07-2094&D2. The investigation involved collecting subsurface soil and groundwater samples to evaluate four potential source areas of contamination to the Southwest Groundwater Plume (including one burial ground) and to profile the current level and distribution of volatile organic compounds and technetium-99 in the dissolved-phase plume along the west plant boundary. These potential source areas fall within two operable units: the Groundwater Operable Unit (OU), which includes groundwater contamination and its sources; and the Burial Grounds OU, which includes buried wastes that are potential sources of groundwater contamination. The results of this investigation will be used, as necessary, to evaluate the need for a response action to address the Burial Grounds OU sources of contamination and to support the development and evaluation of possible remedies for the Groundwater OU. A separate Remedial Investigation/Feasibility Study is planned for the Burial Grounds OU to evaluate the need for response actions for the site burial grounds.

THIS PAGE INTENTIONALLY LEFT BLANK.

CONTENTS

APPENDICES

THIS PAGE INTENTIONALLY LEFT BLANK.

FIGURES

THIS PAGE INTENTIONALLY LEFT BLANK

TABLES

THIS PAGE INTENTIONALLY LEFT BLANK

ABBREVIATIONS AND ACRONYMS

^{234}U	uranium-234
^{235}U	uranium-235
^{237}Np	neptunium-237
^{238}U	uranium-238
^{239}Pu	plutonium-239
^{99}Tc	technetium-99
ABS	absorption factors
AT123D	Analytical Transient 1-, 2-, 3-Dimensional Model
BERA	Baseline Ecological Risk Assessment
bgs	below ground surface
BHHRA	baseline human health risk assessment
BRA	baseline risk assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cis-1,2-DCE	*cis*-1,2-dichloroethene
COC	contaminant of concern
COPEC	chemical of potential ecological concern
DCA	dichloroethane
DCE	dichloroethene
D&D	decontamination and decommissioning
DNAPL	dense nonaqueous-phase liquid
DOE	U.S. Department of Energy
DPT	direct push technology
DQO	Data Quality Objective
DWRC	dual-wall reverse circulation
Eh	oxidation reduction potential
ELCR	excess lifetime cancer risk
EPA	U.S. Environmental Protection Agency
FFA	Federal Facility Agreement
GC	gas chromatograph
GI	gastrointestinal
HI	hazard index
HU	hydrogeologic unit
INEEL	Idaho National Engineering and Environmental Laboratory
K_d	soil/water partition coefficient
KDEP	Kentucky Department for Environmental Protection
K_H	Henry's Law constant value
K_{oc}	soil organic carbon partition coefficient
K_{ow}	octanol-water partition coefficient
LCD	Lower Continental Deposits
MCL	Maximum Contaminant Level
MDL	method detection limit
MEPAS	Multimedia Environmental Pollutant Assessment Software
MIP	membrane interface probe
MW	monitoring well
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	perchloroethene (tetrachloroethene)

PGDP	Paducah Gaseous Diffusion Plant
pH	hydrogen-ion concentration
POC	pathway of concern
POE	point of exposure
PTZ	permeable treatment zone
RA	Remedial Action
Rad	Total U, ^{234}U, ^{235}U, ^{238}U, ^{237}Np, ^{239}Pu, ^{99}Tc, gross alpha, gross beta
RGA	Regional Gravel Aquifer
RI	Remedial Investigation
SADA	Spatial Analysis and Decision Assistance
SERA	screening ecological risk assessment
SESOIL	Seasonal Soil Compartment Model
SI	Site Investigation
SMP	Site Management Plan
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TCA	trichloroethane
TCE	trichloroethene
Total U	Total uranium
TVA	Tennessee Valley Authority
UCD	Upper Continental Deposits
UCL	upper confidence limit
UCRS	Upper Continental Recharge System
VC	vinyl chloride
VOC	volatile organic compound
WAG	waste area group

EXECUTIVE SUMMARY

The Southwest Groundwater Plume refers to an area of groundwater contamination at the Paducah Gaseous Diffusion Plant (PGDP) in the Regional Gravel Aquifer (RGA) that is south of the Northwest Groundwater Plume and west of the C-400 Building. The plume was identified during the Waste Area Grouping (WAG) 27 Remedial Investigation (RI) in 1998. Additional work to characterize the plume (Solid Waste Management Unit [SWMU] 210) was performed as part of the WAG 3 RI and Data Gaps Investigations, both in 1999. The primary groundwater contaminants are trichloroethene (TCE) with lesser amounts of other volatile organic compounds (VOCs) and the radionuclide technetium-99 (^{99}Tc). This Site Investigation (SI) Report presents the basic strategies and procedures for fieldwork, soil sampling, and groundwater sampling conducted as part of the Southwest Groundwater Plume SI and the results of that work.

The SI was conducted in accordance with the approved *Site Investigation Work Plan for the Southwest Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/OR/07-2094&D2, (DOE 2004). The investigation evaluated the following four potential source areas of contamination to the Southwest Groundwater Plume and profiled the current level and distribution of VOCs and ^{99}Tc in the plume along the west plant fenceline.

Deleted: fenceline

Deleted: boundary

- C-747-C Oil Landfarm (SWMU 1)
- C-720 Building, specifically areas near the northeast and southeast corners of the building
- Storm sewer between the south side of the C-400 Building and Outfall 008 (a part of SWMU 102)
- C-747 Contaminated Burial Yard (SWMU 4)

Three of the four potential source areas and the dissolved-phase plume have been addressed in previous investigations. Very little investigation has focused previously on the storm sewer as a potential source of groundwater contamination.

The objectives of the current SI were to collect sufficient data to do the following:

- Determine which units are sources of contamination to the Southwest Groundwater Plume;
- Determine which units are not sources of contamination to the Southwest Groundwater Plume;
- Fill data gaps for risk assessment of the identified source areas; and
- Reduce uncertainties and increase the understanding of the Southwest Groundwater Plume and potential sources so that appropriate response actions can be identified, as necessary.

The data collection activities were designed to answer the principal study questions that were developed for each potential source area in the SI work plan (DOE 2004). At SWMU 1, the C-720 area, and along the storm sewer, VOC contamination in the shallow soils of the Upper Continental Deposits were profiled using direct push technology (DPT) combined with a membrane interface probe (MIP). Discrete-depth soil samples were collected to approximately 60 ft below ground surface (bgs) at SWMU 1 and the C-720 area and 20 ft bgs along the storm sewer. These samples were sent to laboratories for analyses of VOCs (for all sites) and metals and radionuclides (only for samples from the C-720 area and from along the storm sewer). Temporary borings (85 to 106.5 ft bgs) were used to collect discrete-depth groundwater samples from the RGA at SWMU 4 and in the dissolved-phase plume. These samples were analyzed for VOCs and ^{99}Tc contamination. Existing RGA monitoring wells (MWs) within the area of the plume were sampled for VOCs, metals, and radionuclides. Four MWs were installed near

SWMU 4 to monitor the migration of contamination within the plume. In addition, lithologic data were collected from the borings and the MWs. The analytical results are summarized in Section 4 of this SI Report.

Scope of the Southwest Groundwater Plume within the Sitewide Groundwater Operable Unit Strategy

The Groundwater Operable Unit (OU) is one of five media-specific sitewide OUs at PGDP being used to evaluate and implement remedial actions. The U.S. Department of Energy (DOE), U.S. Environmental Protection Agency (EPA), and the Commonwealth of Kentucky have agreed upon five strategic cleanup initiatives as follows (from *Site Management Plan* [SMP], DOE 2005a):

- Decontamination and Decommissioning (D&D) OU Strategic Initiative,
- Groundwater OU Strategic Initiative,
- Burial Grounds OU Strategic Initiative,
- Surface Water OU Strategic Initiative, and
- Soils OU Strategic Initiative.

The initiatives' objectives include taking early actions as necessary to prevent and reduce exposure and unacceptable risks. This includes completion of a series of prioritized response actions, ongoing site characterization activities to support future response action decisions, and D&D of the currently operating gaseous diffusion plant once it ceases operation, followed by a comprehensive sitewide evaluation, with implementation of additional and final actions as needed to ensure long-term protectiveness. The intended scope, sequence, and timing of the OU initiatives is documented in the SMP (DOE 2005a) and in the *Federal Facility Agreement for the Paducah Gaseous Diffusion Plant* (FFA) (EPA 1998a).

The primary objectives of these initiatives are to take actions necessary to prevent both on-site and off-site human exposure that presents any unacceptable risk, to ensure safe environmental conditions for industrial workers performing ongoing gaseous diffusion plant operations, and to implement actions that provide the greatest opportunities to achieve significant risk reduction before site closure.

For the Groundwater OU, and consistent with EPA guidance (EPA 1999), a phased approach is used to meet the primary objectives. A phased approach is used because the complex groundwater contamination problems at the site (i.e., complex hydrogeology, multiple sources of contamination, and suspected presence of dense nonaqueous-phase liquid [DNAPL]) prevent the PGDP from implementing one comprehensive, cost-effective remedy at this time. Additionally, the phased approach allows the site to use information gained in earlier phases of the cleanup to refine and implement subsequent cleanup objectives and actions.

The phased approach for the Groundwater OU consists of implementing a series of steps that will meet short-term protection goals, intermediate performance goals, and long-term, final cleanup goals. Sequencing the steps in this manner is consistent with EPA's recommendation to use these goals to accomplish the following EPA objectives (EPA 2001; EPA 2004):

- Focus resources at facilities that warrant attention in the near term;

- Control short-term threats;

- Prioritize actions within facilities to address the greatest risks first; and

- Make progress toward the ultimate goal of returning contaminated groundwater to its maximum beneficial use.

As described in the SMP (DOE 2005a), the following steps are used at the PGDP to implement the phased approach for the Groundwater OU:

(1) Prevent human exposure (short-term goal);

(2) Reduce, control, or minimize the major groundwater source areas contributing to off-site contamination (intermediate performance goals); and

(3) Evaluate and select long-term solutions for the off-site dissolved-phase groundwater plumes and remaining groundwater sources (long-term, final cleanup goals).

In implementing this phased approach, DOE has implemented a Water Policy removal action to meet the short-term goal of preventing human exposure to contaminated groundwater and has taken multiple, additional actions to meet the intermediate performance goal of reducing, controlling, or minimizing major groundwater source areas.

This SI for the Southwest Groundwater Plume and its sources will support evaluations regarding Steps 2 and 3 of the phased approach by providing information concerning the potential for release of contamination from source areas, the migration of contamination to downgradient points of exposure (POEs), and risks to human health and the environment posed by contamination below and migrating from the sources. In addition, the SI provides information useful for any additional evaluations of SWMU 4 to be completed in the forthcoming Remedial Investigation/Feasibility Study for the Burial Grounds OU.

Baseline Risk Assessment and Source Identification Conclusions

As part of the SI, a baseline risk assessment (BRA) was conducted in two parts: the baseline human health risk assessment (BHHRA) and the screening ecological risk assessment (SERA). In these assessments, information collected during this SI and results from previous risk assessments were used to characterize the baseline risks[1] posed to human health and the environment resulting from contact with contaminants in groundwater drawn from the Southwest Groundwater Plume in the RGA. In addition, fate and transport modeling was conducted, and the BRA used these modeling results to estimate the baseline risks that might be posed to human health and the environment through contact with groundwater impacted by contaminants migrating from the SWMU 1 and C-720 Building potential source areas to four POEs. The POEs assessed were at the source, the plant boundary (see Fig. 1.4), property boundary, and near the Ohio River.

Vapor transport modeling was conducted to evaluate the potential air concentrations in a residential basement for soil and groundwater contamination at the SWMU 1 and C-720 Building areas and at the plant and property boundary POEs. These concentrations were used as the predicted household air concentrations for estimating excess lifetime cancer risk and hazard for the rural resident. The BRA also summarizes risks from direct contact with other media at the potential sources using information taken from previous assessments and studies, which are listed in Section 6 of this report. A summary of the BRA and source identification conclusions follows for each of the Southwest Groundwater Plume source zones included in the scope of this SI and for the Southwest Groundwater Plume. Environmental data

[1] Baseline risks are conservative estimates of the risks that may be present now or in the future in the absence of response actions and current and future access controls (DOE 2000a).

were also collected from the area of SWMU 4, a burial ground. These data will be used in evaluation of SWMU 4 in the Burial Grounds OU RI. For purposes of assessment of the probabilistic modeling results, the 95% Upper Confidence Limit (UCL) of the modeled peak median concentration of TCE is used for comparisons with Maximum Contaminant Limits (MCLs) and risk-based standards.

SWMU 1

- Results from the samples collected at SWMU 1 indicate that TCE, trichloroethane, and their associated degradation products still exist at the SWMU 1 source area to a depth of 55 ft as defined in the WAG 27 RI Report. Total VOC concentrations greater than 10 mg/kg were not detected in any sample collected during the SI.

- The conceptual model of subsurface contamination for SWMU 1 consists of a discrete zone of soils below the waste oil application areas with TCE DNAPL ganglia that extends from near the surface to the top of the RGA (approximately 55 ft bgs). The area of this contamination is estimated to be approximately 8700 ft^2 (0.2 acre). Ganglia of TCE DNAPL continue to leach dissolved-phase TCE to the Upper Continental Recharge System (UCRS) groundwater. Dissolved TCE levels within the source zone exceed 10,000 µg/L (which is consistent with the presence of free-phase TCE in ganglia[2]). Shallow groundwater flow is dominantly vertical in the SWMU 1 area.

- The BHHRA identified several contaminants of concern (COCs) in water drawn from the RGA and assumed to be used by a hypothetical, on-site, resident at SWMU 1. TCE and other VOCs made up 78% of a cumulative excess lifetime cancer risk (ELCR) of 7 × 10^{-4}. Metals contributed the majority of the remaining cumulative ELCR, and ^{99}Tc accounted for less than 1% of the cumulative ELCR. In addition, VOCs and metals made up 85% and 14,102%, respectively, of the cumulative health index (HI) of 100.

- Two scenarios were evaluated for the probabilistic transport modeling: 1) a variable degradation scenario in which the degradation rate for TCE was allowed to vary over the potential range of values and 2) a fixed degradation scenarnio in which the TCE degradation half-life was held constant at 26.6 yr for the UCRS and no degradation for the RGA. All other parameters in the probabilistic analysis were allowed to vary for both scenarios. The variable degradation scenario indicates that TCE migrating from the SWMU 1 source is not likely to result in exceedances of the TCE MCL at the property boundary or the Ohio River POEs; however, the modeling did indicate that exceedances of the TCE MCL may occur at the plant boundary POE. The fixed degradation scenario indicates that TCE migrating from the SWMU 1 source is likely to result in exceedances of the TCE MCL at the plant and property boundaries, but not at the Ohio River POE.

C-720 Area

- The results of the investigation of the northeast corner of the C-720 area are consistent with the suspected historical TCE release mechanism (routine equipment cleaning and rinsing) presented in the WAG 27 RI Report and confirmed that dissolved contamination has migrated to the area's deeper soil. Results of soil sampling indicate that soils containing very low levels of VOC contamination and other contaminants are detectable in the subsurface of the northeast corner of the C-720 area. Total

Deleted: remedial investigation

Deleted: Although soil and groundwater data from the area of SWMU 4 was collected during this SI, the source area associated with the SWMU 4 burial ground was not included in the fate and transport or risk analysis sections of this SI report. The data collected during this SI that is associated with the SWMU 4 source area associated with SWMU 4 will be further evaluated as part of the Burial Grounds Operable Unit.

Deleted: 6

Deleted: 1

Deleted: 19

Deleted: 80

Deleted: e

Deleted: 0 years

Deleted: Probabilistic transport modeling

Deleted: due

Deleted: s

---

2 With the exception of the lone highest value of TCE contamination reported in soil at SWMU 1 (400,000 µg/kg), the TCE-in-soil levels are easily accounted for by dissolved phase contamination derived from a small DNAPL source zone. For further information, the reader is referred to *Feasibility Study for the Groundwater Operable Unit at Paducah Gaseous Diffusion Plant Paducah, Kentucky*, DOE/OR/07-1857&D2, Volume 4, Appendix C5 (DOE 2001).

VOC concentrations greater than 10 mg/kg were not found in the SI samples. Neither metals nor radionuclide contamination was routinely detected above provisional soil background concentrations.

- Samples collected from the southeast corner of the C-720 area had very low levels of TCE with no associated degradation products. These results indicate that the locations sampled were at the periphery of the source area defined in the WAG 27 RI Report. Neither metals nor radionuclide contamination was routinely detected.

- In the C-720 area conceptual model, the largest TCE source zone underlies a very limited area (0.3 acres) below and adjacent to the outlet for the storm drain on the east end, south side, of the C-720 Building or a nearby storm sewer inlet for the parking lot. In both cases, the interval of contaminated soils extends from the base of the storm sewer (5 ft depth) to the base of the UCRS (60 ft depth). Soil TCE levels are elevated throughout the entire depth of the UCRS within the source zone, but the TCE levels are significantly lower in the soils above the water table, which is at 15 ft bgs.

- The BHHRA identified several COCs in water drawn from the RGA and used by a hypothetical, on-site, resident at the C-720 area. TCE and other VOCs made up 93% of a cumulative ELCR of 2×10^{-3} at the C-720 area. Metals contributed the majority of the remaining cumulative ELCR, and the contribution from ^{99}Tc to cumulative ELCR was less than 1%. At the C-720 area, VOCs and metals made up 76% and 24%, respectively, of the cumulative HI of 10,276.

Deleted: 69
Deleted: 31
Deleted: 70

- While the C-720 area contributed ^{99}Tc to the UCRS, conservative transport modeling in previous RI reports indicates that neither metals nor radionuclides are migrating from the current sources at the C-720 area at rates that would result in exceedances of MCLs for these contaminants at the POEs.

- Probabilistic transport modeling indicates that the TCE migrating from the source at the C-720 Building area is not likely to result in exceedances of TCE MCL at any POE.

- Two scenarios were evaluated for the probabilistic transport modeling: 1) a variable degredation scenario in which the degradation rate for TCE was allowed to vary over the potential range of values and 2) a fixed degradation scenarnio in which the TCE degradation half-life was held constant at 26.6 yr for the UCRS and no degradation for the RGA. All other parameters in the probabilistic analysis were allowed to vary for both scenarios. The variable degradation scenario indicates that TCE migrating from the C-720 building area source is not likely to result in exceedances of the TCE MCL at any POE. The fixed degradation scenario indicates that TCE migrating from the C-720 building area source is likely to result in exceedances of the TCE MCL at the plant boundary, but not at the DOE property boundary or the Ohio River POEs.

Deleted: 0 years
Deleted: s

Storm Sewer from C-400 to Outfall 008

- Soil sample results of the SI indicated that VOCs were present at low levels. Neither metals nor radionuclides were routinely detected at concentrations above provisional soil background concentrations.

- Based on the results of a video survey of the storm sewer and the results from soil samples collected adjacent to the storm sewer, the integrity of the storm sewer is intact; therefore, the storm sewer does not contribute VOCs or ^{99}Tc to the Southwest Groundwater Plume.

- VOCs made up 100% of a cumulative ELCR of 8×10^{-6} in the area of the storm sewer. The HI for the storm sewer was less than 1 and, therefore, not of concern.

- Transport modeling was not performed for the storm sewer because the SI determined that the storm sewer is not a contributing source to the Southwest Groundwater Plume.

SWMU 4

- Previous investigations at SWMU 4 (notably the WAG 3 RI) have indicated hazardous substances in the subsurface soils and groundwater within and immediately adjacent to the boundaries of SWMU 4. The sampling for SWMU 4 as part of this SI focused on characterization of VOCs and ^{99}Tc in groundwater from upgradient and downgradient locations. The SWMU 4 data was not included in the fate and transport and risk calculations sections of this report. The data collected during this SI associated with the SWMU 4 source area will be further evaluated for fate and transport and risk analysis as part of the Burial Grounds OU. The groundwater samples obtained during this SI indicate that SWMU 4 is a source of TCE and ^{99}Tc contamination to the SW Plume and that an upgradient source of contamination also influences dissolved contaminant levels in the SW Plume at the SWMU 4 area.

Southwest Groundwater Plume

- The Southwest Plume refers to an area of groundwater contamination at PGDP in the RGA that is found south of the Northwest Plume and west of the C-400 Building. The primary contaminants are TCE with lesser amounts of other VOCs and the radionuclide, ^{99}Tc.

- The conceptual model for the Southwest Groundwater Plume incorporates the conceptual models for SWMU 1, the C-720 area, and SWMU 4, which on the scale of the Southwest Groundwater Plume are point sources of contamination. Another contributor to dissolved contamination to the Southwest Groundwater Plume may be the C-400 TCE DNAPL source, which is the subject of an ongoing response action, *Record of Decision for Interim Remedial Action for the Groundwater Operable Unit for the Volatile Organic Compound Contamination at the C-400 Cleaning Building at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-2150&D2/R2 (DOE 2005b). Additionally, ^{99}Tc is migrating into the C-720 area. The TCE level currently in the plume exceeds the MCL at the plant boundary, and the current ^{99}Tc level exceeds 900 pCi/L at the plant boundary. (EPA equates 900 pCi/L to the 4 mrem/yr MCL for man-made beta emitters.)

- Several COCs were identified in the dissolved portion of the Southwest Groundwater Plume. TCE and other VOCs made up 90% of a cumulative ELCR of 3×10^{-3}. The contribution from ^{99}Tc to cumulative ELCR was less than 1%; however, uranium-234 and uranium-238 made up 6% of the cumulative ELCR. In addition, VOCs and metals made up 75% and 25%, respectively, of the cumulative HI of 200.

<u>**Uncertainties/Assumptions**</u>

Although all activities planned in the SI work plan were successfully completed, the following uncertainties or assumptions will need to be considered when evaluating response actions for the Southwest Groundwater Plume or its sources:

- The extent to which, the C-400 Building area is a contributing source of TCE contamination to the Southwest Groundwater Plume and the impact that the planned remedial action at the C-400 area will have on the Southwest Groundwater Plume;

- The effects of plant shutdown on groundwater flow direction and velocity;

Deleted: The goals of the SI did not require soil sampling at SWMU 4.

Deleted: Soil and groundwater samples of the WAG 3 RI indicated that the south burial pit, defined by geophysical surveys as an area measuring approximately 100 x 350 ft (15 ft deep), is the primary source of contamination by TCE and its degradation products at SWMU 4. Several soil samples collected from a previous investigation below the waste pit have TCE levels in excess of 10 mg/kg and associated UCRS groundwater samples commonly have TCE levels greater than 10,000 µg/L. In addition, TCE levels in groundwater samples indicated the presence of a secondary source of TCE DNAPL in the RGA.

Deleted: The TCE DNAPL mass estimated to be at SWMU 4 is significantly greater than that estimated for either SWMU 1 or the C-720 area. Previous investigations have identified radionuclides, heavy metals, VOCs, semivolatile organic compounds, and polychlorinated biphenyls as site-related contaminants.

Deleted: The discussion of data collected from the area of the SWMU 4 burial ground in this SI is limited to nature and extent.

Deleted: ¶
The largest contaminated area as defined by TCE contamination is 77,500 ft^2 (1.8 acre) of the total SWMU 4 area of 265,716 ft^2 (6.1 acre). This source area extends through the UCRS to a depth of 55 ft, the top of the RGA. A secondary source estimated to be of the same area is believed to be in the RGA below SWMU 4. In addition,

Deleted: results

Deleted: <#>The BHHRA identified several COCs in water drawn from the RGA and assumed to be used by a hypothetical, on-site, resident at SWMU 4. TCE and other VOCs made up 99% of a cumulative ELCR of 6×10^{-3} at SWMU 4. The contribution from ^{99}Tc to cumulative ELCR was less than 1%. In addition, VOCs and metals made up 99% and 1%, respectively, of the cumulative HI of 900.¶
<#>Results of screening-level transport modeling in the WAG 3 RI Report indicates that several metals, VOCs, and radionuclides could be migrating from SWMU 4 at levels that result in unacceptable concentrations at the plant boundary, property boundary, and Ohio River POEs. Probabilistic transport modeling indicates that TCE migrating from the SWMU 4 sources (i.e., so ... [1]

Deleted: scheduled

Deleted: :

- The presence in groundwater at the C-720 area contaminated with ^{99}Tc not associated with releases from the C-720 area; and

- Uncertainty associated with the presence and rate of degradation of TCE in the UCRS and RGA subsurface environment.

Deleted: <#>The potential for wastes at SWMU 4 to contain DNAPL not considered in the transport modeling; and¶

Deleted: .

THIS PAGE INTENTIONALLY LEFT BLANK

1. INTRODUCTION

Paducah Gaseous Diffusion Plant (PGDP) is an active uranium enrichment facility located approximately 10 miles west of Paducah, Kentucky, and 3.5 miles south of the Ohio River in the western part of McCracken County (Fig. 1.1). The plant is on an U. S. Department of Energy (DOE) site; the total acreage is divided as follows:

- 748 acres-within a fenced security area;
- Approximately 822 acres-uninhabited buffer zone surrounding the plant area; and
- 1986 acres–leased to Commonwealth of Kentucky as part of West Kentucky Wildlife Management Area.

Bordering the PGDP reservation to the northeast, between the plant and the Ohio River, is a Tennessee Valley Authority (TVA) reservation on which is located the Shawnee Steam Plant (Fig. 1.2). Current and anticipated future land use for the PGDP and surrounding areas is depicted in Fig. 1.3, taken from the PGDP Site Management Plan (SMP) (DOE 2005a).

Trichloroethene (TCE), a chlorinated solvent that is a volatile organic compound (VOC), is the most widespread groundwater contaminant associated with PGDP. The TCE breakdown products *cis*-1,2-dichloroethene (*cis*-1,2-DCE), *trans*-1,2-DCE, and vinyl chloride (VC) also are present in some areas. These contaminants have resulted in three dissolved-phase plumes that are migrating from PGDP toward the Ohio River. These groundwater plumes are the Northwest Groundwater Plume (Solid Waste Management Unit [SWMU] 201), the Northeast Groundwater Plume (SWMU 202), and the Southwest Groundwater Plume (SWMU 210), hereafter referred to as the Southwest Plume (Fig. 1.4).

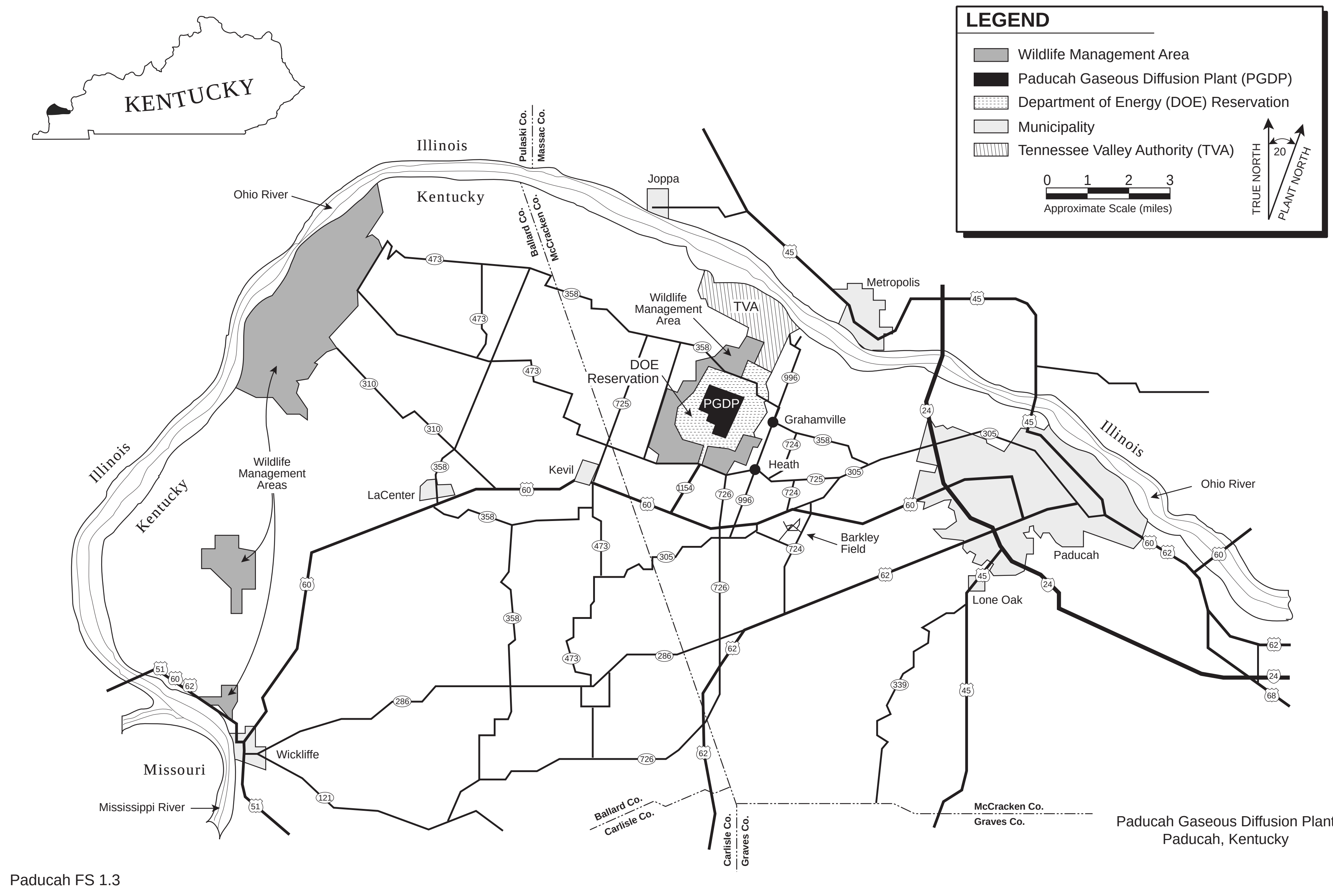
In addition to the plumes defined by TCE, a plume primarily defined by technetium-99 (^{99}Tc), a man-made radioisotope, also has been identified at PGDP. This plume extends from the center of PGDP toward the Ohio River (Fig. 1.5).

1.1 SCOPE OF THE SOUTHWEST PLUME WITHIN THE GROUNDWATER STRATEGY

The Groundwater Operable Unit (OU) is one of five media-specific OUs at PGDP being used to evaluate and implement remedial actions. DOE, U.S. Environmental Protection Agency (EPA), and the Commonwealth of Kentucky have agreed upon five strategic cleanup initiatives as follows (from SMP, DOE 2005a):

- Decontamination and Decommissioning (D&D) OU Strategic Initiative,
- Groundwater OU Strategic Initiative,
- Burial Grounds OU Strategic Initiative,
- Surface Water OU Strategic Initiative, and
- Soils OU Strategic Initiative.

The initiatives' objectives include taking early actions, as necessary, to prevent and reduce exposure and unacceptable risks. This includes completion of a series of prioritized response actions, ongoing site characterization activities to support future response action decisions, and D&D of the currently operating

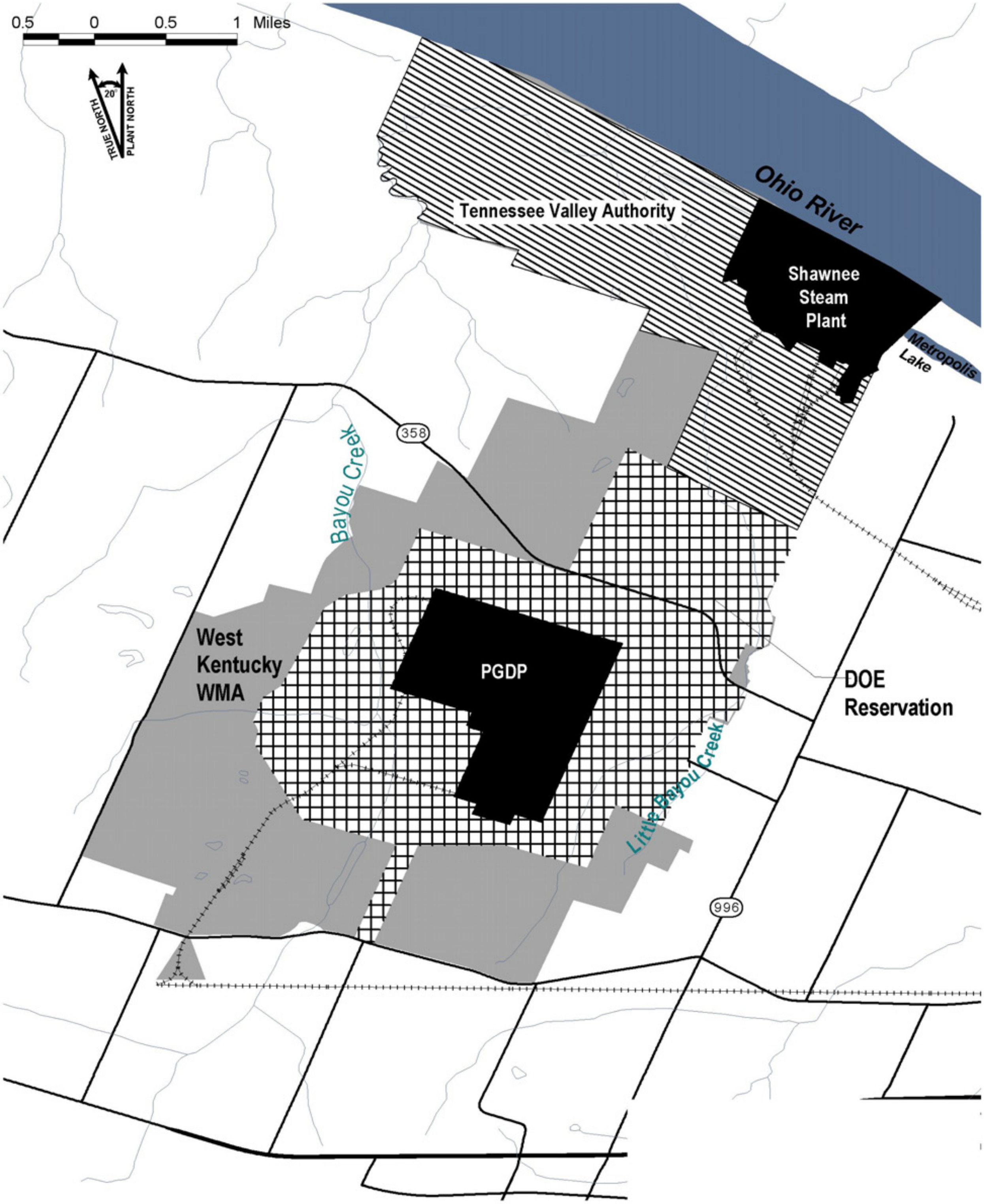


U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH Remediation Services
A Portage Shaw Joint Venture Company

Fig. 1.1. PGDP vicinity map.

FIGURE No. FS1-3
DATE 05-14-01



U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

Fig. 1.2. PGDP surroundings.

PADUCAH Remediation Services
A Portage Shaw Joint Venture Company

FIGURE No. SIs/areas.apr
DATE 09-21-04

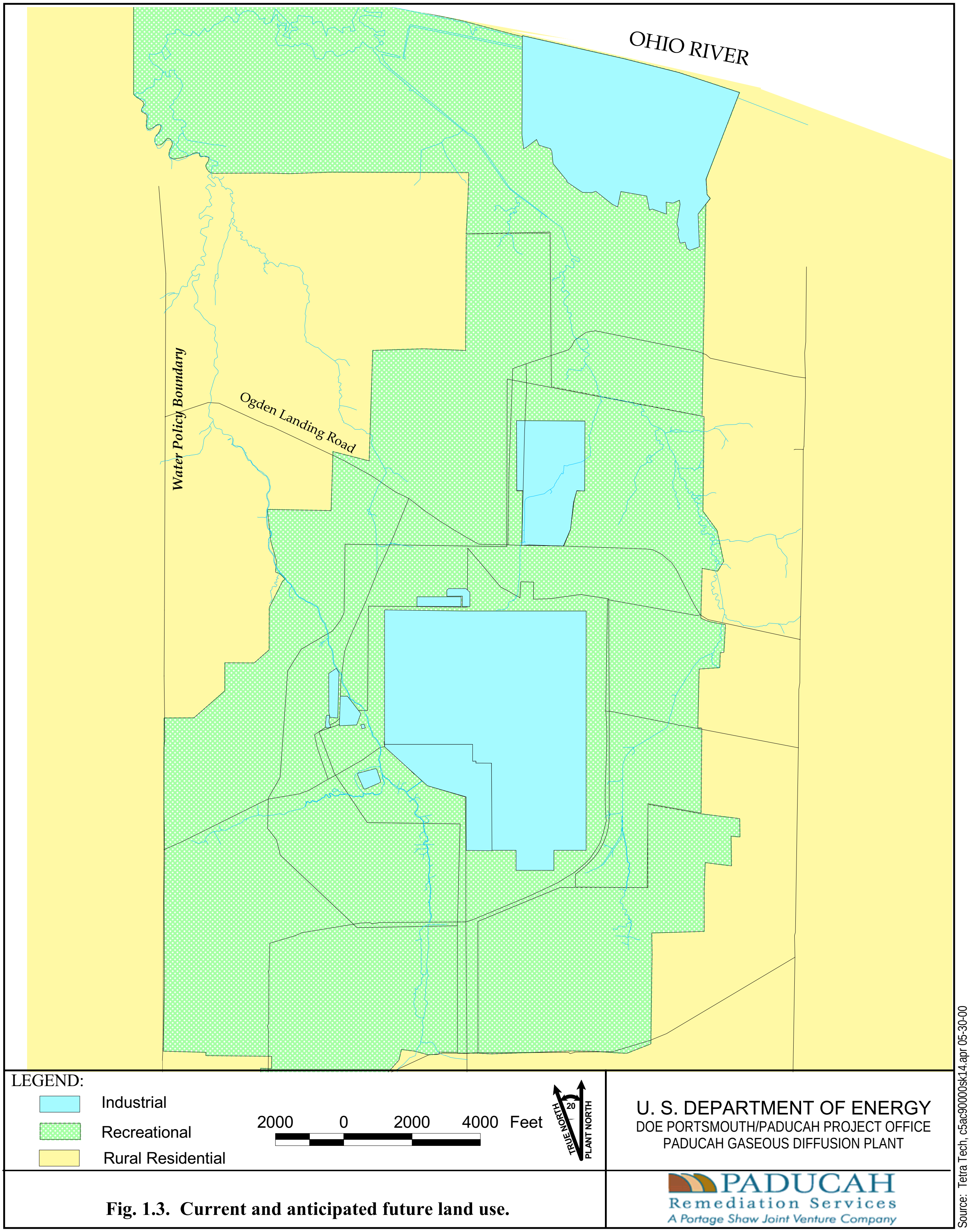
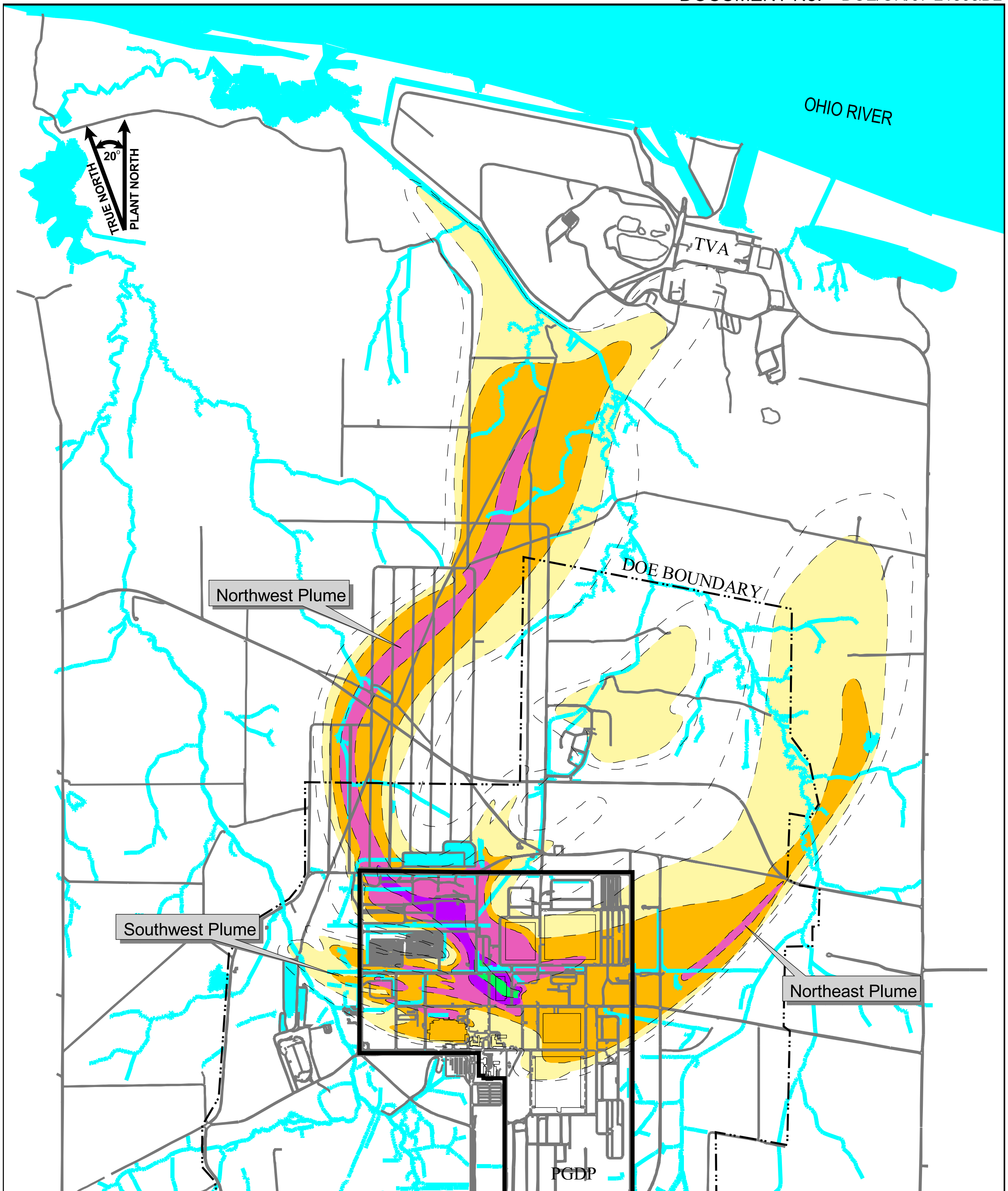


Fig. 1.3. Current and anticipated future land use.



LEGEND:

ISOCONCENTRATION BOUNDARY (INTERPRETED FOR JUNE 2004)

3000 0 3000 Ft

TCE CONCENTRATIONS (ug/L)

TCE CONCENTRATIONS (ug/L)
>100,000
10,000 - 100,000
1,000 - 10,000
100 - 1,000
5 - 100
1 - 5

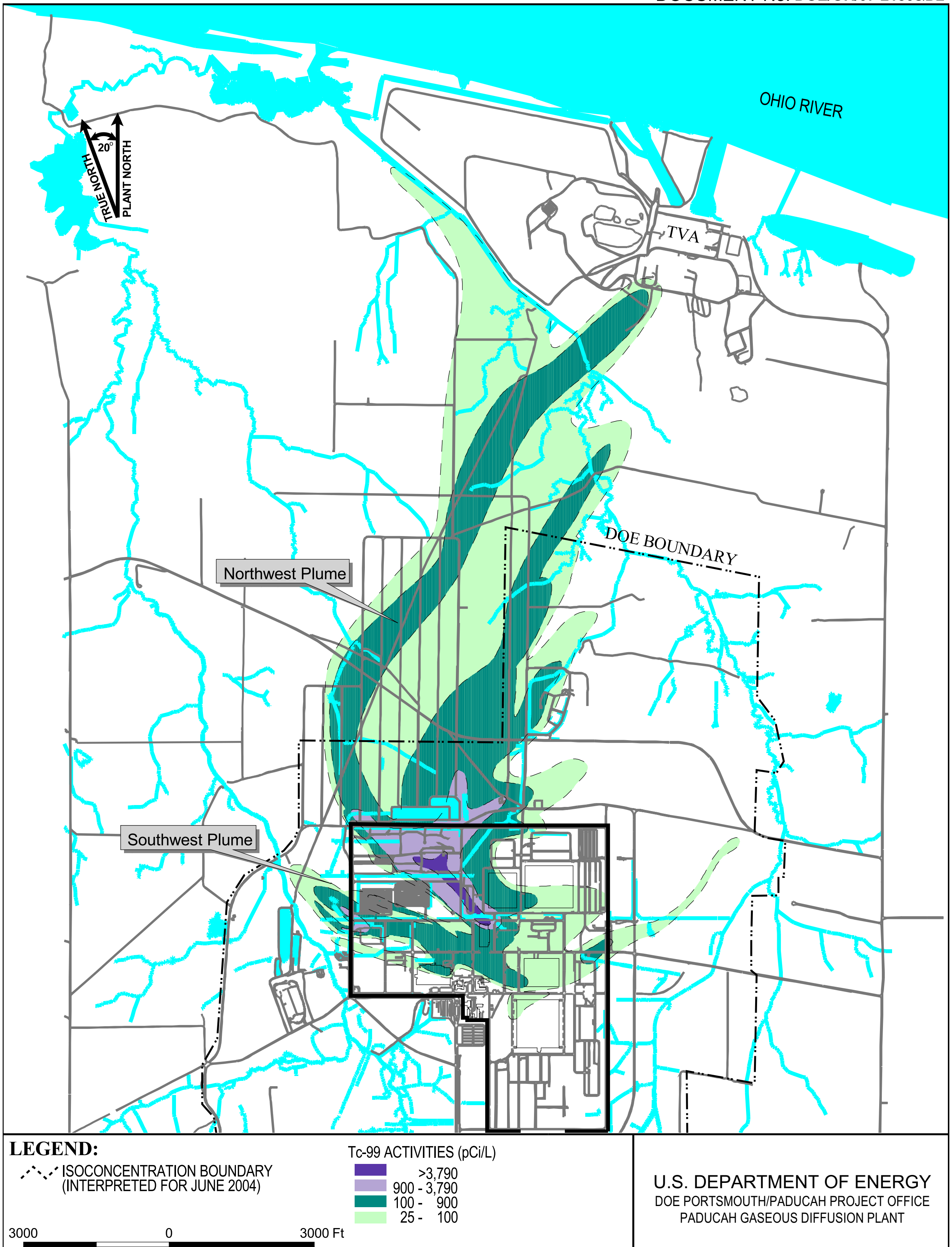
U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

Fig. 1.4. Trichloroethene plume locations.

PADUCAH Remediation Services
A Portage Shaw Joint Venture Company

FIGURE No. c5ac90001sk678R1.apr
DATE 04-10-06

DOCUMENT No. **DOE/OR/07-2180&D2**



U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

Fig. 1.5. [99]Tc plume locations.

PADUCAH Remediation Services
A Portage Shaw Joint Venture Company

FIGURE No. c5ac90001sk679R1.apr
DATE 04-10-06

gaseous diffusion plant once it ceases operation. This will be followed by a comprehensive sitewide evaluation, with implementation of additional and final actions, as needed, to ensure long-term protectiveness. The intended scope, sequence, and timing of the OU initiatives are documented in the SMP (DOE 2005a) and in the *Federal Facility Agreement for the Paducah Gaseous Diffusion Plant* (FFA) (EPA 1998a).

Deleted: -

The primary objectives of these initiatives are to take actions necessary to prevent both on-site and off-site human exposure that presents any unacceptable risk, to ensure safe environmental conditions for industrial workers performing ongoing gaseous diffusion plant operations, and to implement actions that provide the greatest opportunities to achieve significant risk reduction before site closure.

For the Groundwater OU, and consistent with EPA guidance (EPA 1999), a phased approach is used to meet the primary objectives. A phased approach is used because the complex groundwater contamination problems at the site (i.e., complex hydrogeology, multiple sources of contamination, and suspected presence of dense nonaqueous-phase liquid [DNAPL]) prevent the PGDP from implementing one comprehensive, cost-effective remedy at this time. Additionally, the phased approach allows the site to use information gained in earlier phases of the cleanup to refine and implement subsequent cleanup objectives and actions.

The phased approach for the Groundwater OU consists of implementing a series of steps that will meet short-term protection goals, intermediate performance goals, and long-term, final cleanup goals. Sequencing the steps in this manner is consistent with EPA's recommendation to use these goals to accomplish the following EPA objectives (EPA 2001; EPA 2004):

- Focus resources at facilities that warrant attention in the near term;
- Control short-term threats;
- Prioritize actions within facilities to address the greatest risks first; and
- Make progress toward the ultimate goal of returning contaminated groundwater to its maximum beneficial use.

As described in the SMP (DOE 2005a), the following steps are used at the PGDP to implement the phased approach for the Groundwater OU:

(1) Prevent human exposure (short-term goal);

(2) Reduce, control, or minimize the major groundwater source areas contributing to off-site contamination (intermediate performance goals); and

(3) Evaluate and select long-term solutions for the off-site dissolved-phase groundwater plumes and remaining groundwater sources (long-term, final cleanup goals).

In implementing this phased approach, the following Groundwater OU actions have been implemented to meet the short-term goal of preventing human exposure to contaminated groundwater:

- Provided an alternative source of drinking water to certain, nearby residences (1989); and
- Extended municipal water lines as a permanent source of drinking water to certain, nearby residences (1995).

The following additional actions have been taken for the Groundwater OU to meet the intermediate performance goal of reducing, controlling, or minimizing major groundwater source areas:

- Constructed and implemented groundwater treatment systems for both the Northwest and Northeast Plumes to reduce contaminant migration (1995 and 1997, respectively);

- Applied *in situ* treatment of TCE-contaminated soil at the cylinder drop test site using innovative technology (i.e., the LASAGNA™ technology) to eliminate a potential source of groundwater contamination (2002);

- Removed petroleum-contaminated soil from SWMU 193 to eliminate a potential source of groundwater contamination (2002);

- Conducted two key groundwater technology studies, including a successful treatability study to evaluate the effectiveness of the six-phase heating technology for *in situ* treatment of DNAPL at the C-400 Cleaning Building area (DOE 2003), and a partial field demonstration to evaluate the technical constructability of a permeable treatment zone; and

- Initiated activities in accordance with an approved Record of Decision to treat the known DNAPL source zone at the area of the C-400 Cleaning Building using *in situ* electrical resistance heating.

This SI for the Southwest Groundwater Plume and its sources will support evaluations regarding Steps 2 and 3 of the phased approach by providing information concerning the potential for release of contamination from source areas, the migration of contamination to downgradient points of exposure (POEs), and risks to human health and the environment posed by contamination below and migrating from the sources. In addition, the SI provides information useful for the additional evaluations of SWMU 4 to be completed in the forthcoming Remedial Investigation/Feasibility Study for the Burial Grounds OU.

1.2 PURPOSE OF REPORT

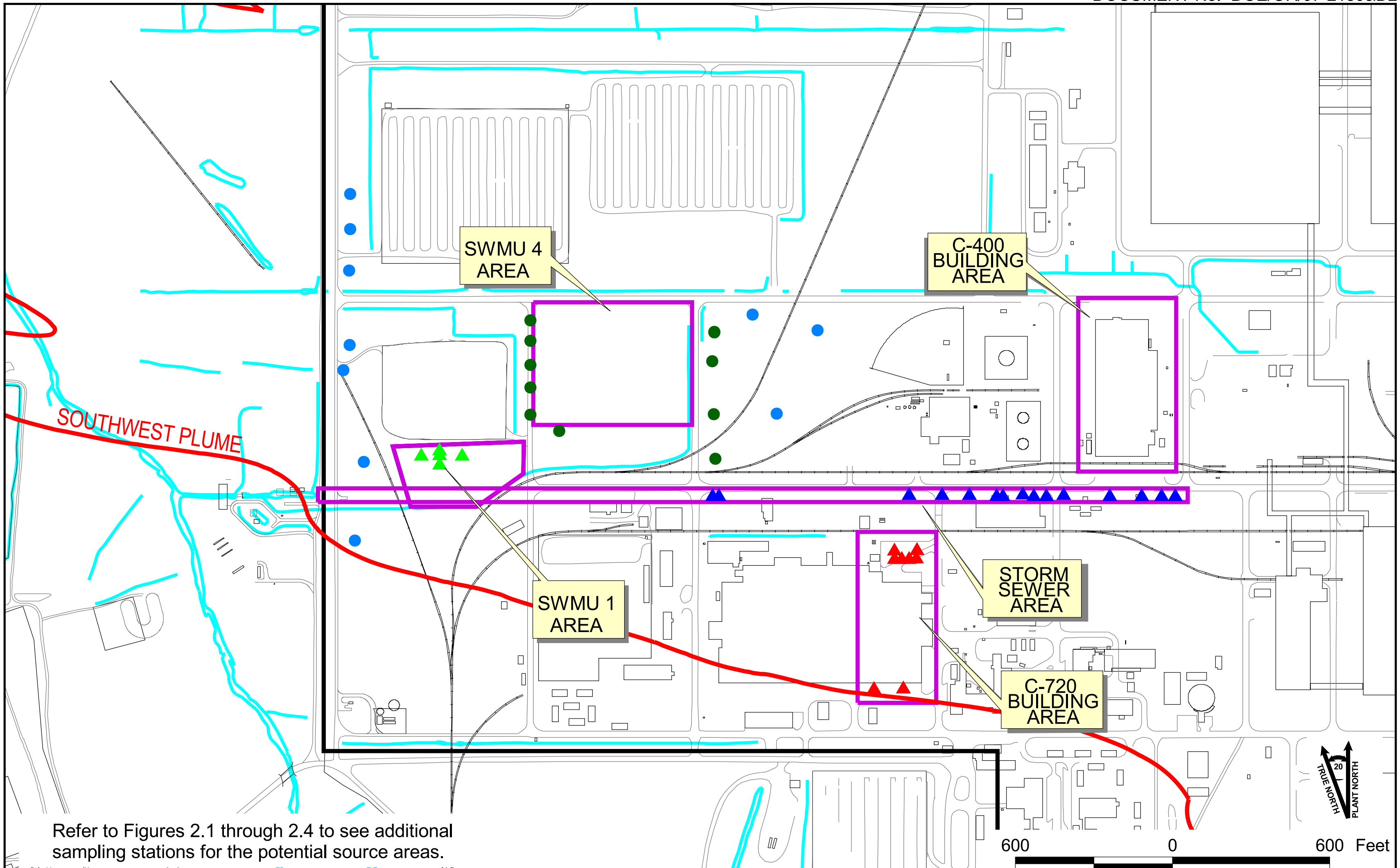
This Site Investigation (SI) focused on four potential source areas of contamination to the Southwest Plume and profiled the distribution of VOCs and ^{99}Tc in this plume along the west plant boundary. The four potential source areas (Fig. 1.6) investigated were the following:

- C-747-C Oil Landfarm (SWMU 1);
- C-720 Building, specifically areas near the northeast and southeast corners of the building;
- Storm sewer between the south side of the C-400 Building and Outfall 008 (a part of SWMU 102)[1]; and
- C-747 Contaminated Burial Yard (SWMU 4).

Three of the four source areas and the dissolved-phase plume have been addressed in previous investigations. Very little investigation focused previously on the storm sewer as a potential source of groundwater contamination. These previous investigations are listed below.

- *Results of the Site Investigation, Phase I, at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (CH2M HILL 1991).

[1] All storm sewers at PGDP are included in SWMU 102. This SI, therefore, considers only one portion of SWMU 102.



Refer to Figures 2.1 through 2.4 to see additional sampling stations for the potential source areas.

LEGEND:

- SOUTHWEST PLUME
- POTENTIAL SOURCE AREA

SOUTHWEST PLUME SITE INVESTIGATION SAMPLING LOCATIONS

SOIL SAMPLING - DPT/MIP
- ▲ SWMU 1 AREA
- ▲ STORM SEWER (SWMU 102)
- ▲ C-720 BUILDING AREA

GROUNDWATER SAMPLING - DWRC
- ● SWMU 4 AREA
- ● SOUTHWEST PLUME (SWMU 210)

U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH Remediation Services
A Portage Shaw Joint Venture Company

Fig. 1.6. Southwest Plume potential source areas.

FIGURE No. \SIs\data_assess1r2.apr
DATE 04-10-06

- *Results of the Site Investigation, Phase II, at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, April (CH2M HILL 1992).

- *Final Remedial Action Report for Waste Area Grouping (WAG) 23 and Solid Waste Management Unit 1 of WAG 27 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1998).

- *Remedial Investigation Report for Waste Area Grouping 27 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1999a).

- *Remedial Investigation Report for Waste Area Grouping 6 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1999b).

- *Remedial Investigation Report for Waste Area Grouping 3 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 2000b).

- *Data Report for the Sitewide Remedial Evaluation for Source Areas Contributing to Off-Site Groundwater Contamination at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* (also know as Data Gaps document) (DOE 2000c).

- *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 2001).

The objectives of the SI, as discussed in the project's work plan (DOE 2004) were to collect sufficient data to do the following:

- Determine which units investigated are sources of contamination to the Southwest Plume;

- Determine which units investigated are *not* sources of contamination to the Southwest Plume;

- Collect sufficient data to resolve data gaps for each of the investigated units; and

- Reduce uncertainties and increase the understanding of the Southwest Plume and potential sources so that response actions can be identified.

Deleted: Fill

Deleted: risk assessment of two of

Deleted: source areas

1.3 SITE BACKGROUND

The Southwest Plume was identified during the WAG 27 Remedial Investigation (RI) in 1998 (DOE 1999a). Additional work to characterize the plume was performed as part of WAG 3 RI (DOE 2000b) and the Data Gaps Investigation in 1999 (DOE 2000c). As discussed in those reports, the primary contaminant defining the plume is TCE. Other contaminants found in the plume are additional VOCs and the radionuclide, ^{99}Tc.

In June 2003, a scoping meeting was held with Kentucky Department for Environmental Protection (KDEP), EPA, DOE, and its contractor to determine the best strategy to complete the Southwest Plume SI. The following problem statement for this investigation was developed as a result of the meeting:

> *Hazardous substances, primarily VOCs and technetium-99 (^{99}Tc), have been detected above the maximum concentration limit in groundwater monitoring wells (MWs) west of the C-400 Building and south of the groundwater contamination area identified as the Northwest Plume. Several SWMUs overlie the area of groundwater*

contamination, which has been named the Southwest Plume. As a result of past investigations, some of these SWMUs have been identified as potential sources of groundwater contamination. It is unknown if or how much of the detected hazardous substances are migrating from these units or if the substances are originating from upgradient sources.

1.3.1 Site Description

Groundwater sampling conducted as part of the WAG 27 RI (DOE 1999a) confirmed the existence of the Southwest Plume. Additional sampling during the Sitewide Evaluation for Source Areas Contributing to Off-Site Groundwater Contamination (commonly called "Data Gaps") (DOE 2000c) and the WAG 3 RI (DOE 2000b) provided additional detail of the plume's structure and identified a previously unknown potential source at SWMU 4. Groundwater samples from below the south burial pit in SWMU 4 included 3 samples with greater than 10,000 μg/L TCE (up to 67,000 μg/L TCE in boring 004-027).

The maximum detected TCE concentration in the Southwest Plume outside of SWMU 4 measured at that time was 10,000 μg/L in boring DG-030, located within the plant boundary immediately west of SWMU 4. Outside the plant boundary, the maximum measured TCE concentration in the Southwest Plume was 480 μg/L in DG-016. The highest level of ^{99}Tc in the Southwest Plume was 3710 pCi/L, taken from soil boring 001-182 in the lower Regional Gravel Aquifer (RGA), located west of SWMU 4 near the plant boundary.

1.3.2 Site History

The Southwest Plume integrates contaminants from multiple sources. Four potential source areas were investigated as part of the Southwest Plume SI. The history of each of those areas is presented below.

1.3.2.1 C-747-C Oil Landfarm (SWMU 1)

Between 1973 and 1979, the C-747-C Oil Landfarm (Fig. 1.6) was used for landfarming of waste oils contaminated with TCE; uranium; polychlorinated biphenyls (PCBs); and 1,1,1-trichloroethane (TCA). These waste oils are believed to have been derived from a variety of plant processes. The landfarm consisted of two 1,125 ft^2 plots that were plowed to a depth of 1 to 2 ft. Waste oils were spread on the surface every 3 to 4 months, then the area was limed and fertilized. Investigations that have collected data on SWMU 1 include the Phase I and Phase II Site Investigations (CH2M HILL 1991 and 1992, respectively), additional sampling performed to support the WAG 23 Feasibility Study, the WAG 23 Remedial Action (RA) (DOE 1998), and the WAG 27 RI. These investigations and actions identified VOCs, PCBs, dioxins, semivolatile organic compounds (SVOCs), heavy metals, and radionuclides as contaminants of concern (COCs). As part of the WAG 23 RA, 23 yd^3 of dioxin-contaminated soil was excavated and removed from the unit. Samples collected to support the WAG 23 RA indicated the presence of *cis*-1,2- DCE concentrations as high as 2,400 mg/kg. During the WAG 27 RI, the maximum TCE and VC concentrations detected in shallow soils were 439 and 4.89 mg/kg, respectively. Most TCE concentrations were less than 100 mg/kg.

1.3.2.2 C-720 Building

Two areas of VOC contamination that were determined to be potential sources of off-site contamination in the WAG 27 RI at the C-720 Building were targeted for further investigation. One area is underneath the parking lot and equipment storage area at the northeast corner of the building. The second area is located underneath the parking lot adjacent to the loading docks at the southeast corner of the building. The areas of investigation are shown in Fig. 1.6.

Northeast Corner: Contamination found to the northeast of the C-720 Building is believed to have been released during routine equipment cleaning and rinsing performed in the area. Solvents were used to clean parts, and the excess solvent may have been discharged on the ground. Spills and leaks from the cleaning process also may have contaminated surface soils in the area. Solvents may have migrated as dissolved contamination, as rainfall percolating through the soils and migrating to deeper soils and the shallow groundwater, or as DNAPL, migrating to adjacent and underlying soils. In the WAG 27 RI, the maximum TCE concentration detected (8.1 mg/kg) was in a sample from Boring 720-027, which was located immediately north of the parking lot.

Southeast Corner: The source of VOC contamination found to the southeast of the C-720 Building is not certain. The VOCs found in this area may have originated from spills that occurred within the building, with subsequent discharge to storm drains leading to the southeast corner of the building or from spills or leaks on the loading dock or parking lot located to the southeast of the building. The area of contamination discovered during the WAG 27 RI is near the outlet to one of the storm drains for the east end of the building. A storm sewer inlet for the southeast parking lot also is located in the vicinity. The north edge of the parking lot, where the contamination occurs, is the location of one of the loading docks for the C-720 Building, an area where chemicals, including solvents, may have been loaded or unloaded. In the WAG 27 RI, the maximum TCE concentration detected (68 mg/kg) was in a sample from Boring 720-002.

1.3.2.3 Storm sewer between the south side of the C-400 Building and Outfall 008 (part of SWMU 102)

During the WAG 6 RI, VOC contamination of subsurface soils was identified near two of the lateral lines that feed into the main storm sewer that runs south of the C-400 Building to Outfall 008 on the west side of PGDP. At one time, the eastern lateral appears to have been connected to the TCE degreaser sump inside the C-400 Building. The TCE that leaked from the sump/storm sewer connection to the surrounding soils has been identified as a source of groundwater contamination. There is a possibility that some of the TCE was transported down the lateral to the main storm sewer line running to Outfall 008, encountered an undetermined breach in the storm sewer, and leaked to the surrounding soils to become a source of TCE to the Southwest Plume. The area of investigation is shown in Fig. 1.6.

Construction Details: The C-400 Building to Outfall 008 storm sewer drains the central west portion of the plant. Major areas and buildings that contribute storm water runoff to the system include all of the following:

- C-631 Cooling Towers,
- C-331 Process Building – roof drains for northwest quadrant,
- C-310 Building – roof drains for north half,
- C-410/C-420 Complex,
- C-400 Building,
- C-409 Building,
- C-600 Steam Plant area,
- C-720 Building – roof drains for north and west sides and associated shops on north side,
- C-746-H3 Storage Pad, and
- C-740 Storage Yard.

Construction drawings show that the Outfall 008 storm sewer begins to the east of the C-400 Building as a 15-inch diameter pipe. The video survey of the Outfall 008 storm sewer that was part of the Southwest Plume SI revealed that the main storm sewer south of the C-400 Building is a 36-inch diameter, reinforced concrete pipe that enlarges to a 48-inch diameter pipe and then a 54-inch diameter pipe between 10^{th} and 8^{th} Streets. West of 8^{th} Street, the Outfall 008 storm sewer continues as a 72-inch diameter pipe. The video survey confirmed that the bottom of the storm sewer is between 13 and 15 ft below ground surface (bgs). Construction drawings indicate that the feeder lines into the main storm sewer range from 8-inch diameter vitreous clay pipe to 24-inch diameter concrete pipe.

1.3.2.4 C-747 Contaminated Burial Yard (SWMU 4)

The C-747 Contaminated Burial Yard (SWMU 4) operated from 1951 through 1958 and was used for disposal of contaminated and uncontaminated trash, some of which was burned. Waste materials from the C-400 Building, originally designated for the C-404 Burial Area, may have been placed at SWMU 4 as well. Scrapped equipment with surface contamination from the enrichment process also was buried. The site consists of several pits excavated to about 15 ft. The waste was placed in the pits and was covered with 2 to 3 ft of soil. A 6-inch clay cap was installed in 1982. The site was investigated during the Phase II SI and the WAG 3 RI (DOE 2000b). The COCs identified in these reports include radionuclides, heavy metals, solvents, semivolatile organics, and PCBs. This Southwest Plume SI focused on the TCE and Tc^{99} contamination in RGA groundwater east and west of the unit. This SI did not evaluate the fate and transport or risk contributions from those COCs or the nature and extent of contamination within the boundaries of the unit. The Burial Grounds OU RI will evaluate these areas further.

Deleted: and

1.3.3 Previous Investigations

Table 1.1 illustrates the previous investigations completed in the Southwest Plume area and the potential source area to which they apply.

Table 1.1. Summary of previous investigations and areas investigated

Date	Title	SWMU 1	C-720	Storm sewer	SWMU 4	SW plume
1989-1990	Phase I Site Investigation	✓		✓	✓	
1990-1991	Phase II Site Investigation	✓	✓	✓	✓	
March 1996	Site-specific sampling	✓				
1997	WAG 6 Remedial Investigation			✓		
1998	WAG 27 Remedial Investigation	✓	✓		✓	✓
1999	Sitewide Data Gaps Investigation				✓	✓
1999	WAG 3 Remedial Investigation				✓	✓

1.4 REPORT ORGANIZATION

This SI report was prepared following the guidance found in Appendix D of the FFA for PGDP (EPA 1998a). Only the subsections contained in the referenced outline that are applicable to this SI are included. These subsections and their location in this report are as follows: Section 2 summarizes the SI activities; Section 3 summarizes the physical characteristics of the Southwest Plume area; Section 4 describes the nature and extent of contamination, based on the results of this and previous investigations for SWMU 1 and C-720 Building sources; Section 5 describes the fate and transport of the contaminants for SWMU 1 and C-720 Building sources; Section 6 contains the summary of baseline risk assessment (BRA) for SWMU 1 and C-

720 Building source areas; Section 7 contains the summary and conclusions; and Section 8 contains references. Section 4 also includes a discussion of groundwater data collected in this SI associated with SWMU 4 and the SW Plume, but does not include nature of extent of source contamination at SWMU 4.

The following appendices are included to support the information presented in the text. Appendix A contains a technical memorandum comparing the activities conducted in the field to those planned in the work plan. Appendix B contains an electronic copy of the analytical data generated during this investigation. Appendices C, D, and E contain the video from the storm sewer survey, the Membrane Interface Profiling report, and the lithologic logs from the borings, respectively. Appendix F contains the source and transport modeling results, and Appendix G presents the BRA. (Note: Appendices B and C are contained on one compact disk.)

2. STUDY AREA INVESTIGATION

This section presents a description of the study area investigation activities and methods used during the Southwest Plume SI. All sampling was conducted in accordance with the medium-specific procedures consistent with EPA Region IV Standard Operating Procedures (EPA 1991). A technical memorandum regarding the procedures is in Appendix A. The general sampling strategy focused on contaminant source investigations, geological investigations, and groundwater investigations. (For additional discussion of the geological structures discussed in the following section, please see Section 3.)

2.1 CONTAMINANT SOURCE INVESTIGATIONS

Contaminant source investigations took place at each of the four potential source areas. At SWMU 1, the C-720 area, and along the storm sewer, VOC contamination in the shallow soils of the Upper Continental Deposits (UCD) was profiled using direct push technology (DPT) combined with a membrane interface probe (MIP). Discrete-depth soil samples collected from each area were sent to the laboratory for VOC analysis. Additionally, samples from the C-720 area and along the storm sewer were analyzed for metals and radionuclides. At SWMU 4, temporary borings were used to collect discrete-depth groundwater samples from the RGA. These samples were analyzed for VOC and ^{99}Tc contamination. All samples were sent to a Sample Management Office laboratory and results provided to the SI. As specified in the Quality Assurance Project Plan (DOE 2004), the data were assessed and 10% was validated. Additional information regarding sampling methods is presented in a technical memorandum included in Appendix A.

2.1.1 C-747-C Oil Landfarm – SWMU 1

At SWMU 1, the SI focused on the area of the soils containing the highest VOC concentrations identified during the WAG 27 RI. The problem statement for this unit developed in the Data Quality Objective (DQO) analysis in the Southwest Plume SI work plan is as follows:

> *Hazardous substances, primarily TCE, have been detected above the maximum concentration limit in a groundwater MW immediately north of SWMU 1. During previous investigations, hazardous substances, including TCE, were detected in the subsurface soils within the boundaries of the unit. Decisions regarding remediation require further characterization of the magnitude of the existing levels of TCE and its degradation products[1] and the extent of the zone of highest contaminated soils.*

The principal study question for this unit is as follows:

> *What is the magnitude and extent of the high-concentration zone of TCE, its degradation products, and other VOCs at SWMU 1?*

To answer the principal study question, five DPT/MIP borings (shown in Fig. 2.1) were placed within and adjacent to the soil contamination area defined during the WAG 27 RI. In addition to the MIP profile, soil samples were collected approximately at 15 ft intervals, based upon readings from the MIP profile, and sent to the laboratory for VOC analysis. Additionally, soil samples were sent to the laboratory

---

[1] The Groundwater Operable Unit Feasibility Study (DOE 2001) identifies the TCE degradation products as *1,1*-DCE; *1,2*-DCE (*cis-1,2*-DCE and *trans-1,2*-DCE); and VC. These are intermediate dechlorination products that commonly form in anaerobic settings.

DOCUMENT No. DOE/OR/07-2180&D2

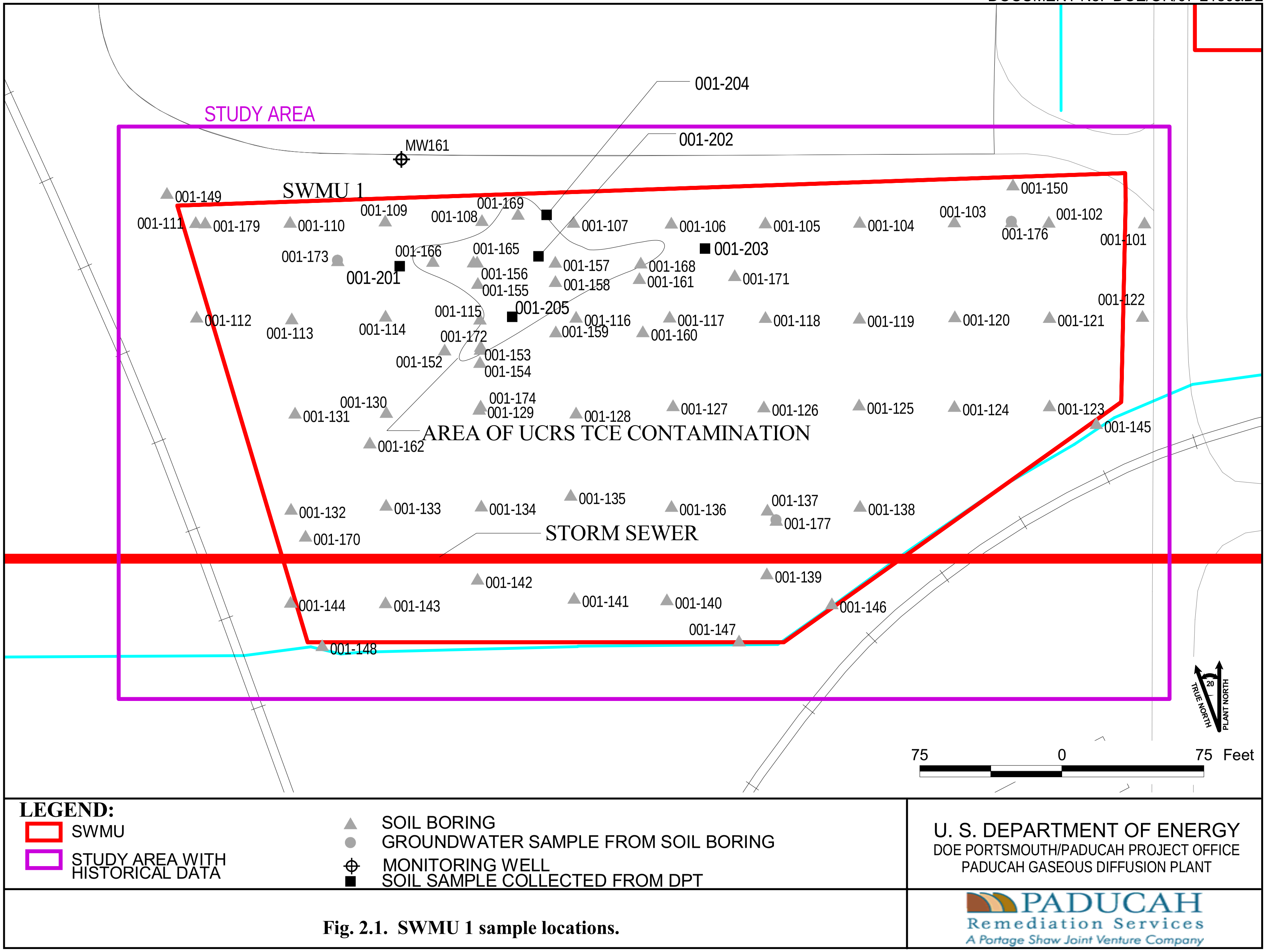


Fig. 2.1. SWMU 1 sample locations.

FIGURE No. \SIs\data_assess1r2.apr
DATE 12-14-04

for headspace analysis using SW846-3810. Results from these headspace analyses, which were available within seven days after sample collection, were used to determine if contingency borings were needed at SWMU 1. Based upon comparisons to "trigger levels" (soil VOC concentrations greater than 10,000 μg/kg) specified in the Southwest Plume SI work plan, no contingency borings were needed. Table 2.1 provides a summary of the sampling for each boring.

Table 2.1. Summary of soil sampling and analysis for the C-747-C Oil Landfarm – SWMU 1

Boring	Drilling method	Total depth (ft)	Sample depth (ft bgs)	Media	Analytes	Sample date
001-201	DPT/MIP	60'	15.5, 30, 50.5, 56	Soils	VOCs	May 2004
001-202	DPT/MIP	60'	13, 30.5, 47, 59.5	Soils	VOCs	June 2004
001-203	DPT/MIP	60'	15, 33, 47, 51.5	Soils	VOCs	May 2004
001-204	DPT/MIP	60'	20.5, 30.5, 45.5, 58.5	Soils	VOCs	June 2004
001-205	DPT/MIP	60'	18, 30, 46, 54.5	Soils	VOCs	June 2004

bgs = below ground surface
DPT = direct push technology
ft = feet
MIP = membrane interface probe
VOCs = volatile organic compounds

2.1.2 C-720 Area

The problem statement for the C-720 area developed in the DQO analysis in the Southwest Plume SI work plan is as follows:

> *Temporary borings from previous investigations and MWs have encountered hazardous substances above background levels in the soils and groundwater in the vicinity of the C-720 Building. The extent and magnitude of two areas of contamination near the east end of the building are not known.*

The principal study question for this area is as follows:

> *What is the magnitude and extent of the areas of contamination near the east end of the C-720 Building?*

Based upon information collected during the WAG 27 RI, the C-720 area was divided into two source areas: the northeast corner and the southeast corner. Each of these areas is discussed below.

Northeast Corner: The investigation at the Northeast Corner of the C-720 area focused on the soils underneath the parking lot, with VOCs, metals, and radionuclides being the contaminants of interest.

The principal study question to be answered for this area is as follows:

> *What is the concentration of the VOCs, metals, and radionuclides in the soils below the parking lot at the northeast corner of the C-720 Building?*

To answer the principal study question for the northeast corner, six DPT/MIP borings, shown in Fig. 2.2, were placed between the north edge of the parking lot and a storm sewer to which all surface runoff for the parking lot flows. In addition to the MIP profile, soil samples were collected at 15 ft intervals and sent to the laboratory for VOCs, metals, and radionuclides analysis. Additionally, soil

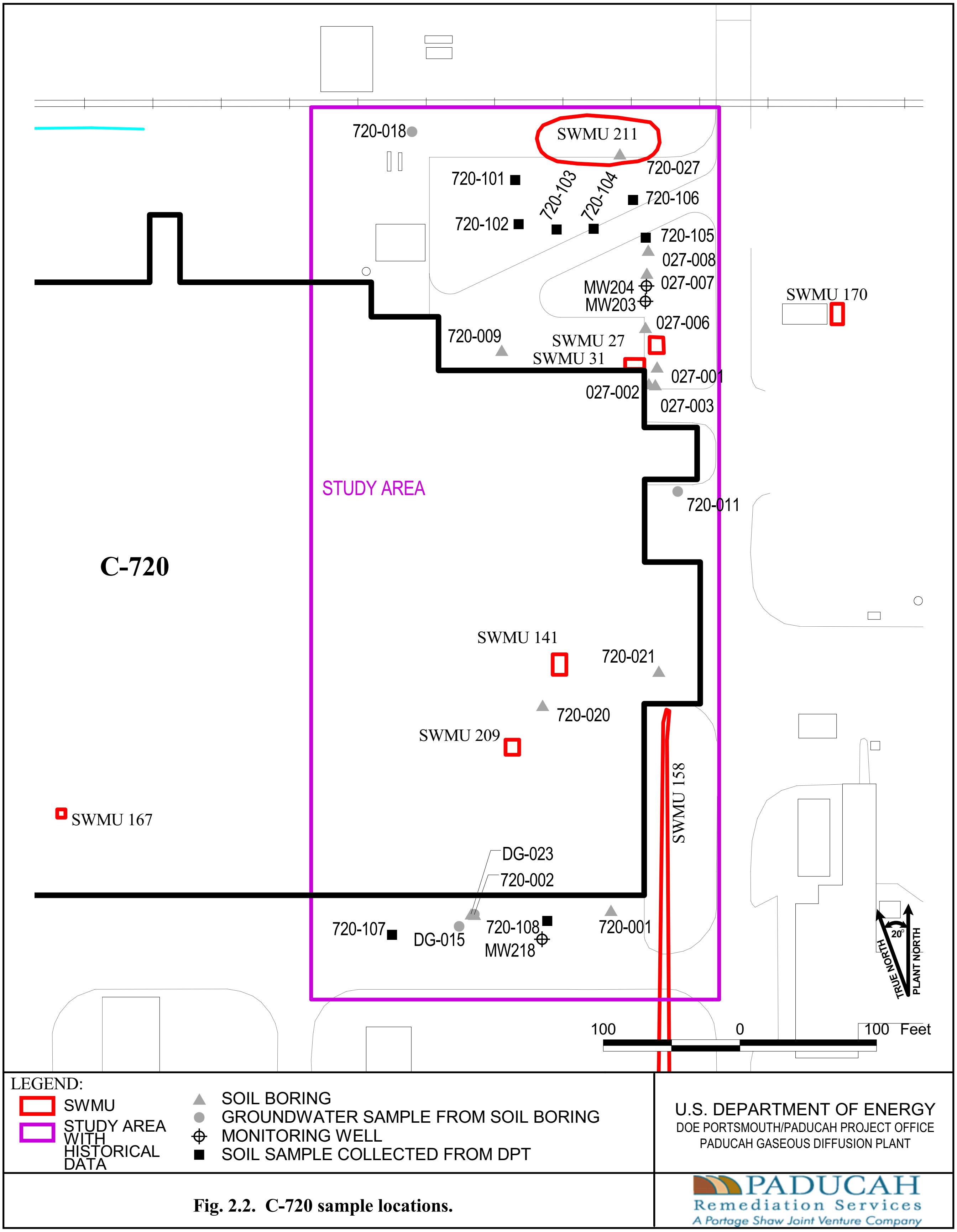


Fig. 2.2. C-720 sample locations.

samples were sent to the laboratory for headspace analysis using SW846-3810. Results from these headspace analyses, which were available within two days after sample collection, were used to determine if contingency borings were needed at the northeast corner of the C-720 area. Based upon comparisons to "trigger levels" (soil concentrations of TCE and its degradation products greater than 10,000 μg/kg) specified in the Southwest Plume SI work plan, no contingency borings were needed. A groundwater well completed in the UCD located at the east edge of the parking lot, MW204, also was sampled. Water samples were analyzed for VOCs, metals, and radionuclides. Table 2.2 provides a summary of the sampling for each boring.

Table 2.2. Summary of soil and groundwater sampling and analysis for the C-720 Building area

Boring	Drilling method	Total depth (ft)	Sample depth (ft bgs)	Media	Analytes	Sample date
			Northeast corner			
720-101	DPT/MIP	60'	18.5, 38, 48.5, 59	Soils	VOCs, Metals, Rad	June 2004
720-102	DPT/MIP	60'	18.5, 33.5, 48.5, 58.5	Soils	VOCs, Metals, Rad	June 2004
720-103	DPT/MIP	60'	18.5, 34, 48.5, 59.5	Soils	VOCs, Metals, Rad	June 2004
720-104	DPT/MIP	60'	19, 33.5, 48.5, 59.5	Soils	VOCs, Metals, Rad	June 2004
720-105	DPT/MIP	60'	18.5, 33.5, 49.5, 59.5	Soils	VOCs, Metals, Rad	June 2004
720-106	DPT/MIP	60'	18.5, 33, 49, 59.5	Soils	VOCs, Metals, Rad	June 2004
			Southeast corner			
720-107	DPT/MIP	60'	24, 29, 48.5, 59.5	Soils	VOCs, Metals, Rad	June 2004
720-108	DPT/MIP	60'	18.3, 33.5, 48.6, 59.5	Soils	VOCs, Metals, Rad	June 2004
			Monitoring wells			
MW203[a]	RGA Well			Groundwater	VOCs, Metals, Rad	July 2004
MW204	UCRS Well			Groundwater	VOCs, Metals, Rad	July 2004

[a] The results of sample analysis for MW203 were used in the assessment of the dissolved-phase portion of the Southwest Plume.

bgs = below ground surface
DPT = direct push technology
ft = feet
MIP = membrane interface probe
MW = monitoring well
Rad = total uranium (U), ^{234}U, ^{235}U, ^{238}U, neptunium-237 (^{237}Np), plutonium-239 (^{239}Pu), ^{99}Tc, gross alpha, and gross beta
UCRS = Upper Continental Recharge System
VOCs = volatile organic compounds

Southeast Corner: The investigation at the Southeast Corner of the C-720 area focused on the soils underneath the parking lot and immediately adjacent to the loading dock, with VOCs, metals, and radionuclides being the contaminants of interest.

The principal study question to be answered for this area is as follows:

What is the concentration of the VOCs, metals, and radionuclides in the soils below the parking lot at the southeast corner of the C-720 Building?

To answer the principal study questions and implement the decision rules for the southeast corner, two DPT/MIP borings were placed, one east and one west of the location for 720-002 (see Fig. 2.2), through the parking lot adjacent to the C-720 Building loading dock. In addition to the MIP profile, soil samples were collected at 15 ft intervals and sent to the laboratory for VOCs, metals, and radionuclide analysis. Additionally, soil samples were sent to the laboratory for headspace analysis using SW846-3810. Results from these headspace analyses, which were available within 2 days after sample collection, were used to determine if contingency borings were needed at the southeast corner of the C-720 area. Based upon comparisons to "trigger levels" (greater than 10,000 μg/kg VOCs) specified in the Southwest Plume SI Work Plan, no contingency borings were needed. Table 2.2 provides a summary of the sampling for each boring.

2.1.3 Storm Sewer from the C-400 Building to Outfall 008 – Part of SWMU 102

The problem statement for this unit developed in the DQO analysis in the Southwest Plume SI work plan is as follows:

> *Processes associated with the C-400 Building are documented sources of subsurface soil and groundwater contamination. The subject storm sewer collects storm water runoff from the C-400 area. Additionally, the storm sewer may have captured liquids from C-400 processes. It is not known if the storm sewer has transported contaminants or if contaminants have leaked from the storm sewer to the surrounding soils.*

The principal study questions to be answered for this unit are these:

> *What is the current structural integrity of the storm sewer?*
>
> *Are there contaminants in the backfill material of the storm sewer and the adjacent soils that may act as sources of contamination for the Southwest Plume?*

To answer these questions, a utility survey and soil profiling and sampling were performed. These activities are discussed below.

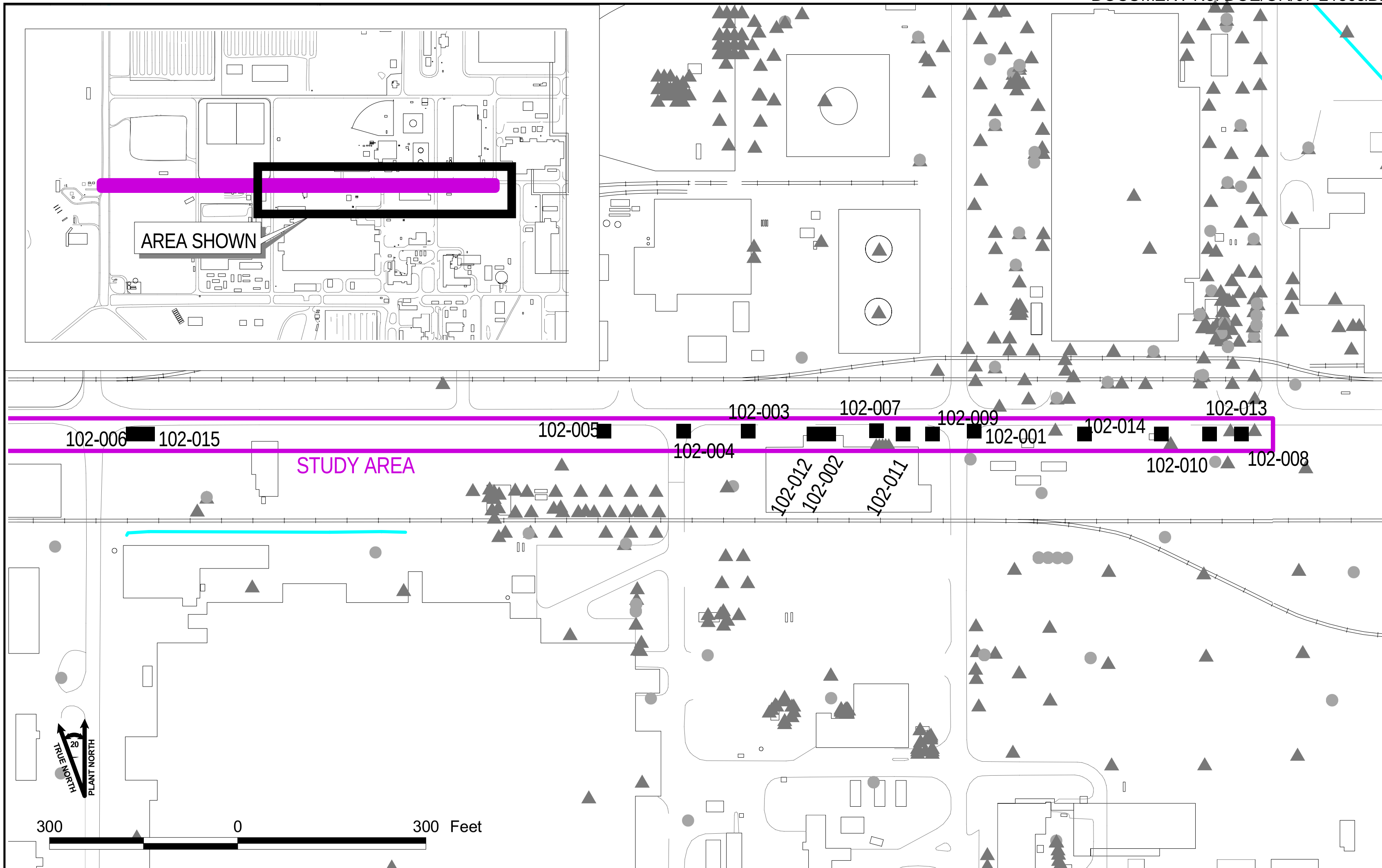
Utility Survey: To answer the first principal study question, a video system, utilizing a remotely operated video camera, a mechanism for moving the camera through the pipe, and a video recorder on the surface, was deployed to inspect approximately 3,000 ft of the main storm sewer, extending downstream from the east side of the C-400 Building toward Outfall 008. Additional information regarding the utility survey can be found in the technical memorandum in Appendix A and in Appendix C.

The video was evaluated, and 15 DPT/MIP borings (Fig. 2.3) were placed according to the following decision rules developed in the DQO analysis:

> *If the video camera survey detects holes or fractures in the bottom half of the storm sewer, then plan a DPT/MIP boring for each location to sample for contamination.*
>
> *If more than 15 holes or fractures are found in the bottom half of the storm sewer, then place priority on the 15 holes or fractures located closest to the C-400 and C-720 Buildings.*

Soil Profiling and Sampling: DPT/MIP borings were placed adjacent to potential holes and fractures in the storm sewer, as identified by the video survey (Table 2.3), as close to the pipe as possible (two-to-three-ft distance) so that soil samples could be collected from the base of the backfill material in which the storm sewer rests. Each boring penetrated to a depth of 20 ft. The soil samples were sent to the laboratory for analysis for VOCs, metals, and radionuclides. Additionally, soil samples were sent to the laboratory for headspace analysis using SW846-3810. Results from these headspace analyses, which were available within two days after sample collection, were used to determine if contingency borings were needed along the storm sewer. No contingency borings were needed. Table 2.4 provides a summary of the sampling for each boring.

DOCUMENT No. DOE/OR/07-2180&D2



LEGEND:

- SWMU
- STUDY AREA WITH HISTORICAL DATA
- SOIL BORING
- GROUNDWATER SAMPLE FROM SOIL BORING
- MONITORING WELL
- SOIL SAMPLE COLLECTED FROM DPT

Fig. 2.3. SWMU 102 sample locations.

U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH Remediation Services
A Portage Shaw Joint Venture Company

FIGURE No. SI\dataassess.apr
DATE 09-20-04

Table 2.3. Criteria for placement of SWMU 102 boreholes (based on utility video survey)

Manhole			
East	West	Observations from video survey	Borehole
C-725G East		Anomaly in pipe at 15 ft west of C-725G East	102-008
		Anomaly in pipe at 66 ft west of C-725G East	102-013
		Break in service connection at 142.5 west of C-725G East	102-010
	C-725F East	Anomaly in pipe at 170 ft east of C-725F East	102-014
C-725F East	C-725E East	Joint problem with infiltration at 54 ft east of C-725E East	102-001
C-725E	C-725D	Anomaly in pipe at 181 ft east of C-725D	102-009
		Anomaly in pipe at 134 ft east of C-725D	102-011
		Anomaly in pipe at 91.3 ft east of C-725D	102-007
		Pipe problem with heavy debris at 15 ft east of C-725D	102-002
C-725D East	C-725C	Anomaly in pipe at 281 ft east of C-725C	102-012
		Joint problem with infiltration at 176 ft east of C-725C	102-003
		Longitudinal fracture in pipe at 73 ft east of C-725C	102-004
C-725C East	C-725B	Joint problem with infiltration at 189 ft east of C-725B	102-005
C-725A West	C-725B West	Joint problem with infiltration at 263 ft west of C-725A West	102-015
		Anomaly in pipe at 286 ft west of C-725A West	102-006

Table 2.4. Summary of soil sampling and analysis for the storm sewer from theC-400 Building to Outfall 008 – Part of SWMU 102

Boring	Drilling method	Total depth (ft)	Sample depth (ft bgs)	Media	Analytes	Sample date
102-001	DPT/MIP	20'	19.3	Soils	VOCs, Metals, Rad	July 2004
102-002	DPT/MIP	20'	19.8	Soils	VOCs, Metals, Rad	June 2004
102-003	DPT/MIP	20'	18.8	Soils	VOCs, Metals, Rad	June 2004
102-004	DPT/MIP	20'	19.7	Soils	VOCs, Metals, Rad	June 2004
102-005	DPT/MIP	20'	19.8	Soils	VOCs, Metals, Rad	June 2004
102-006	DPT/MIP	20'	18.8	Soils	VOCs, Metals, Rad	June 2004
102-007	DPT/MIP	20'	19.5	Soils	VOCs, Metals, Rad	June 2004
102-008	DPT/MIP	20'	20	Soils	VOCs, Metals, Rad	August 2004
102-009	DPT/MIP	20'	19.8	Soils	VOCs, Metals, Rad	July 2004
102-010	DPT/MIP	20'	20	Soils	VOCs, Metals, Rad	August 2004
102-011	DPT/MIP	20'	19.8	Soils	VOCs, Metals, Rad	July 2004
102-012	DPT/MIP	20'	19.8	Soils	VOCs, Metals, Rad	June 2004
102-013	DPT/MIP	20'	20	Soils	VOCs, Metals, Rad	August 2004
102-014	DPT/MIP	20'	20	Soils	VOCs, Metals, Rad	August 2004
102-015	DPT/MIP	20'	19.3	Soils	VOCs, Metals, Rad	June 2004

bgs = below ground surface
DPT = direct push technology
ft = feet
MIP = membrane interface probe
Rad = total uranium (U), ^{234}U, ^{235}U, ^{238}U, ^{237}Np, ^{239}Pu, ^{99}Tc, gross alpha, and gross beta
UCRS = Upper Continental Recharge System
VOCs = volatile organic compounds

2.1.4 C-747 Contaminated Burial Yard – SWMU 4

At SWMU 4, the intent of the SI was to provide additional information that can be used to determine if this SWMU contributes VOC and ^{99}Tc contamination to the RGA and, if so, how much. The problem statement for this unit developed in the DQO analysis in the Southwest Plume SI work plan is as follows:

> *Hazardous substances, including VOCs and radionuclides, have been detected above MCLs in the subsurface soils and groundwater within and immediately adjacent to the boundaries of SWMU 4. It is unknown if or how much contamination is entering the RGA from this unit.*

The principal study questions for this unit are these:

> *What are the VOCs and their concentrations in the RGA upgradient (east) of SWMU 4?*
>
> *What are the VOCs and their concentrations in the RGA downgradient (west) of SWMU 4?*
>
> *What are the ^{99}Tc activities in the RGA upgradient (east) of SWMU 4?*
>
> *What are the ^{99}Tc activities in the RGA downgradient (west) of SWMU 4?*

To answer the principal study questions, ten temporary groundwater borings were drilled by dual-wall reverse circulation (DWRC) and sampled: four east of SWMU 4, five west of SWMU 4, and one near the southwest corner of SWMU 4. The locations of these borings are shown in Fig. 2.4. All borings were drilled to the base of the RGA (see Table 2.5). Groundwater samples were collected approximately at 10 ft intervals and analyzed for VOCs and ^{99}Tc in a laboratory. Additionally, groundwater samples were sent to the laboratory for headspace analysis using SW846-3810. Results from these headspace analyses, which were available within seven days after sample collection, were used to confirm that SWMU 4 was a source of dissolved contamination to the RGA. Had SWMU 4 proved not to be a source of contamination to the RGA, further characterization of SWMU 4 would have awaited the concurrence of DOE, KDEP, and EPA on a revised assessment approach. Additional information regarding drilling and groundwater sampling is found in the technical memorandum in Appendix A. Table 2.5 provides a summary of the sampling for each boring.

2.2 GEOLOGICAL INVESTIGATION

The geological investigation used information acquired with each new boring to develop logs of the subsurface sediments at each source area. Information used included the depth, color, grain size, and texture of samples from soil cuttings collected every 5 ft and at significant lithology changes. Additional information on lithologic description methods is available in the technical memorandum found in Appendix A. Additionally, lithologic logs for the SI borings can be found in Appendix E.

DOCUMENT No. DOE/OR/07-2180&D2

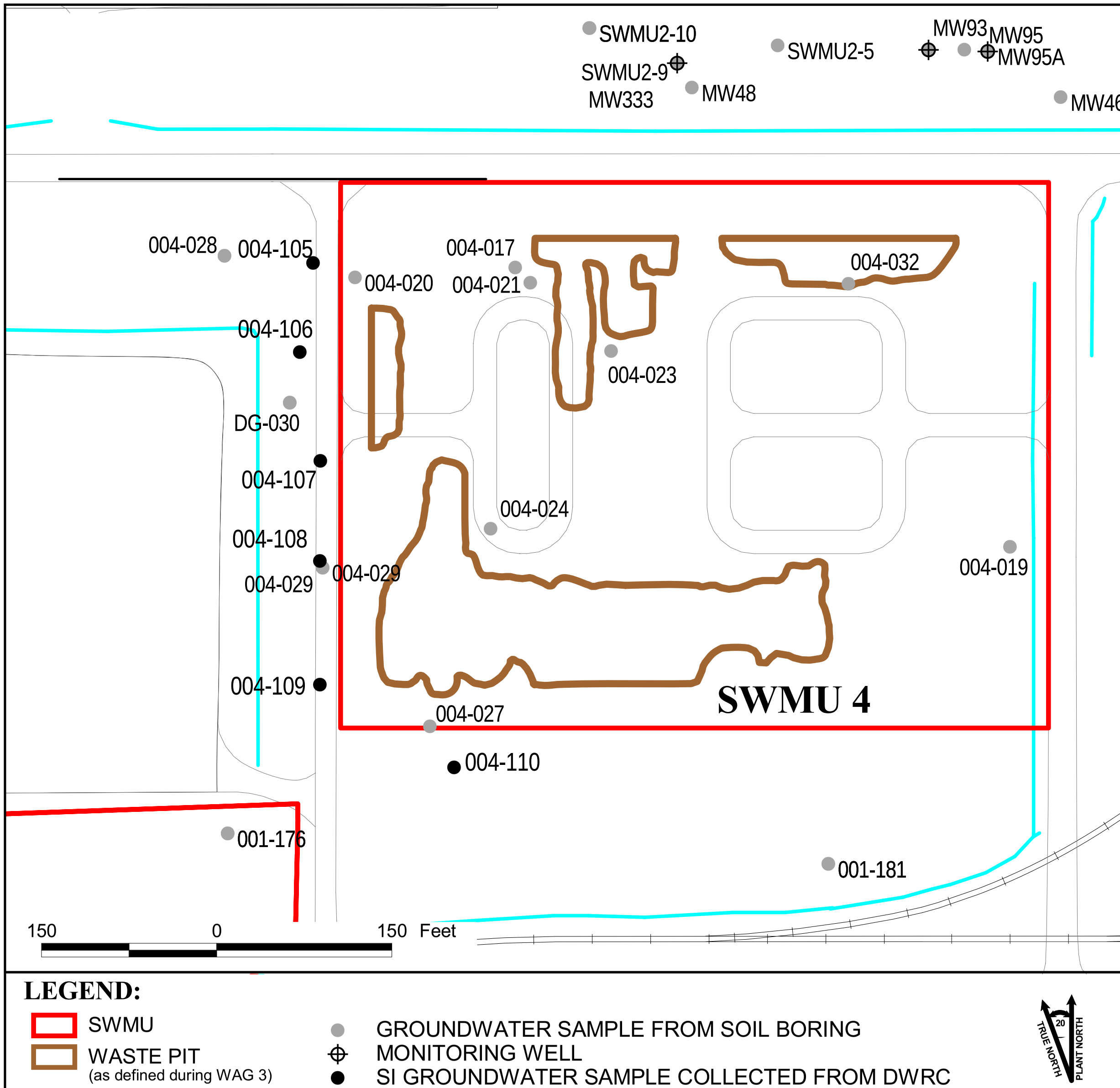


Fig. 2.4. SWMU 4 sample locations.

PADUCAH Remediation Services
A Portage Shaw Joint Venture Company

FIGURE No. \SIs\data_assess1r2.apr
DATE 12-28-04

Table 2.5. Summary of groundwater sampling and analysis for the C-747 Contaminated Burial Yard – SWMU 4

Boring	Drilling method	Total depth (ft)	Sample depth (ft bgs)	Media	Analytes	Date sampled
004-101	DWRC	92	68.5, 78.5, 88.5	Groundwater	VOCs, ^{99}Tc	May – June 2004
004-102	DWRC	91	68.5, 80, 90	Groundwater	VOCs, ^{99}Tc	June 2004
004-103	DWRC	100	68.5, 78.5, 88.5, 98.5	Groundwater	VOCs, ^{99}Tc	July 2004
004-104	DWRC	95	65, 70, 80, 90, 95	Groundwater	VOCs, ^{99}Tc	May 2004
004-105	DWRC	102	63.5, 73.5, 78.5, 88.5, 98.5	Groundwater	VOCs, ^{99}Tc	July 2004
004-106	DWRC	103	68.5, 78.5, 88.5, 98.5	Groundwater	VOCs, ^{99}Tc	July 2004
004-107	DWRC	103	63.5, 73.5, 78.5, 88.5, 98.5	Groundwater	VOCs, ^{99}Tc	July 2004
004-108	DWRC	102	63.5, 73.5, 78.5, 88.5, 98.5	Groundwater	VOCs, ^{99}Tc	July 2004
004-109	DWRC	103	68.5, 78.5, 88.5, 98.5	Groundwater	VOCs, ^{99}Tc	July 2004
004-110	DWRC	103	63.5, 68.5, 78.5, 88.5, 98.5	Groundwater	VOCs, ^{99}Tc	July 2004

bgs = below ground surface
DWRC = dual-wall reverse circulation
ft = feet
^{99}Tc = technetium-99
VOCs = volatile organic compounds

2.3 GROUNDWATER INVESTIGATION

The groundwater investigation used groundwater samples collected at discrete depths from temporary borings and from several existing RGA MWs to better define the extent of VOCs and ^{99}Tc in the dissolved-phase portion of the Southwest Plume (SWMU 210). Groundwater samples from existing MWs also were analyzed for metals and other radionuclides. The technical memorandum, Appendix A, describes the sampling methods that were used.

The problem statement for the groundwater investigation developed in the DQO analysis in the Southwest Plume SI work plan is as follows:

> *Hazardous substances, primarily VOCs and ^{99}Tc, have been detected above the maximum concentration limit in groundwater MWs west of the C-400 Building and south of the groundwater contamination area identified as the Northwest Plume. This area of groundwater contamination has been named the Southwest Plume. The existing MWs are not located such that the types and levels of contaminants migrating beyond the plant boundary can be monitored. There is no information currently available to determine if the C-400 Building is a contributor to the Southwest Plume.*

The principal study questions for the groundwater investigation are the following:

> *What VOCs are present in the RGA groundwater where the RGA groundwater passes below the west plant boundary?*

> *What are the concentrations of VOCs in the RGA groundwater where the RGA groundwater passes below the west plant boundary?*

What are the ^{99}Tc activities in the RGA groundwater where the RGA groundwater passes below the west plant boundary?

Is the C-400 Building contributing VOCs or ^{99}Tc to the RGA groundwater in the Southwest Plume?

To address the first three principal study questions, all of which consider the nature and extent of the Southwest Plume, seven temporary groundwater borings were installed just east of the west plant boundary. These borings spanned 1,200 ft of the previously-defined 1,900-ft plume width at the plant boundary. To address the fourth question, which considers if the C-400 Building is a source to the Southwest Plume, three temporary groundwater borings were placed in the area immediately west of the steam plant and C-400 Building. The groundwater investigation borings are shown in Fig. 2.5. In addition to the temporary borings, existing RGA MWs within the current boundaries of the plume were sampled. Table 2.6 provides a listing of each well sampled.

2.3.1 Southwest Plume – SWMU 210

Temporary borings, drilled by the DWRC method, were used to collect information that better defines the lateral and vertical extent of the Southwest Plume. All borings were drilled to the base of the RGA (see Table 2.6). Groundwater samples were collected approximately at 10 ft intervals and analyzed for VOCs and ^{99}Tc in a laboratory. Additionally, groundwater samples were sent to the laboratory for headspace analysis using SW846-3810. Results from these headspace analyses, which were available within two to seven days after sample collection, were used to determine if new wells (up to four) were required to monitor the core of the Southwest Plume at SWMU 4 and near the west plant boundary. Based upon the criterion specified in the Southwest Plume SI work plan (areas of greater than 1,000 µg/L TCE), four new wells were installed on the downgradient side of SWMU 4. Additional information regarding drilling and groundwater sampling is found in the technical memorandum in Appendix A. Table 2.6 provides a summary of the sampling for each boring.

2.3.2 Existing MWs

In addition to the samples collected from the temporary borings, groundwater samples from existing MWs were collected. The MWs were sampled in accordance with approved procedures and work guides, and samples were analyzed for VOCs, metals, and radionuclides in a laboratory. Additional information can be found in the technical memorandum in Appendix A. The wells sampled are identified in Table 2.6.

2.3.3 New MWs

Based upon the 1,000-µg/L-TCE-criterion in the Southwest Plume SI work plan, four new MWs were installed during the SI to be included in the routine environmental monitoring program of PGDP. Table 2.7 summarizes construction details of the wells. Fig. 2.5 shows the location of these wells. Additional information regarding installation of each of the wells may be found in the technical memorandum, Appendix A.

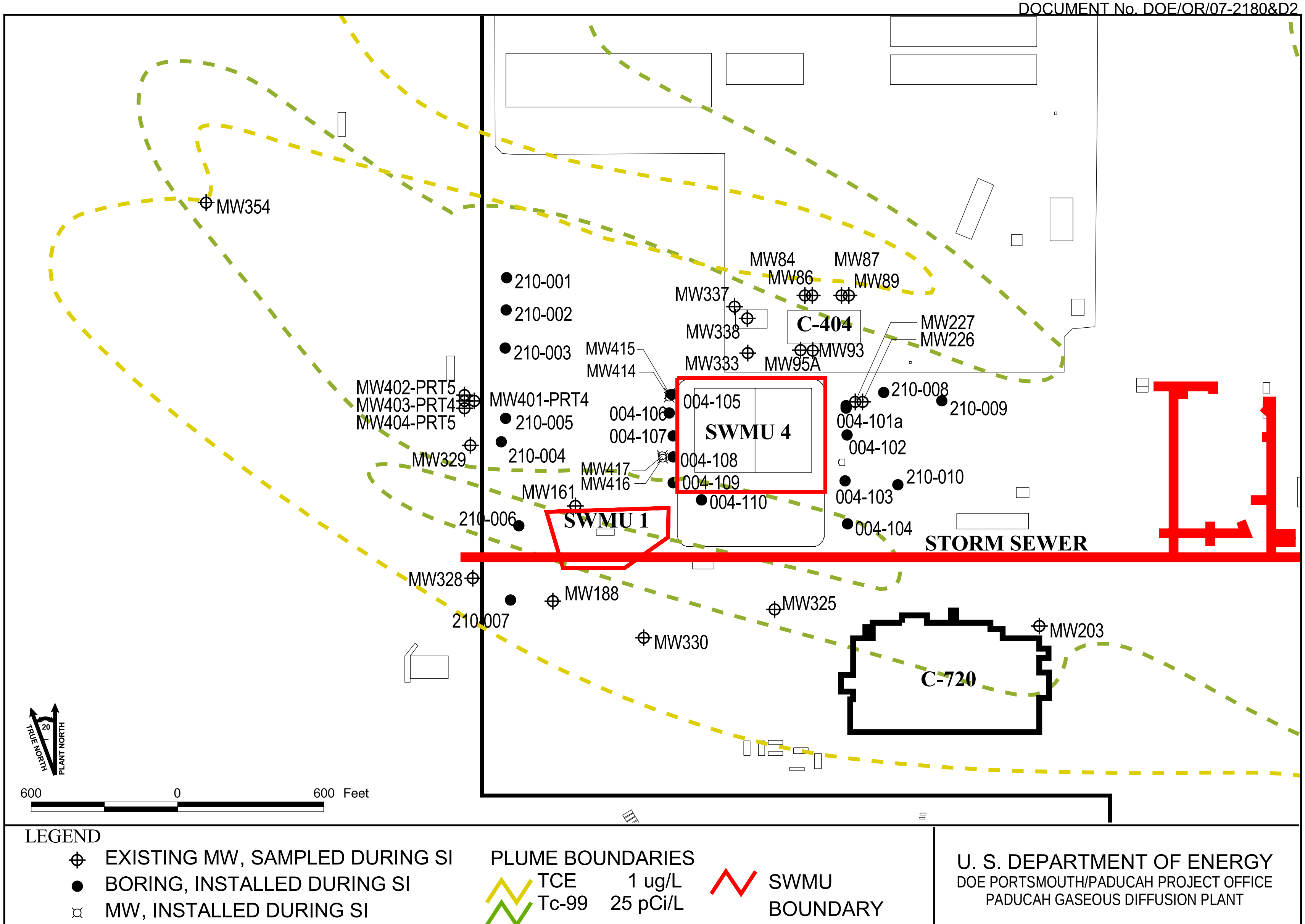


Fig. 2.5. Southwest Plume dissolved-phase sampling.

U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH Remediation Services
A Portage Shaw Joint Venture Company

FIGURE No. data-assess3r10705.apr
DATE 07-06-05

Table 2.6. Summary of groundwater sampling and analysis for the dissolved-phase portion of the Southwest Plume – SWMU 210

Boring	Drilling method	Total depth (ft)	Sample depth/Screen depth (ft bgs)	Analytes	Sample date
			Temporary borings		
210-001	DWRC	98.5	63.5, 68.5, 78.5, 88.5, 93.5	VOCs, ^{99}Tc	June 2004
210-002	DWRC	100	58.5, 68.5, 78.5, 88.5, 98.5	VOCs, ^{99}Tc	June 2004
210-003	DWRC	104	73.5, 78.5, 88.5, 98.5	VOCs, ^{99}Tc	June 2004
210-004	DWRC	108.5	63.5, 68.5, 78.5, 88.5, 98.5, 106.5	VOCs, ^{99}Tc	June 2004
210-005	DWRC	100	68.5, 84, 90, 100	VOCs, ^{99}Tc	June 2004
210-006	DWRC	100	60, 70, 80, 90, 100	VOCs, ^{99}Tc	May-June 2004
210-007	DWRC	100	65, 70, 80, 90, 100	VOCs, ^{99}Tc	May 2004
210-008	DWRC	85	68.5, 78.5, 85	VOCs, ^{99}Tc	June 2004
210-009	DWRC	85	64.5, 70, 80, 85	VOCs, ^{99}Tc	July 2004
210-010	DWRC	96	63.5, 73.5, 78.5, 88.5, 94	VOCs, ^{99}Tc	July 2004
			Existing monitoring wells		
MW84	RGA Well	(SWMU 3 Well)[a]	65.5 – 75.9	VOCs, Metals, Rad	July 2004
MW86	RGA Well	(SWMU 3 Well)	75.2 – 85.6	VOCs, Metals, Rad	July 2004
MW87	RGA Well	(SWMU 3 Well)	63.9 – 74.3	VOCs, Metals, Rad	July 2004
MW89	RGA Well	(SWMU 3 Well)	77.7 – 88.1	VOCs, Metals, Rad	July 2004
MW93	RGA Well	(SWMU 3 Well)	69.5 – 79.9	VOCs, Metals, Rad	July 2004
MW95A	RGA Well	(SWMU 3 Well)	78 – 88	VOCs, Metals, Rad	July 2004
MW161	RGA Well		78 – 83	VOCs, Metals, Rad	July 2004
MW188	RGA Well		70 – 75	VOCs, Metals, Rad	July 2004
MW203	RGA Well		71 – 76	VOCs, Metals, Rad	July 2004
MW226	RGA Well	(SWMU 3 Well)	78.9 – 89.4	VOCs, Metals, Rad	July 2004
MW227	RGA Well	(SWMU 3 Well)	64.5 - 75	VOCs, Metals, Rad	July 2004
MW325	RGA Well		78.7 – 83.7	VOCs, Metals, Rad	August 2004
MW326	RGA Well		83.5 – 88.5	VOCs, Metals, Rad	July 2004
MW328	RGA Well		60.8 – 65.8	VOCs, Metals, Rad	July 2004
MW329	RGA Well		65.5 – 70.5	VOCs, Metals, Rad	July 2004
MW330	RGA Well		72.5 – 77.5	VOCs, Metals, Rad	July 2004
MW333	RGA Well	(SWMU 2 Well)[a]	69.2 - 79	VOCs, Metals, Rad	July 2004
MW337	RGA Well	(SWMU 2 Well)	64.6 – 74.3	VOCs, Metals, Rad	July 2004
MW338	RGA Well	(SWMU 2 Well)	64.6 – 74.3	VOCs, Metals, Rad	July 2004
MW354	RGA Well		65 – 70	VOCs, Metals, Rad	July 2004
MW401 (port #4)	RGA Well	(PTZ Well)[a]	85.5 – 88	VOCs, Metals, Rad	July 2004
MW402 (port #5)	RGA Well	(PTZ Well)	78 – 80.5	VOCs, Metals, Rad	July 2004
MW403 (port #4)	RGA Well	(PTZ Well)	85.5 – 88	VOCs, Metals, Rad	July 2004
MW404 (port #5)	RGA Well	(PTZ Well)	78 – 80.5	VOCs, Metals, Rad	July 2004

[a] SWMU 3 is the C-404 Low-level Radioactive Waste Burial Ground. SWMU 2 is the C-749 Uranium Burial Ground. Both of these burial grounds are to the north of SWMU 4. The permeable treatment zone (PTZ) wells are located along plant boundary of the PGDP.

bgs = below ground surface
DWRC = dual-wall reverse circulation
ft = feet
MW = monitoring well
PTZ = Permeable Treatment Zone
Rad = total uranium (U), ^{234}U, ^{235}U, ^{238}U, ^{237}Np, ^{239}Pu, ^{99}Tc, gross alpha, and gross beta
RGA = Regional Gravel Aquifer
SWMU = solid waste management unit
^{99}Tc = technetium-99
VOCs = volatile organic compounds

Table 2.7. Summary of new MWs installed in the Southwest Plume

MW	Drilling method	Total depth (ft) bgs	Screened interval (ft) bgs
MW414	Rotary Sonic	76.05	63.85 – 73.85
MW415	Rotary Sonic	100.43	88.03 – 98.03
MW416	Rotary Sonic	77.32	64.92 – 74.92
MW417	Rotary Sonic	104.40	92.20-102.20

bgs = below ground surface
ft = feet
MW = monitoring well

2.4 SAMPLING PROTOCOLS

Detailed discussions of sampling protocols are presented in Appendix A. The following discussion provides a summary of the methods used.

2.4.1 Soil Sampling

The MIP initially was used to profile potential VOC contamination within the vadose zone. Sampling intervals were modified to reflect this profile. For this SI, the returning MIP carrier gas stream was split, with half of the gas stream routed through the usual photoionization and electron capture detectors of the MIP and half routed to a sorbent trap, for testing with an independent field gas chromatograph. The field gas chromatograph results provided a quick identification of the organic chemicals that were being detected. Appendix D presents the MIP results. With the exception of results for boring 001-201, for the 0-to-15 ft and 15-to-30 ft depth interval samples, the field gas chromatograph (GC) results are consistent with those of analysis of the soil samples. (The field GC did not detect the presence of VOCs, while the soil sample analyses reported significant contamination present.) Because the MIP detectors were the primary field screening tool used and they provided a useful log of contaminant levels over depth and because the analyses of the soil samples are the primary data used in the assessment of contamination, the lack of a detect in the field GC analyses of the shallow samples for boring 001-201 did not impact the interpretation of nature and extent of contamination at SWMU 1. The field GC analyses were backup sources of data that were not required to answer the SI’s primary questions, but did provide a check on the operation of the MIP system.

DPT was used to collect continuous 5-ft sample cores. Cores were collected in a Lexan tube, the tube was cut open, and the soil was examined. The VOC soil samples were collected first and as quickly as possible to limit potential for release to the environment. These samples were placed in 125 ml jars directly out of the tube prior to homogenization and were packed as firmly as possible to limit headspace in the container. Soil from the remainder of the tube was homogenized in a stainless steel bowl prior to containerization. Samples were immediately placed on ice to maintain a constant 4ºC temperature.

A significant amount of soil was used to fill each VOC container. It is entirely possible for the soil characteristics to change considerably from the first VOC sample collected to the last. Discrepancies among VOC results from samples collected from the same interval may be a reflection of the change in soil characteristics.

2.4.2 Groundwater Sampling

DPT, inserted through the DWRC, also was used during some of the early sampling before drill bit modifications prevented flowing sand problems from interfering with the sampling. Table 2.8 identifies the drilling and sampling system used for each groundwater sample collected from a temporary soil boring. The intent of the groundwater sampling was to collect a sample at the interface of the UCD and Lower Continental Deposits (LCD), every 10 ft interval from that point, and at the interface of the LCD and the McNairy Formation. In the event a groundwater sample could not be collected on the 10 ft interval, additional attempts were made every 5 ft. Attempts were made to collect groundwater samples within the intervals at 60 ft, 70 ft, 80 ft, 90 ft, and 100 ft. The borehole was completed when the McNairy Formation clay was encountered.

When the sampling depth had been determined, a sampling pump was lowered to the bottom of the borehole. The SI field team used a submersible pump to collect most samples, although they used a traditional bladder pump and a mechanical bladder pump to collect a few samples early in the SI. Samplers purged groundwater from the borehole with each sampling system prior to collection of the water sample to eliminate any significant bias to the sample quality because of the type of sample system used. With the submersible pump system, the groundwater flow was diverted through an in-line flow cell mounted with a Horiba™ and an oxidation reduction potential (Eh) probe. The bladder pump and mechanical bladder pumps produced less discharge. Samplers collected the discharge from these pumps in a cup to monitor field parameters. Geochemical parameters were monitored to ensure stabilization of the groundwater sample and a return to original aquifer conditions. Documented parameters included hydrogen-ion concentration (pH), dissolved oxygen, specific conductance, Eh, and temperature. Appendix E includes records of the geochemical parameter values monitored during purging for each groundwater sample and well development. When the geochemical parameters were considered stabilized, the groundwater flow was diverted away from the in-line flow cell through clean tubing and a sample was collected. VOC samples were collected in 40 ml vials with no headspace and were followed by the remaining samples. Samples were immediately placed on ice to maintain a 4ºC constant temperature.

Table 2.8. Summary of groundwater sampling from temporary soil borings for the Southwest Plume SI

Boring	Sample Date	Total Depth	Sample Depth	Drilling Method	Sampling Method
004-101	5/4/2004	92	76.5	DWRC - original bit	Grundfos pump
004-101A	6/25/2004	88.5	68.5, 78.5, 88.5	DWRC - modified bit	Grundfos pump
004-102	6/29/2004	91	68.5, 80, 90	DWRC - modified bit	Grundfos pump
004-103	7/28/2004	100	68.5, 78.5, 88.5, 98.5	DWRC - modified bit	Grundfos pump
004-104	5/10/2004	95	65, 70	DWRC - original bit	Bladder pump
	5/11/2004		80	DWRC - original bit	Bladder pump
	5/12/2004		90, 95	DWRC - original bit	Bladder pump
004-105	7/10/2004	102	63.5, 73.5, 78.5	DWRC - modified bit	Grundfos pump
	7/11/2004		88.5, 98.5	DWRC - modified bit	Grundfos pump
004-106	7/12/2004	103	68.5, 78.5, 88.5	DWRC - modified bit	Grundfos pump
	7/13/2004		98.5	DWRC - modified bit	Grundfos pump
004-107	7/14/2004	103	63.5, 73.5, 78.5, 88.5, 98.5	DWRC - modified bit	Grundfos pump
004-108	7/19/2004	102	63.5, 73.5	DWRC - modified bit	Grundfos pump
	7/20/2004		78.5, 88.5, 98.5	DWRC - modified bit	Grundfos pump
004-109	7/22/2004	103	68.5, 78.5, 88.5, 98.5	DWRC - modified bit	Grundfos pump
004-110	7/26/2004	103	63.5, 68.5	DWRC - modified bit	Grundfos pump
	7/27/2004		78.5, 88.5, 98.5	DWRC - modified bit	Grundfos pump
210-001	6/15/2004	98.5	63.5	DWRC - modified bit	Grundfos pump
	6/17/2004		68.5, 78.5, 88.5, 93.5	DWRC - modified bit	Grundfos pump
210-002	6/10/2004	100	58.5	DWRC - modified bit	Grundfos pump
	6/11/2004		68.5, 78.5, 88.5, 98.5	DWRC - modified bit	Grundfos pump
210-003	6/18/2004	104	73.5	DWRC - modified bit	Grundfos pump
	6/21/2004		78.5, 88.5, 98.5	DWRC - modified bit	Grundfos pump
210-004	6/22/2004	108.5	63.5	DWRC - modified bit	Grundfos pump
	6/23/2004		68.5, 78.5, 88.5, 98.5, 106.5	DWRC - modified bit	Grundfos pump
210-005	6/3/2004	100	68.5	DWRC - rollercone bit	Grundfos pump
	6/8/2004		84, 90, 100	DPT through DWRC	Mechanical bladder pump
210-006	5/27/2004	100	60, 70	DWRC - modified bit	Grundfos pump
	5/28/2004		80	DWRC - modified bit	Grundfos pump
	6/1/2004		90, 100	DPT through DWRC	Mechanical bladder pump
210-007	5/14/2004	100	60	DWRC - modified bit	Grundfos pump
	5/17/2004		70	DWRC - modified bit	Grundfos pump
	5/19/2004		80	DWRC - modified bit	Grundfos pump
	5/25/2004		90, 100	DPT through DWRC	Mechanical bladder pump
210-008	6/30/2004	85	68.5, 78.5, 85	DWRC - modified bit	Grundfos pump
210-009	7/1/2004	85	64.5, 70, 80, 85	DWRC - modified bit	Grundfos pump
210-010	7/7/2004	96	63.5, 73.5, 78.5	DWRC - modified bit	Grundfos pump
	7/8/2004		88.5, 94	DWRC - modified bit	Grundfos pump

THIS PAGE INTENTIONALLY LEFT BLANK

3. PHYSICAL CHARACTERISTICS OF THE STUDY AREA

This section presents a description of the physical characteristics of the study areas as determined from Southwest Plume SI field activities. The focus of the fieldwork was the collection of soil and groundwater samples for laboratory analysis. Additional aspects of the physical characteristics of the study areas are addressed in the WAG 3 RI Report (DOE 2000b) for the C-747 Contaminated Burial Yard (SWMU 4) and the WAG 27 RI Report (DOE 1999a) for the C-747-C Oil Landfarm (SWMU 1), the C-720 Area, and the Southwest Plume (SWMU 210).

3.1 GEOLOGY

Figure 3.1 summarizes the geologic and hydrogeologic systems of the PGDP region. The area of the Southwest Plume lies within the buried valley of the ancestral Tennessee River in which Pleistocene Continental Deposits (the fill deposits of the ancestral Tennessee River Basin) rest unconformably on Cretaceous marine sediments. Pliocene through Paleocene formations in the area of the Southwest Plume were removed by the scouring of the ancestral Tennessee River Basin. The geology encountered in this investigation was consistent with that described in earlier investigations.

The upper McNairy Formation consists of 60 to 70 ft of interbedded units of silt and fine sand. The McNairy Formation was not examined extensively during this investigation. As the first major aquitard (i.e., less permeable geologic unit) encountered below the RGA, groundwater sampling ceased upon reaching the upper contact of the McNairy.

The Continental Deposits resemble a large low-gradient alluvial fan that covered much of the region and eventually buried the erosional topography. Thicker sequences of Continental Deposits, as found underlying PGDP, represent valley fill deposits and can be informally divided into a lower unit (gravel facies) and an upper unit (clay facies). The LCD is the gravel facies consisting of chert gravel in a matrix of poorly sorted sand and silt that rests on an erosional surface representing the beginning of the valley fill sequence. In total, the gravel units average approximately 30 ft thick, but some thicker deposits (as much as 50 ft) exist in deeper scour channels. The UCD is primarily a sequence of fine-grained, clastic facies varying in thickness from 15 ft to 55 ft that consist of clayey silts with lenses of sand and occasional gravel.

The surface deposits found in the vicinity of PGDP consist of loess and alluvium. Both units are composed of clayey silt or silty clay and range in color from yellowish-brown to brownish-gray or tan, making field differentiation difficult.

Drilling methods used for each study area depended on the objective of the investigation. The MIP and DPT were used to examine and sample the sediments of the UCD. (See Appendix D for the MIP Report.) DWRC, supplemented by DPT at depth in three borings, and Rotary Sonic were used to examine sediments and sample groundwater down to the upper McNairy Formation contact and install MWs. Appendix A presents information on the drilling and sampling methods used. Lithologic logs are included in Appendix E.

SYSTEM	SERIES	FORMATION	THICKNESS (IN FEET)	DESCRIPTION	HYDROGEOLOGIC SYSTEMS
QUATERNARY	PLEISTOCENE AND RECENT	ALLUVIUM	0-40	Brown or gray sand and silty clay or clayey silt with streaks of sand.	Upper Continental Recharge System
QUATERNARY	PLEISTOCENE	LOESS	0-43	Brown or yellowish-brown to tan unstratified silty clay.	Upper Continental Recharge System
QUATERNARY	PLEISTOCENE	CONTINENTAL DEPOSITS	3-121	Upper Continental Deposits (Clay Facies) - mottled gray and yellowish brown to brown clayey silt and silty clay, some very fine sand, trace of gravel. Often micaceous.	Upper Continental Recharge System
TERTIARY	PLIOCENE-MIOCENE (?)	CONTINENTAL DEPOSITS	3-121	Lower Continental Deposits (Gravel Facies) - reddish-brown clayey, silty and sandy chert gravel and beds of gray sand.	Regional Gravel Aquifer
TERTIARY	EOCENE	JACKSON, CLAIBORNE, AND WILCOX FORMATIONS	0-200+	Red, brown or white fine to coarse grained sand. Beds of white to dark gray clay are distributed at random.	
TERTIARY	EOCENE	JACKSON, CLAIBORNE, AND WILCOX FORMATIONS	0-100+	White to gray sandy clay, clay conglomerates and boulders, scattered clay lenses and lenses of coarse red sand. Black to dark gray lignitic clay, silt or fine grained sand.	
TERTIARY	PALEOCENE	PORTERS CREEK CLAY	0-200	Dark gray, slightly to very micaceous clay. Fine grained clayey sand, commonly glauconitic in the upper part. Glauconitic sand and clay at the base.	
TERTIARY	PALEOCENE	CLAYTON FORMATION	Undetermined	Lithologically similar to underlying McNairy Formation.	McNairy Flow System2
UPPER CRETACEOUS		McNAIRY FORMATION	200-300	Grayish-white to dark gray micaceous clay, often silty, interbedded with light gray to yellowish-brown very fine to medium grained sand with lignite and pyrite. The upper part is interbedded clay and sand, and the lower part is sand.	McNairy Flow System2
UPPER CRETACEOUS		TUSCALOOSA FORMATION	Undetermined	White, well rounded or broken chert gravel with clay.	McNairy Flow System2
MISSISSIPPIAN		MISSISSIPPIAN CARBONATES	500+	Dark gray limestone and interbedded chert, some shale.	

U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

Fig. 3.1. Generalized lithostratigraphic column of the PGDP region.

PADUCAH Remediation Services
A Portage Shaw Joint Venture Company

FIGURE No. Lithostratigraphic column.ppt
DATE 12-28-04

3.1.1 C-747-C Oil Landfarm – SWMU 1

The investigation of this unit consisted of five MIP/DPT borings (001-201 through 001-205) placed within and adjacent to the area of highest soil contamination defined during the WAG 27 RI (Fig. 2.1). Borings did not exceed a depth of 60 ft. The sediments encountered consisted primarily of silt/sandy silt/silty sand with some clay. This is indicative of the UCD overlaid with surface soil. In general, the soils typically are silts to a depth of 25 to 30 ft. Sand is common below a depth of 30 ft. The final interval sampled (55 ft – 60 ft) often exhibited a noticeable increase in grain size and a significant increase in moisture content consistent with the interface between the UCD and the LCD.

3.1.2 C-720 Area

Previous investigations have indicated hazardous substances above background levels in the soils in the vicinity of the C-720 Building. This SI sampled two potential source areas to the Southwest Plume: the northeast and southeast corners of the C-720 area. None of the soil borings in the C-720 area exceeded a depth of 60 ft. The sediments in the borings ranged from clays to silts to sands, consistent with the UCD overlaid by surface soil. The investigation of the northeast corner consisted of six MIP/DPT borings (720-101 through 720-106) placed between the north edge of the parking lot and a storm sewer to which all surface runoff for the parking lot flows (Fig. 2.2). Silt and clay was the predominant soil texture to a depth to 15 to 20 ft. Interbedded sand and clay units were common below those depths. Clay and sandy clay/clayey sand occurred near the bottom of most of the borings in the northeast corner.

Two MIP/DPT borings (720-107 and 720-108) were sampled for the investigation of the southeast corner of the C-720 area, placed through the parking lot adjacent to the C-720 Building loading dock (Fig. 2.2). Similar to the northeast corner, silt and clay occurred to a depth of 15 ft and interbedded sand and clay units were common below. Medium-to-coarse-grained sand, suggestive of the interface between the UCD and the LCD, was encountered near the bottom of the two borings in the southeast corner.

3.1.3 Storm Sewer from the C-400 Building to Outfall 008 – Part of SWMU 102

The investigation of the storm sewer included 15 MIP/DPT borings (102-001 through 102-015). Each boring was placed as closely to the storm sewer as possible in an attempt to collect soil samples from the base of the backfill material in which the storm sewer rests. Borings did not exceed 20 ft in depth. The soil cores consisted primarily of silt and clay with occasional lenses of sand toward the bottom of the sample interval. Since this was an area of construction, the majority of the sediments encountered below ground surface were possibly backfill material.

3.1.4 C-747 Contaminated Burial Yard – SWMU 4

The current investigation consisted of the installation of ten temporary soil borings to collect soil samples for description and groundwater samples for laboratory analysis (004-101 through 004-110) adjacent to SWMU 4: four of the borings east of the unit (004-101 through 004-104), five of the borings west of the unit (004-105 through 004-109), and one boring south of the unit (004-110) (Fig. 2.4).

DWRC was used to advance the borehole to the top of the McNairy Formation. Soil cuttings analysis, together with the drilling response, was able to accurately identify the tops of the LCD and McNairy Formation. In the area of SWMU 4, the top of the coarse sand and gravel units that mark the LCD typically occurred between 60 and 65 ft. The top of the McNairy Formation appeared to slope downward to the southwest.

3.1.5 Southwest Plume – SWMU 210

This investigation consisted of ten temporary groundwater borings (210-001 through 210-010) (Fig. 2.5) using DWRC. Seven temporary groundwater borings (210-001 through 210-007) were installed just east of the west plant boundary. Three temporary groundwater borings (210-008 through 210-010) were placed in the area immediately west of the steam plant and C-400.

This area is similar to and overlaps the study area for SWMU 4. Lithologic contacts in these borings are consistent with results from SWMU 4. The middle of the transect along the west plant boundary (borings 210-003 and 210-004) appears to be the location of a channel scour in the top of the McNairy Formation.

3.2 HYDROGEOLOGY

The primary groundwater flow systems associated with the Southwest Plume are the UCRS and the RGA. In the area of the Southwest Plume, groundwater flow and contaminant migration through the upper 45 ft to 55 ft of sediments (UCD) is downward with little lateral spreading. This flow system is termed the UCRS. Locally the UCRS consists of 3 hydrogeologic units (HUs), an upper silt interval (HU1), an intermediate horizon of sand and gravel lenses (HU2), and a lower silt and clayey silt interval (HU3). Groundwater flow rates in the UCRS tend to be on the order of 0.1 ft/day. The silts and clays of the UCRS readily adsorb some contaminants, such as many metals and radionuclides, retarding the migration of these contaminants in groundwater from the source areas. Moreover, laterally extensive silt and clay horizons in the UCRS may halt the downward migration of DNAPLs, but foster the development of DNAPL pools in the subsurface.

A thick interval of late Pleistocene sand and gravel units over the depth interval of 55ft to 100 ft (LCD) is the shallow aquifer underlying most of PGDP, known as the RGA. The RGA is the main pathway for lateral flow and dissolved contaminant migration off-site. Variations in hydraulic conductivity and the location of discrete sources of recharge govern the local direction of groundwater flow. However, overall flow within the RGA trends north-northeast toward the regional hydraulic base level defined by the Ohio River. Groundwater flow rates within the RGA are approximately 1 ft/day. Contaminant migration tends to be less retarded in the coarse sediments of the RGA.

3.2.1 C-747-C Oil Landfarm – SWMU 1

The investigation consisted of soil sampling within the upper 60 ft. Soil samples verified the presence of the HU1, HU2, and HU3 members of the UCRS. HU3 sediments tended to be coarser grained than typical. The RGA was not encountered, although the final interval sampled (55 ft – 60 ft) often revealed a noticeable increase in grain size and a significant increase in moisture content, consistent with trends near the top of the RGA.

3.2.2 C-720 Area

The investigation consisted of soil sampling to a depth of 60 ft. As in other soil borings in the C-720 Area, the soil textures are inconsistent with the typical HU2/HU3 interface, the top of the HU3 appears to consist predominately of silty sands. The RGA was not encountered.

3.2.3 Storm Sewer from the C-400 Building to Outfall 008 – Part of SWMU 102

The investigation consisted of soil sampling to a depth of 20 ft adjacent to the storm sewer. Since this was an area of construction, the majority of the soils encountered below ground surface probably was backfill material. The soils typically were silts, clays, and fine sands that were similar to the HU1 sediments.

3.2.4 C-747 Contaminated Burial Yard – SWMU 4

The investigation involved the collection of groundwater samples from the RGA to determine if SWMU 4 was contributing VOC and ^{99}Tc contamination to the aquifer. Ten temporary borings were drilled adjacent to SWMU 4: four of the borings east of the unit, upgradient relative to groundwater flow; five of the borings west of the unit, downgradient relative to groundwater flow; and one boring south of the unit or crossgradient to the groundwater flow.

In this study area, the thickness of the RGA increased from the east (as little as 21 ft) to the west (as thick as 41 ft). A total of 3 to 5 groundwater samples was collected at each of the temporary borings planned for this investigation. Results were used to determine the extent of the contamination impacting the RGA from SWMU 4 and the preferential pathway for the plume.

3.2.5 Southwest Plume – SWMU 210

The investigation involved the collection of groundwater samples from the RGA to better define the extent of contamination and identify potential sources of contamination. This investigation consisted of the installation of ten temporary groundwater borings: seven were installed just east of the west plant boundary, and three were placed in the area immediately west of the steam plant and C-400. In this study area, the thickness of the coarse-grained sediments typical of the RGA varied, depending upon the depth of the upper McNairy contact, from as little as 15 ft near the northeast corner of SWMU 4 to as much as 47.5 ft near the middle of the Southwest Plume at the west plant boundary.

THIS PAGE INTENTIONALLY LEFT BLANK

4. NATURE AND EXTENT OF CONTAMINATION

This section illustrates and interprets the nature and extent of contamination for each study area. Potential source areas, as determined by the analytical results from field activities, are examined and potential site-related contaminants are identified. A brief description of the sampling protocol for each area is provided in Section 2. A more detailed description of the procedures is provided in the technical memorandum found in Appendix A.

Previous field investigations at PGDP have confirmed the presence of contamination and possible sources for that contamination. The purpose of the Southwest Plume SI is to do all of the following:

- Determine which of the units being investigated under the SI are sources of contamination to the Southwest Plume;

- Determine which units are *not* sources of contamination to the Southwest Plume;

- Fill data gaps for risk assessment of the identified source areas, including completion of fate and transport modeling; and

- Reduce uncertainties and increase the understanding of the Southwest Plume and potential sources so that response actions can be considered.

Evaluation in this report are based on data collected for this SI and results from previous investigations.

4.1 SOURCES OF CONTAMINATION

There is sufficient historical data of operational events to provide an explanation for the presence of contamination at each of the study areas examined in this investigation. The degree to which these events impacted the surrounding area will be determined by the analytical results of the samples collected. In some cases, the close proximity of the study areas makes isolating the original source of contamination difficult.

4.1.1 C-747-C Oil Landfarm – SWMU 1

Between 1973 and 1979, the C-747-C Oil Landfarm was used for landfarming of waste oils contaminated with TCE, uranium, PCBs, and 1,1,1-TCA. These waste oils are believed to have been derived from a variety of plant processes. The Landfarm consisted of two 1125 ft^2 plots that were plowed to a depth of 1 to 2 ft. Waste oils were spread on the surface every 3 to 4 months, and then the area was limed and fertilized. Previous investigations have identified VOCs, PCBs, polynuclear aromatic hydrocarbons (PAHs), dioxins, heavy metals, and radionuclides as site-related contaminants. As part of the WAG 23 RA, 23 yd^3 of dioxin-contaminated soil were excavated and removed from the unit. This Southwest Plume SI focused on the area of the soils containing the highest VOC concentrations, as defined during the WAG 27 RI Report (DOE 1999a).

The conceptual model of subsurface contamination for SWMU 1 consists of a discrete zone of soils with TCE DNAPL ganglia below the plow plots that extends from near the surface to the top of the RGA (approximately 55 ft bgs). The area of this contamination is estimated to be approximately 8700 ft^2 (0.2 acre). Ganglia of TCE DNAPL continue to leach dissolved-phase TCE to the UCRS groundwater.

Dissolved TCE levels within the source zone exceed 10,000 μg/L (which is consistent with the presence of free-phase TCE in ganglia[1]). Shallow groundwater flow is dominantly vertical in the SWMU 1 area.

TCE levels in the RGA are highest below SWMU 1 at the top of the RGA and directly downgradient of the source zone. Mixing of the SWMU 1 leachate with groundwater in the RGA reduces TCE levels from SWMU 1 in the RGA by an order of magnitude and eventually to lesser levels downgradient. As the TCE plume migrates downgradient, area recharge from the overlying UCRS displaces the plume deeper in the RGA. Figure 4.1, adapted from the WAG 27 RI Report (DOE 1999a), illustrates the conceptual site model for TCE contamination from SWMU 1.

4.1.2 C-720 Area

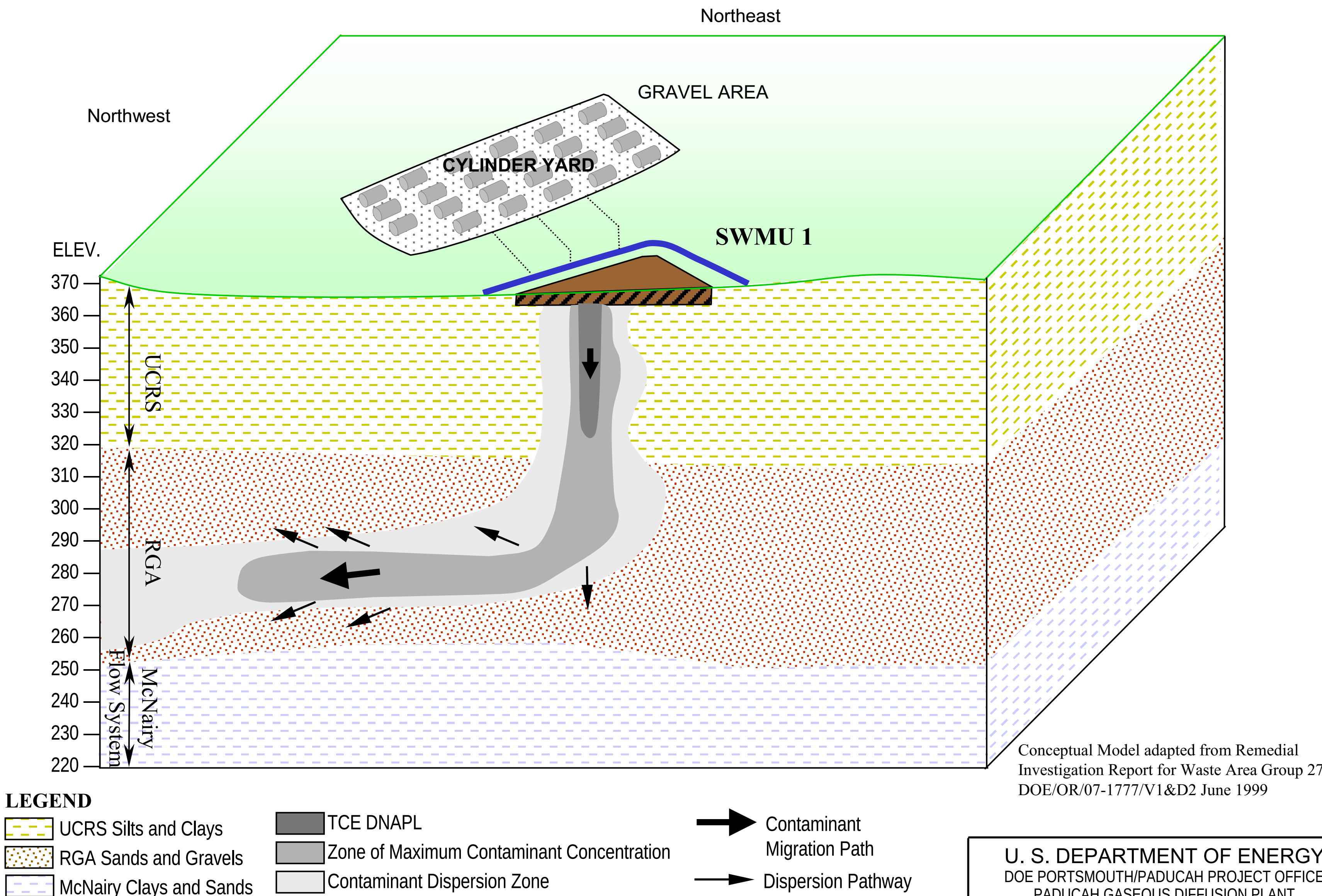
Previous investigations have identified VOCs, SVOCs, metals, and radionuclides as site-related contaminants in soils and groundwater in the vicinity of the C-720 Building. In the SI, two source areas of the C-720 area were further investigated: the northeast corner and the southeast corner. The primary TCE release mechanism for the northeast corner contamination is believed to be routine equipment cleaning and rinsing performed in the area. Solvents (i.e., VOCs) were used to clean parts, and the excess solvent may have been discharged on the ground. Spills and leaks from the cleaning process also may have contaminated surface soils in the area. Solvents may have migrated as dissolved contamination, as rainfall percolating through the soils and migrating to deeper soils and the shallow groundwater, or as DNAPL, migrating to adjacent and underlying soils. Spills and leaks from an underground, acid neutralization tank (C-722) at the northeast corner of the C-720 Building (SWMU 027) are a potential release mechanism for ^{99}Tc found in shallow groundwater (well MW204). The concrete tank, which is lined with an acid-resistant membrane and acid brick, received rinse water from an instrument cleaning shop and a compressor shop pit beginning in the 1950s.

The release mechanism for the southeast corner is less clear. The area of contamination discovered during WAG 27 is near the outlet to one of the storm drains for the east end of the building. There also is a storm sewer inlet for the southeast parking lot in the vicinity. The north edge of the parking lot, where the contamination occurred, is the location of one of the loading docks for the C-720 Building, an area where chemicals, including solvents, may have been loaded or unloaded. The VOCs found in soil and groundwater at the southeast corner may be the result of activities within the building, resulting in VOCs entering the storm drains from the southeast corner of the building, or from activities such as spills or leaks on the loading dock or in the southeast parking lot.

The conceptual model for the C-720 area is similar to SWMU 1, although the release mechanisms are dissimilar. In the C-720 area model, the largest TCE source zone underlies a very limited area below and adjacent to the outlet for the storm drain on the east end, south side, of the C-720 Building or a nearby storm sewer inlet for the parking lot. In either case, the interval of contaminated soils extends from the base of the storm sewer (5 ft depth) to the base of the UCRS (60 ft depth).

Repeated TCE releases allowed DNAPL to accumulate and eventually migrate as a free-phase liquid through the UCRS. However, sufficient time has passed to dissolve the DNAPL so that only ganglia of TCE DNAPL remain. The water table is at a depth of approximately 15 ft. Soil TCE levels are elevated throughout the entire depth of the UCRS within the source zone, but the TCE levels are significantly lower in the soils above the water table where volatilization has been more effective.

[1] With the exception of the lone highest value of TCE contamination reported in soil at SWMU 1 (400,000 μg/kg), the TCE-in-soil levels are easily accounted for by dissolved phase contamination derived from a small DNAPL source zone. For further information, the reader is referred to *Feasibility Study for the Groundwater Operable Unit at Paducah Gaseous Diffusion Plant Paducah, Kentucky*, DOE/OR/07-1857&D2, Volume 4, Appendix C5 (DOE 2001).



U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH Remediation Services
A Portage Shaw Joint Venture Company

Fig. 4.1. SWMU 1 conceptual model.

Dissolved TCE levels within the source zone exceed 10,000 µg/L (which is consistent with the presence of free-phase TCE in ganglia, as documented in other PGDP UCRS DNAPL zones). Shallow groundwater flow is dominantly vertical. Once the contamination reaches the RGA, flow becomes horizontal. TCE levels in the leachate from the C-720 source zone are diluted by an order of magnitude when mixed with RGA groundwater, with the concentrations further declining with distance in a downgradient direction. Figure 4.2, the conceptual model of the C-720 area TCE contamination, is taken from the WAG 27 RI Report (DOE 1999a).

4.1.3 Storm Sewer from the C-400 Building to Outfall 008 – Part of SWMU 102

Previous investigations have indicated VOC contamination of subsurface soils near two of the lateral lines that feed into the main storm sewer that runs south of the C-400 Building to Outfall 008 on the west side of PGDP. As early as the 1950s until 1986, the eastern lateral appears to have been connected to the sump located near the TCE degreaser inside the C-400 Building. The TCE that leaked from the sump/storm sewer connection to the surrounding soils has been identified as a source of groundwater contamination found in the C-400 Building source area (DOE 1999b). There was a possibility that some of the TCE was transported down the lateral to the main storm sewer (then west toward Outfall 008), encountered a hypothetical breach in the storm sewer, and leaked to the surrounding soils to become a source of TCE to the Southwest Plume.

East of the C-400 Building, the main line begins as a 15 inch diameter line. From the east side of the C-400 Building west to Outfall 008, the line is a 36-inch diameter reinforced concrete pipe enlarging to a 72-inch diameter. The bottom of the pipe is between 13 and 15 ft bgs. The feeder lines into the main line range from 24-inch concrete down to 8-inch vitreous clay pipe.

Sample results indicate that the soils adjacent to the Outfall 008 storm sewer were not impacted by releases of metals, radionuclides, or VOCs. A video survey of the storm sewer, performed as part of the SI, documents that the storm sewer remains structurally sound. Thus, the conceptual model of the Outfall 008 storm sewer is a properly functioning unit that has had no releases of contamination to groundwater.

4.1.4 C-747 Contaminated Burial Yard – SWMU 4

The C-747 Contaminated Burial Yard (SWMU 4) operated from 1951 through 1958 and was used for disposal of contaminated and uncontaminated trash, some of which was burned. Waste materials from the C-400 Building, originally designated for the C-404 Burial Area (SWMU 3), may have been placed at SWMU 4 as well. Scrapped equipment with surface contamination from the enrichment process also was buried. The site consists of several pits excavated to about 15 ft. The waste was placed in the pits and was covered with 2 to 3 ft of soil. A 6-inch clay cap was installed in 1982. Previous investigations have identified radionuclides, heavy metals, VOCs, SVOCs, and PCBs as site-related contaminants. This Southwest Plume SI focused on the RGA groundwater east and west of the unit to determine if SWMU 4 or an upgradient area is a source to the Southwest Plume.

Soil and groundwater samples of the WAG 3 RI indicate that the south burial pit, defined by geophysical surveys as an area measuring approximately 100 x 350 ft (and 15 ft deep), is the primary source of contamination by TCE and its degradation products at SWMU 4. Several WAG 3 soil samples collected below the waste pit have TCE levels in excess of 10 mg/kg and associated UCRS groundwater samples commonly have TCE levels greater than 10,000 µg/L. The presence of these levels of TCE contamination in soil and groundwater, more than 40 years after last waste placement, suggests strongly that TCE was present as a free phase liquid in the south waste pit.

Deleted: Current TCE levels in the RGA below and downgradient of SWMU 4 are not indicative of a continuing DNAPL spill or leak to the shallow soils.

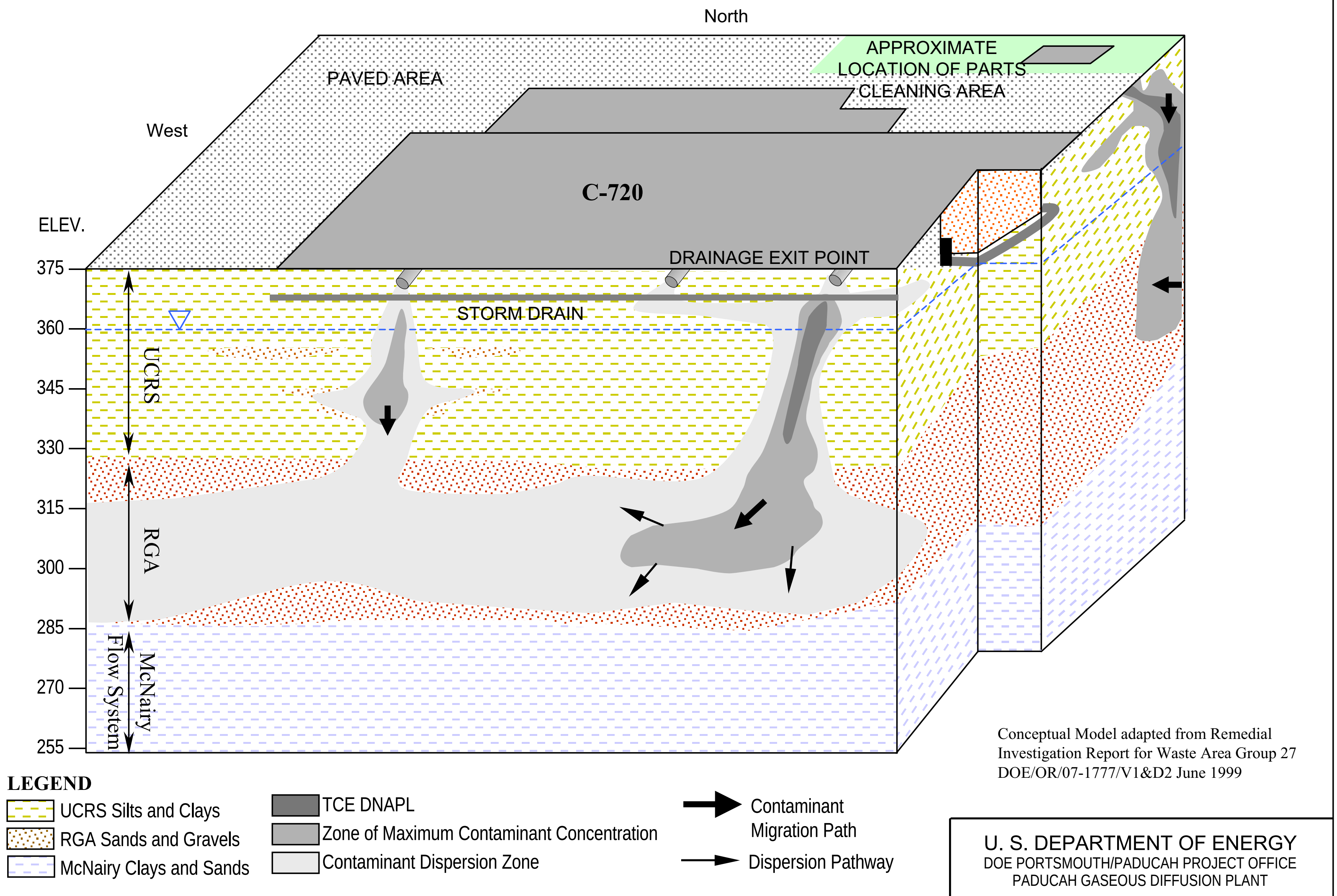


Fig. 4.2. C-720 conceptual model.

PADUCAH Remediation Services
A Portage Shaw Joint Venture Company

The conceptual model for SWMU 4 assumes that TCE ganglia are present in the interred waste and the soils beneath the south waste pit to the base of the UCD. Groundwater flow in the RGA from upgradient areas dilutes TCE levels to 1000-3000 µg/L immediately downgradient of the south burial pit; but, dissolved TCE levels remain well above the MCL (up to 600 µg/L) at the west PGDP plant boundary. Figure 4.3 summarizes the conceptual model for TCE contamination at SWMU 4. Additional analysis including refining of the conceptual site model will be included in the Burial Grounds OU RI report.

Deleted: However, the method of placement and containment of TCE in the south burial pit remains undefined. It is uncertain if drums of TCE-contaminated material remain in the waste pit.¶

Deleted: (A small volume of TCE DNAPL may be present in the RGA beneath SWMU 4.) The TCE DNAPL mass remaining at SWMU 4 is significantly greater than that remaining at either SWMU 1 or at C-720.

Deleted: WAG 3

Deleted: remedial investigation

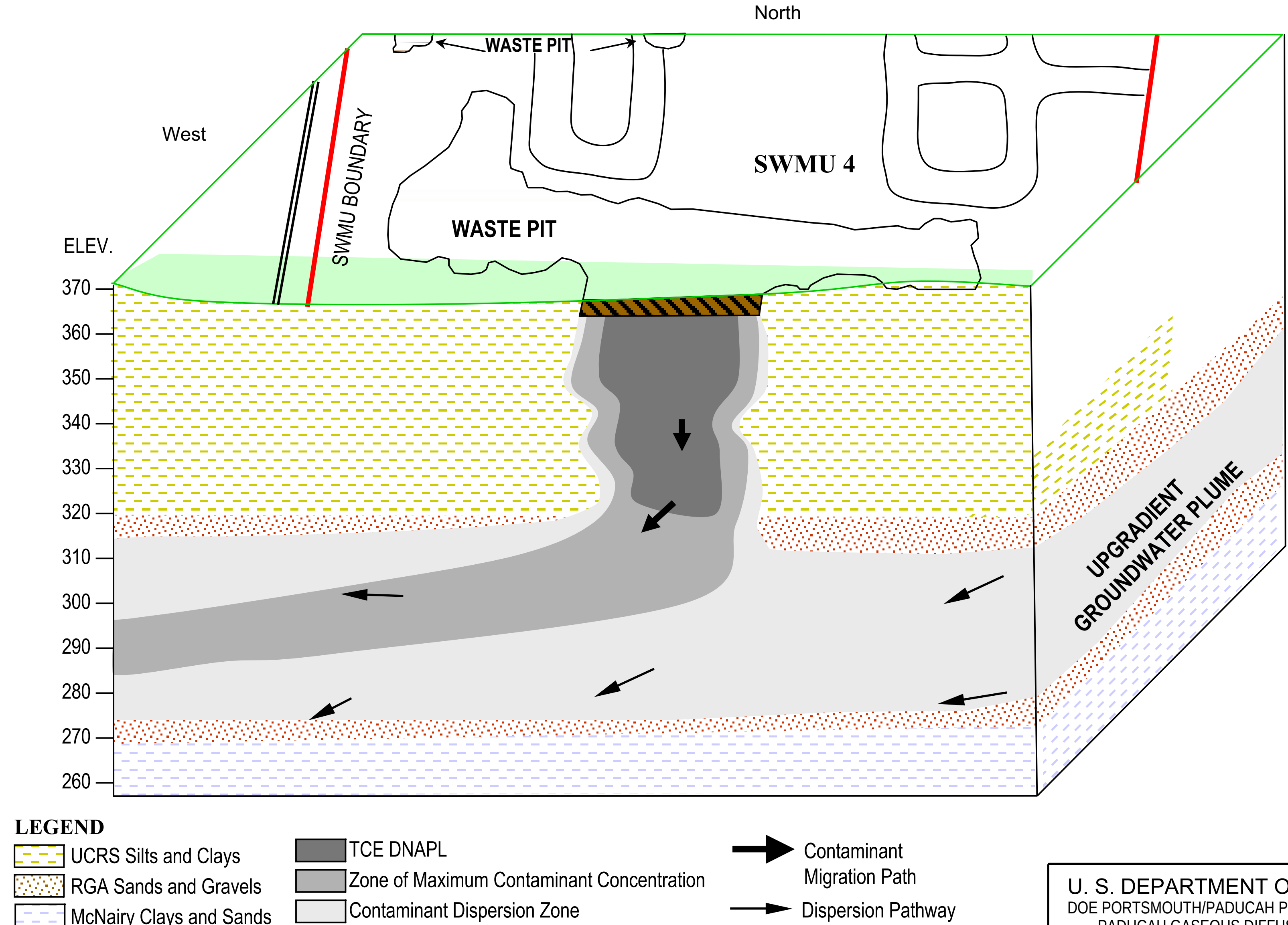
4.1.5 Southwest Plume – SWMU 210

Previous investigations have detected groundwater contamination west of the C-400 Building and south of the groundwater contamination area identified as the Northwest Plume. This area of groundwater contamination is named the Southwest Plume. The current MW system does not monitor the types and levels of contaminants migrating beyond the plant boundary. This investigation sampled within the known boundaries of the Southwest Plume and in areas believed to be impacted by it within the plant boundaries to better define the sources of the plume and the extent of contamination. The scope of the SI did not include defining the extent of the Southwest Plume beyond the plant boundaries.

This SI addressed some of the key uncertainties associated with known sources to the Southwest Plume, including SWMUs 1 and 4 and the C-720 area. SWMU 4 also is being addressed by the Burial Grounds Operable Unit (see *Work Plan for the Burial Grounds Operable Unit Remedial Investigation/Feasibility Study at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-2179&D2 [DOE 2005c]). The conceptual model for the Southwest Plume incorporates the conceptual models for each of these source units, which on the scale of the Southwest Plume are point sources of contamination. Additional contributors to dissolved contamination to the Southwest Plume appear to be the C-400 TCE DNAPL source, which is the subject of a scheduled response action, and a ^{99}Tc source to the east of the C-720 area. This contamination co-mingles below the plant within the westward groundwater flow path defined by the Southwest Plume. TCE levels exceed the MCL at the plant boundary; ^{99}Tc activity exceeds a PGDP groundwater standard. Contaminant levels are reduced below drinking water standards by natural attenuation within the area of the PGDP property before migrating northward to join with the Northwest Plume (off-site).

4.2 SOILS AND VADOSE ZONE

Soil samples were collected from the UCD using DPT at the C-747-C Oil Landfarm, the C-720 Area, and along the storm sewer from the C-400 Building Area to Outfall 008. No soil samples were required for laboratory analysis from SWMU 4 or from other areas overlying the Southwest Plume to address the SI's principal study questions. Analytical results were reviewed to provide an understanding of the nature and extent of potential contamination. Results from soil samples that exceeded method detection limits (MDLs) were compared to the provisional subsurface soil background levels for PGDP (DOE 2000a). All VOC results were addressed as well as any levels of metals and radionuclides that exceeded the provisional subsurface soil background levels. Analytical results below the provisional soil background levels at PGDP are not included in the discussion of this investigation. Analytical data are provided as Appendix B.



U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH Remediation Services
A Portage Shaw Joint Venture Company

Fig. 4.3. SWMU 4 conceptual model.

4.2.1 C-747-C Oil Landfarm – SWMU 1

For the SI, five borings (001-201 through 001-205) were placed within and adjacent to the soil contamination area defined during the WAG 27 RI (Fig. 2.1). Borings did not exceed 60 ft, and soil samples were collected at approximately 15 ft intervals. Sampling intervals were modified to reflect the MIP profile.

Consistent with the WAG 27 RI, results indicate that soils containing elevated VOC concentrations are present at SWMU 1. Of the samples collected as part of the SI (Fig. 4.4), Location 001-202 exhibited the highest levels of TCE (3.5 mg/kg), TCA (0.044 mg/kg), and a variety of degradation products including *cis*-1,2-DCE (1.5 mg/kg); VC (0.018 mg/kg); and 1,1-DCE (0.076 mg/kg). Some or all of these products were detected in samples from all intervals collected, down to a depth of 59.5 ft. Location 001-201 also exhibited significant levels of TCE (1.8 mg/kg) and its degradation product *cis*-1,2-DCE (0.086 mg/kg). These contaminants were detected in samples from all intervals collected down to a depth of 56 ft. Location 001-205 exhibited lower levels of TCE and its degradation products. Of note at this location was the sample interval at 30 ft. The highest TCE (0.98 mg/kg) level for this location was collected at this interval together with TCA (0.0034 mg/kg) and a wide variety of degradation products. Location 001-204 exhibited low levels of TCE (0.37 mg/kg) and its degradation product, *cis*-1,2-DCE (0.2 mg/kg). Samples from Location 001-203 did not contain any detectable concentrations of TCE or its degradation products. A slight detection of carbon disulfide (0.014 mg/kg) at the sample interval at 33 ft was the only contaminant listed above MDLs.

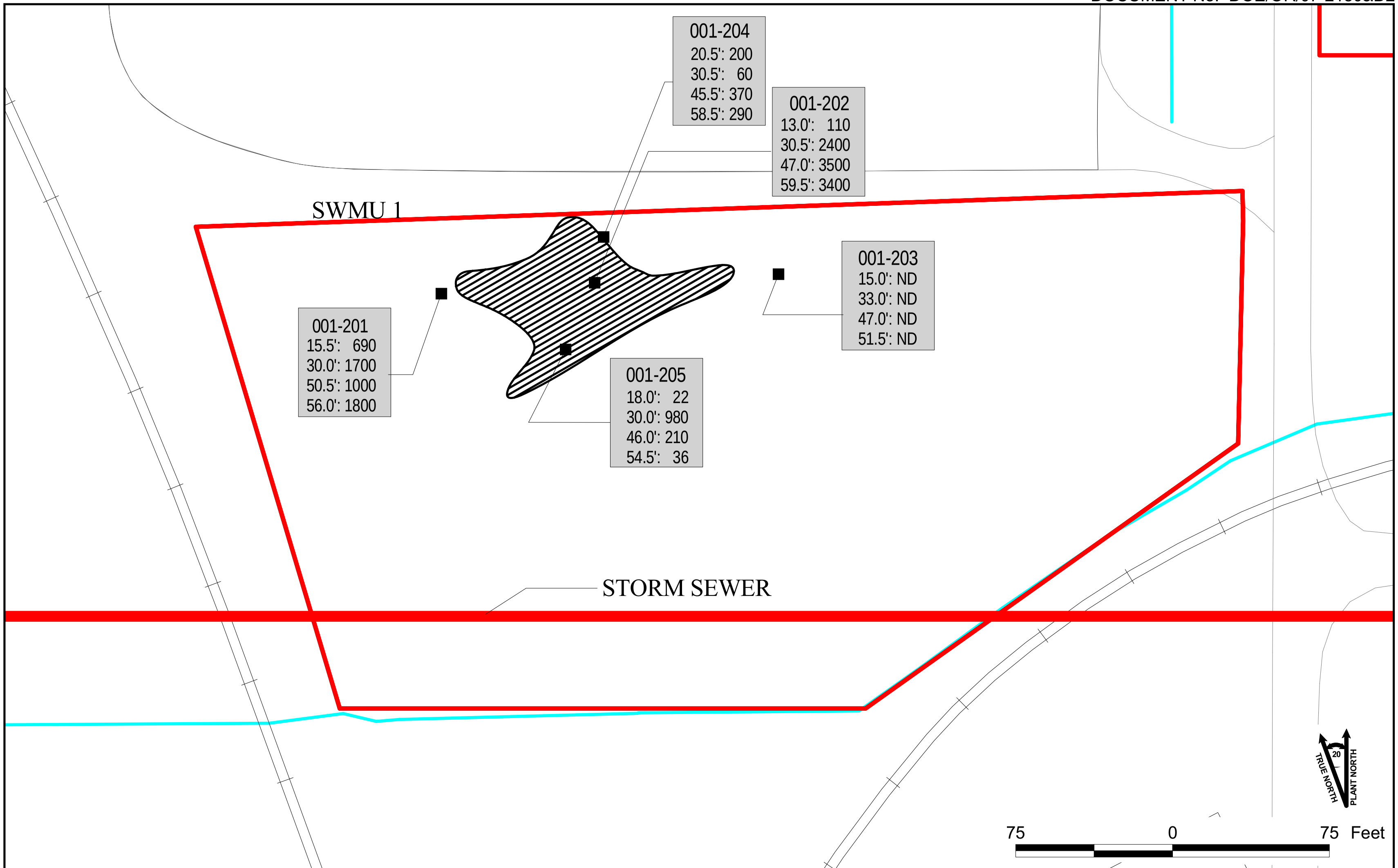
Based on the analytical results from the samples collected at SWMU 1, it appears that TCE, TCA, and their associated degradation products still exist at the SWMU 1 source area as defined in the WAG 27 RI Report down to a depth of 55 ft. All locations included in this investigation, with the exception of 001-203, can be included in the UCRS TCE contamination area at SWMU 1.

Importantly, total VOC concentrations greater than 10 mg/kg (the SI Work Plan criterion to trigger additional characterization) were not detected in any sample collected during the SI; therefore, contingency samples to define a potential DNAPL outside the boundaries of the source area defined in the WAG 27 RI Report were not needed.

4.2.2 C-720 Area

Northeast Corner. The investigation of soils of the northeast corner of the C-720 Area consisted of six borings (720-101 through 720-106) placed between the north edge of the parking lot and a storm sewer to which all surface runoff for the parking lot flows (Fig. 2.2). Because the conceptual release mechanism for the northeast corner TCE contamination is routine equipment cleaning and rinsing performed in the area in the past, locations were selected to sample areas associated with these activities. Borings did not exceed 60 ft, and soil samples were collected at approximately 15 ft intervals. Sampling intervals were modified to reflect the MIP profile. Analytical results below the soil background levels at PGDP were not included in the discussion of this investigation.

Results indicated that soils containing very low levels of VOC contamination and other contaminants resulting from the cleaning and rinsing processes are detectable in the subsurface of the northeast corner of the C-720 Area (Fig. 4.5). Location 720-105 exhibited the highest level of TCE (0.98 mg/kg) and included low levels of degradation products 1,1-DCE (0.022 mg/kg) and *cis*-1,2-DCE (0.052 mg/kg). Carbon disulfide (0.0055 mg/kg) was detected at this location as well, but not detected at any other locations during this investigation of the northeast corner source area. Location 720-104 exhibited a maximum TCE level of 0.63 mg/kg and no degradation products above the MDLs. Location 720-106 had a similar maximum TCE level of 0.6 mg/kg and included *cis*-1,2-DCE (0.019 mg/kg). At this location,



LEGEND:

- SWMU
- AREA OF UCRS TCE CONTAMINATION
- ■ SOIL SAMPLE COLLECTED FROM DPT

Sample Depth & TCE : Result* (ug/kg)

60': 20
70': 22
80': 15
90': 18
100': 18

*maximum result of regular and headspace sampling

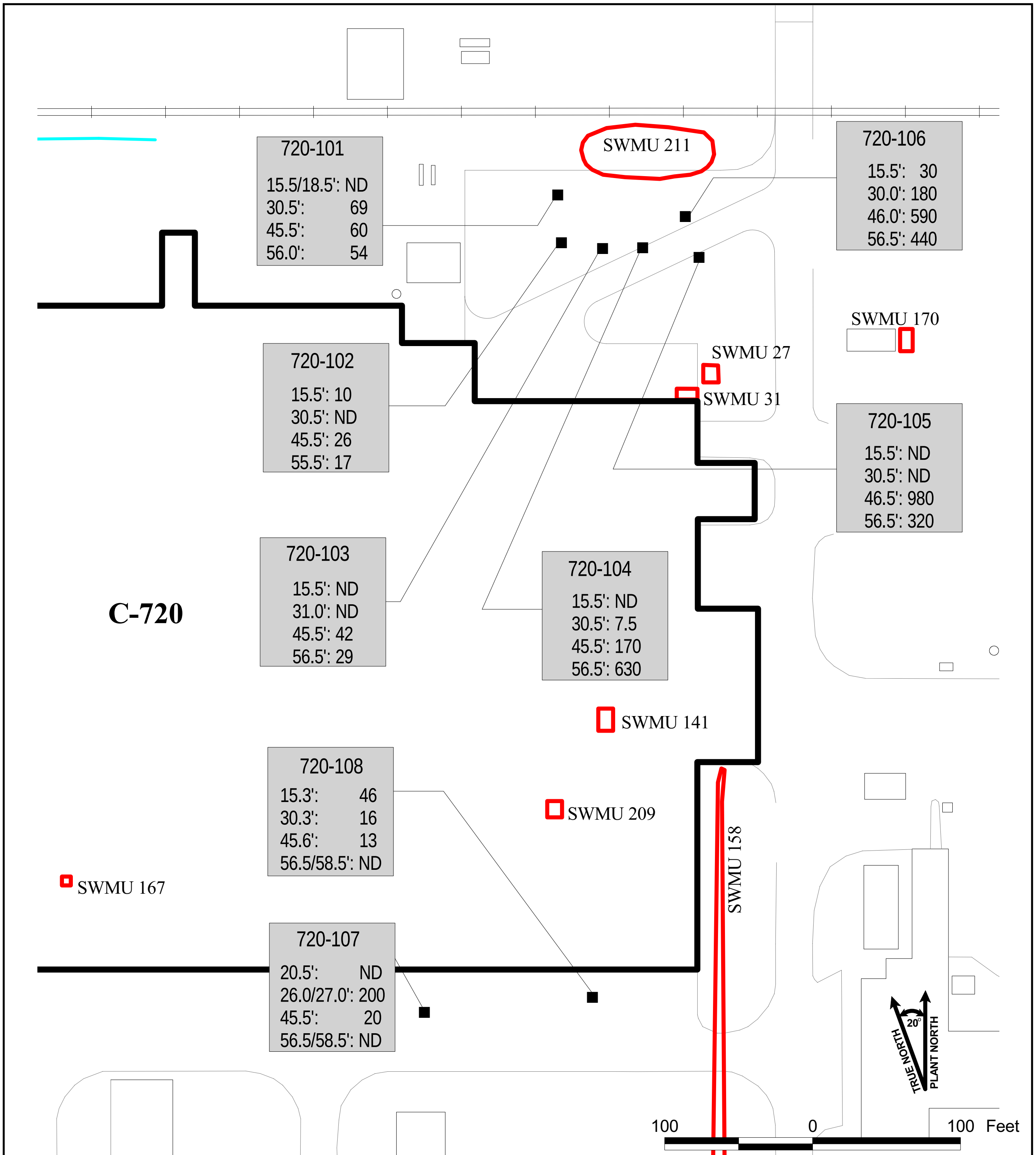
ND=non-detect

U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH Remediation Services
A Portage Shaw Joint Venture Company

Fig. 4.4. TCE results from SWMU 1 SI sampling.

FIGURE No. \SIs\data_assess1r2.apr
DATE 12-14-04



LEGEND:
SWMU
SOIL SAMPLE COLLECTED FROM DPT

Sample Depth & TCE : Result* (ug/kg)
60': 20
70': 22
80': 15
90': 18
100': 18

*maximum result of regular and headspace sampling

ND=non-detect

U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

Fig. 4.5. TCE results from C-720 SI sampling.

PADUCAH Remediation Services
A Portage Shaw Joint Venture Company

FIGURE No. \SIs\data_assess1r2.apr
DATE 12-14-04

beryllium (0.797 mg/kg) and chromium (45.4 mg/kg) were detected above provisional subsurface soil background levels (0.69 and 43 mg/kg, respectively) from the sample interval ending at 18.5 ft. The remaining three locations sampled in the northeast corner had very low levels of TCE (0.01 to 0.06 mg/kg), but included some other contaminants. Location 720-101 exhibited tetrachloroethene (PCE) (0.022 mg/kg) and degradation products 1,2- dichloroethane (DCA) (0.044 mg/kg) and 1,1-DCE (0.18 mg/kg). Carbon tetrachloride (0.035 mg/kg) was detected in the intervals ending at 48.5 ft and 59 ft. Location 720-102 included degradation products *cis*-1,2-DCE (0.0068 mg/kg), 1,2-DCE (0.0029 mg/kg), and 1,1-DCE (0.015 mg/kg). Carbon tetrachloride (0.0048 mg/kg) was detected in the interval ending at 48.5 ft. Cobalt (33.7 mg/kg), exceeding its provisional subsurface soil background level (i.e., 13 mg/kg), was detected in the sample interval ending at 33.5 ft. Location 720-103 exhibited the same degradation products as the other locations: 1,2-DCA (0.0078 mg/kg), *cis*-1,2-DCE (0.009 mg/kg), and 1,1-DCE (0.03 mg/kg). Other contaminants included beryllium (0.737 mg/kg), carbon tetrachloride (0.019 mg/kg), and chloroform (0.0031 mg/kg).

The results of the soils investigation of the northeast corner of the C-720 Area are consistent with the suspected TCE release mechanism of routine equipment cleaning and rinsing and confirmed that dissolved contamination has migrated to the area's deeper soil. Total VOC concentrations greater than 10 mg/kg were not identified in the SI samples (work plan criterion to trigger additional sampling); therefore, contingency samples to define DNAPL outside the currently defined source area were not needed. Neither metals nor radionuclide contamination was routinely detected above provisional soil background concentrations.

Southeast Corner. The investigation of the southeast corner of the C-720 Area consisted of two borings (720-107 and 720-108) placed through the parking lot adjacent to the C-720 Building loading dock (Fig. 2.2). Borings did not exceed 60 ft, and soil samples were collected at approximately 15 ft intervals. Sampling intervals were modified to reflect the MIP profile.

Samples collected from the two locations at the southeast corner of the C-720 area had very low levels of TCE with no associated degradation products. Location 720-107 had a maximum TCE level of 0.2 mg/kg at the sample interval ending at 29 ft, and Location 720-108 had a maximum TCE level of 0.046 mg/kg at the sample interval ending at 18.3 ft. These results indicate that the two locations were at the periphery of the source area defined in the WAG 27 RI Report. As discussed in the RI Report, the concentrations of TCE within the source area defined in the RI (sample Location 720-002) varied from 0.037 mg/kg at 5 to 8 ft bgs to 68 mg/kg at 20 to 21 ft bgs.

Contamination in the southeast corner was delimited by two locations, which have relatively low TCE concentrations. The observed VOC levels did not trigger the collection of contingency samples to define the DNAPL area. Neither metals nor radionuclide contamination was routinely detected.

4.2.3 Storm Sewer from the C-400 Building to Outfall 008 – Part of SWMU 102

The initial phase for the investigation of the storm sewer involved verifying the integrity of the storm sewer itself. Any breaks or cracks in the storm sewer could act as potential pathways for contamination. A video system was used to inspect approximately 3,000 ft of the storm sewer from the east side of the C-400 Building to Outfall 008. The video indicated that the storm sewer had maintained its structural integrity. The actual physical properties of the storm sewer (diameter and length of pipe in sections) were different than expected in some areas, and these differences were documented for future reference. There were no significant holes or fractures visible in the storm sewer. The MIP/DPT samples were placed at locations near potential weaknesses in the storm sewer walls (See Appendix C) at depths of 18.8 to 20 ft bgs, which is near but below the base of the storm sewer.

Initial headspace results from soil samples indicated that VOCs likely were present only in low levels. This was later confirmed with TCE results ranging from 0.0028 to 0.220 mg/kg being found in soil samples. Results for degradation products of TCE also were low or nondetect. (Maximum was *cis*-1,2-DCE at 0.043 mg/kg at Location 102-013.) Three soil samples (Locations 102-008, 102-010, and 102-013) had ^{99}Tc detects. The maximum ^{99}Tc result was 2.39 pCi/g. Two soil samples (Locations 102-013 and 102-014) also had cadmium results of 0.53 and 0.63 mg/kg, respectively, which were above the provisional subsurface background concentration of 0.21 mg/kg. No other metals were detected above background.

From the visual inspection and sampling results, it can be concluded that the integrity of the storm sewer is intact; therefore, the storm sewer does not appear to be contributing VOCs and ^{99}Tc to the Southwest Plume. Additionally, neither metals nor radionuclides were routinely detected at concentrations above provisional soil background concentrations.

4.2.4 C-747 Contaminated Burial Yard – SWMU 4

No soil samples were collected for laboratory analysis during the course of the investigation for this unit. Formation samples were collected for descriptive purposes only.

4.2.5 Southwest Plume – SWMU 210

No soil samples were collected for laboratory analysis during the course of the investigation for this unit. Formation samples were collected for descriptive purposes only.

4.3 GROUNDWATER

Groundwater samples were collected at various depths within the RGA using DWRC at the C-747 Contaminated Burial Yard (SWMU 4) and the Southwest Plume (SWMU 210). The SI's principal study questions did not require additional groundwater sampling to address the C-747-C Oil Landfarm. Moreover, groundwater samples were not required to address the principal study questions for the storm sewer leading from the C-400 Building to Outfall 008.

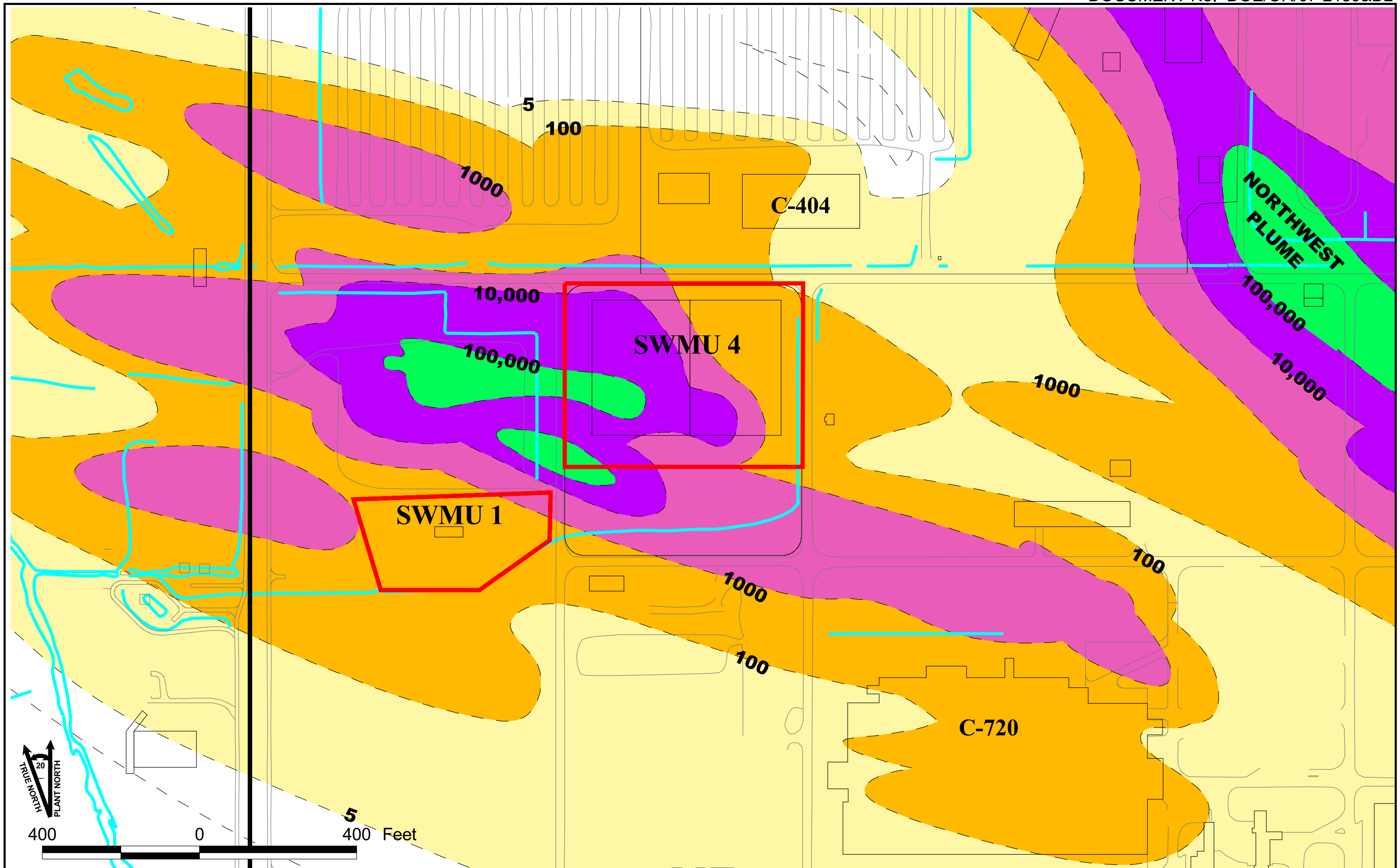
Analytical results from the samples were reviewed to provide an understanding of the nature and extent of potential contamination. Where analyses of previous investigations were included in the assessment of nature and extent, these data were assumed to be representative of conditions at the time of the SI; thus, no attempt was made to "age-correct" the data. Figures 4.6 and 4.7 present the extent of the TCE and ^{99}Tc plumes for the Southwest Plume area as it was understood in 2003, prior to the Southwest Plume Site Investigation. Analytical data is provided as Appendix B.

4.3.1 C-747-C Oil Landfarm – SWMU 1

No groundwater samples were collected during the investigation of this unit. Soil samples were collected from the vadose zone above the RGA for analysis. Sample boreholes were not advanced past the UCD.

4.3.2 C-720 Area

Samples from the well cluster MW203 (RGA) and MW204 (UCRS), were the only groundwater samples collected during the investigation of this unit. Both TCE and ^{99}Tc levels declined from the UCRS to the RGA (280 to 99 µg/L TCE and 1240 to 35.5 pCi/L ^{99}Tc). The 1240 pCi/L was the highest ^{99}Tc activity measured in groundwater. Soil samples were collected from the vadose zone above the RGA for



LEGEND:

TCE Plume Boundary (ug/L):
(INTERPRETED FOR JUNE 2003)

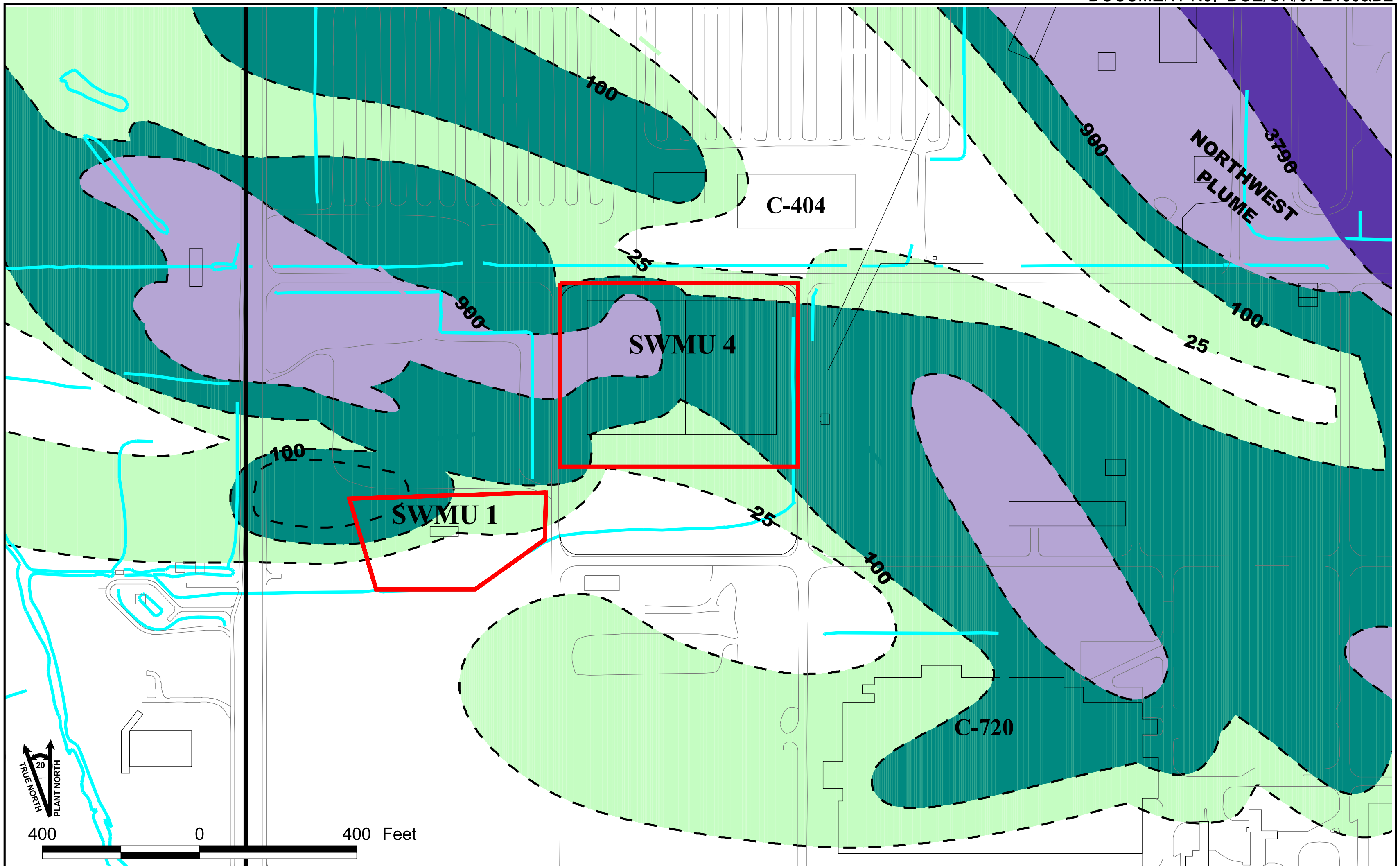
>100,000
10,000-100,000
1000- 10,000
100- 1000
5- 100
1- 5

U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH Remediation Services
A Portage Shaw Joint Venture Company

Fig. 4.6. TCE plume within study area.

FIGURE No. SW_Data_pres1REV2.apr
DATE 04-10-06



LEGEND:

Tc-99 Plume Boundary : (INTERPRETED FOR JUNE 2003)

- 3,790 pCi/L
- 900 pCi/L
- 100 pCi/L
- 25 pCi/L

U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH Remediation Services
A Portage Shaw Joint Venture Company

Fig. 4.7. ^{99}Tc plume within study area.

FIGURE No. SW_Data_pres1REV2.apr
DATE 04-10-06

analysis. None of the soil samples from the C-720 area that were collected for this SI contained detectable levels of ^{99}Tc. Sample boreholes were not advanced past the UCD. These results are consistent with contamination in the shallow soils potentially associated with historic spills and leaks from the C-722 Acid Neutralization Tank.

4.3.3 Storm Sewer from the C-400 Building to Outfall 008 – Part of SWMU 102

No groundwater samples were collected during the investigation of this unit. Samples were collected from the base of the backfill material in which the storm sewer rests. Borings did not exceed a 20 ft depth and were not advanced past the UCD.

4.3.4 C-747 Contaminated Burial Yard – SWMU 4

Previous investigations have indicated hazardous substances in the subsurface soils and groundwater within and immediately adjacent to the boundaries of SWMU 4. The current investigation consisted of the installation of ten temporary groundwater borings (004-101 through 004-110) adjacent to SWMU 4: four of the borings east of the unit (004-101 through 004-104), five of the borings west of the unit (004-105 through 004-109), and one boring near the southwest corner of the unit (004-110) (Fig. 2.4). Groundwater samples were collected every 10 ft from the top of the RGA to its base to determine if SWMU 4 was contributing TCE and ^{99}Tc contamination to the aquifer. Concentration results for TCE and ^{99}Tc for each location are provided in Figs. 4.8 through 4.14. Figures 4.11 through 4.14 present cross sections of the TCE and ^{99}Tc contamination upgradient and downgradient of SWMU 4. The locations of the SI temporary soil borings included in the cross sections can be found on Fig. 4.10.

The four borings east of SWMU 4 were upgradient from the unit and could be considered background locations for this SWMU. TCE results indicated lower concentrations for the shallow intervals at 60 ft and 70 ft for each of these locations (1.2 μg/L to 24 μg/L). TCE results increased significantly for the 80 ft interval (83 μg/L to 160 μg/L). The intervals at 90 ft, 95 ft, and 100 ft exhibited the highest concentrations of TCE (140 μg/L to 680 μg/L) for these four borings. ^{99}Tc was less prevalent in the borings. Location 004-104 did not detect any concentrations of ^{99}Tc above MDLs. Location 004-101 detected ^{99}Tc at the 70 ft interval (25.3 pCi/L), the 80 ft interval (50.3 pCi/L), and the 90 ft interval (88.1 pCi/L). Location 004-102 detected ^{99}Tc at the 80 ft interval (21.3 pCi/L) and the 90 ft interval (93.2 pCi/L). Location 004-103 detected ^{99}Tc at the 90 ft interval (49.9 pCi/L) and the 100 ft interval (82.9 pCi/L).

The one boring south of SWMU 4 is crossgradient from the unit. Location 004-110 exhibited elevated concentrations of TCE for each of the intervals sampled. Results were higher for the shallower intervals (110 μg/L at 60 ft and 86 μg/L at 70 ft) and lower for the deeper intervals (47 μg/L at 80 ft and 62 μg/L at 90 ft) except for the interval at 100 ft (150 μg/L). Location 004-110 detected ^{99}Tc only in the interval at 90 ft (18 pCi/L).

The SI sampled five borings west of SWMU 4 (004-105 through 004-109) to assess the downgradient impact of the unit on TCE and ^{99}Tc levels. Groundwater samples from locations 004-105 through 004-108 (the 4 northernmost borings on the west side) exhibited a pronounced increase in contaminant levels over those observed in samples from locations on the east side of SWMU 4 (borings 004-101 and 004-101A through 004-104).

Analyses revealed that the highest contaminant levels (2,860 and 3,980 μg/L TCE and 474 and 663 pCi/L ^{99}Tc occurred in the upper RGA in boring 004-108 (located near the south end of the west-side boring transect). Elevated levels of TCE (> 1,000 μg/L) and ^{99}Tc (> 100 pCi/L) extend across the middle RGA in the borings to the north (west side). Moreover, TCE concentration ranged from 1,200 to 2,000 μg/L

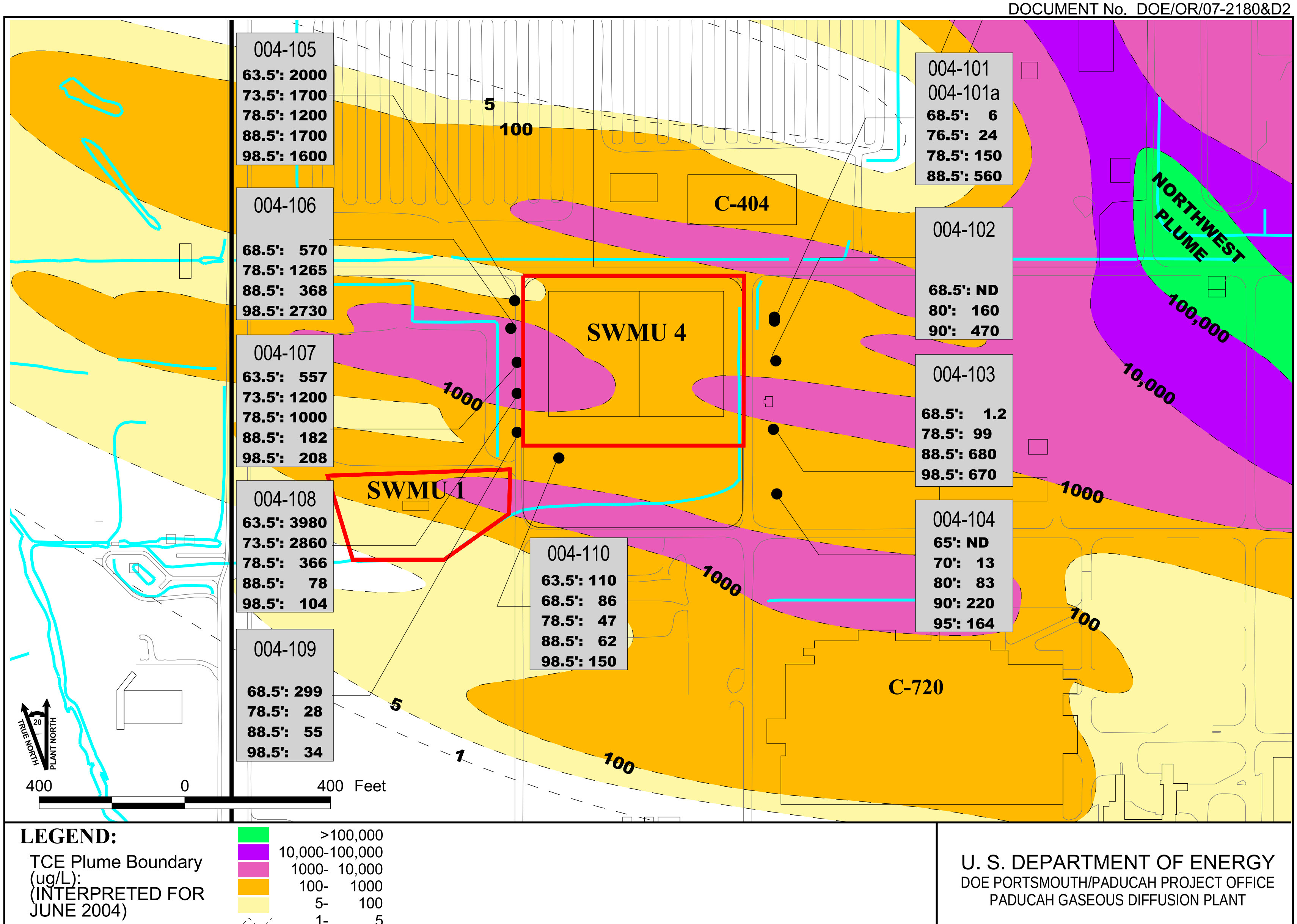


Fig. 4.8. TCE results from SWMU 4 SI sampling.

PADUCAH Remediation Services
A Portage Shaw Joint Venture Company

FIGURE No. SW_Data_pres1REV2.apr
DATE 04-10-06

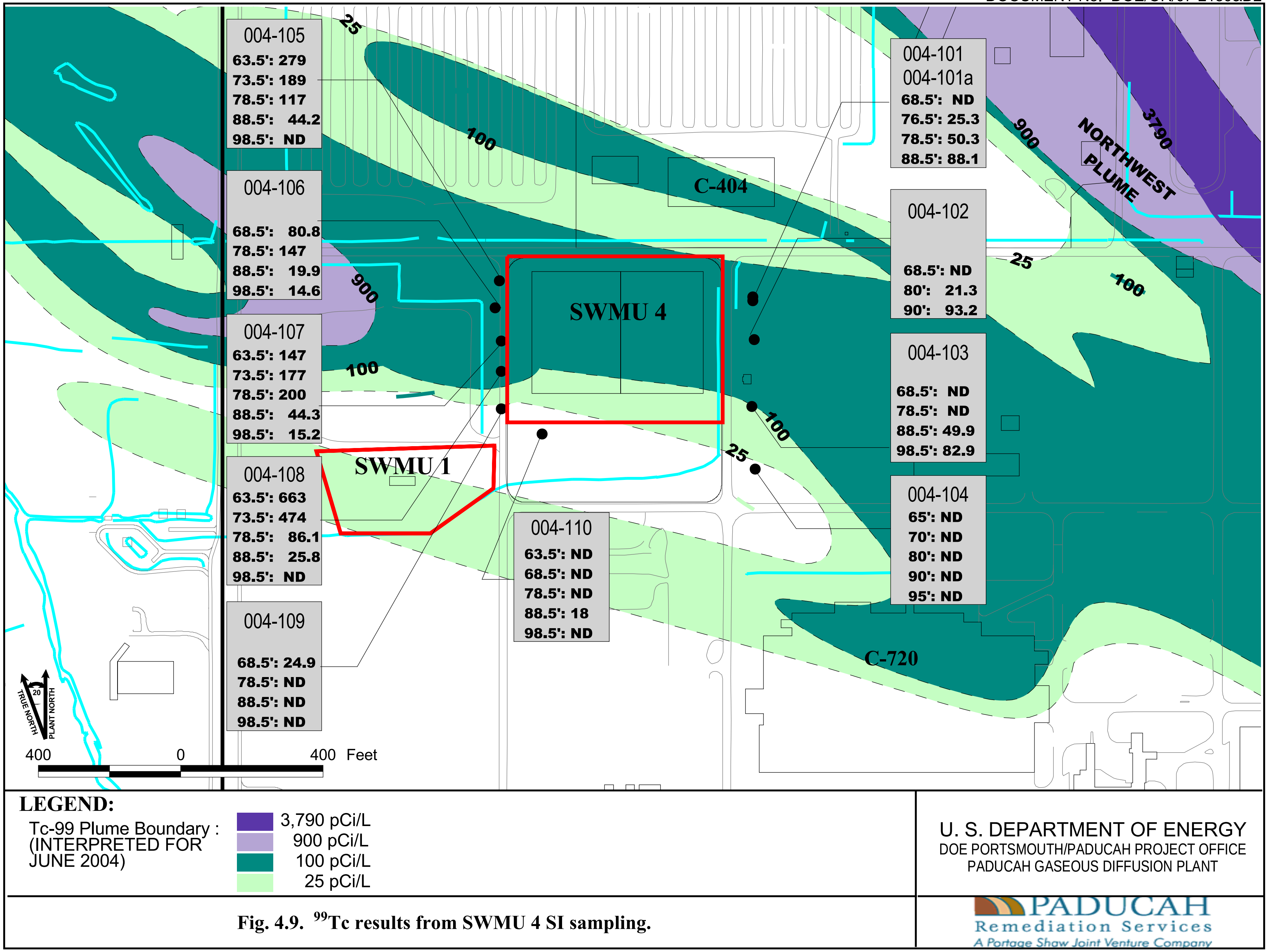


Fig. 4.9. ^{99}**Tc results from SWMU 4 SI sampling.**

FIGURE No. SW_Data_pres1REV2.apr
DATE 04-10-06

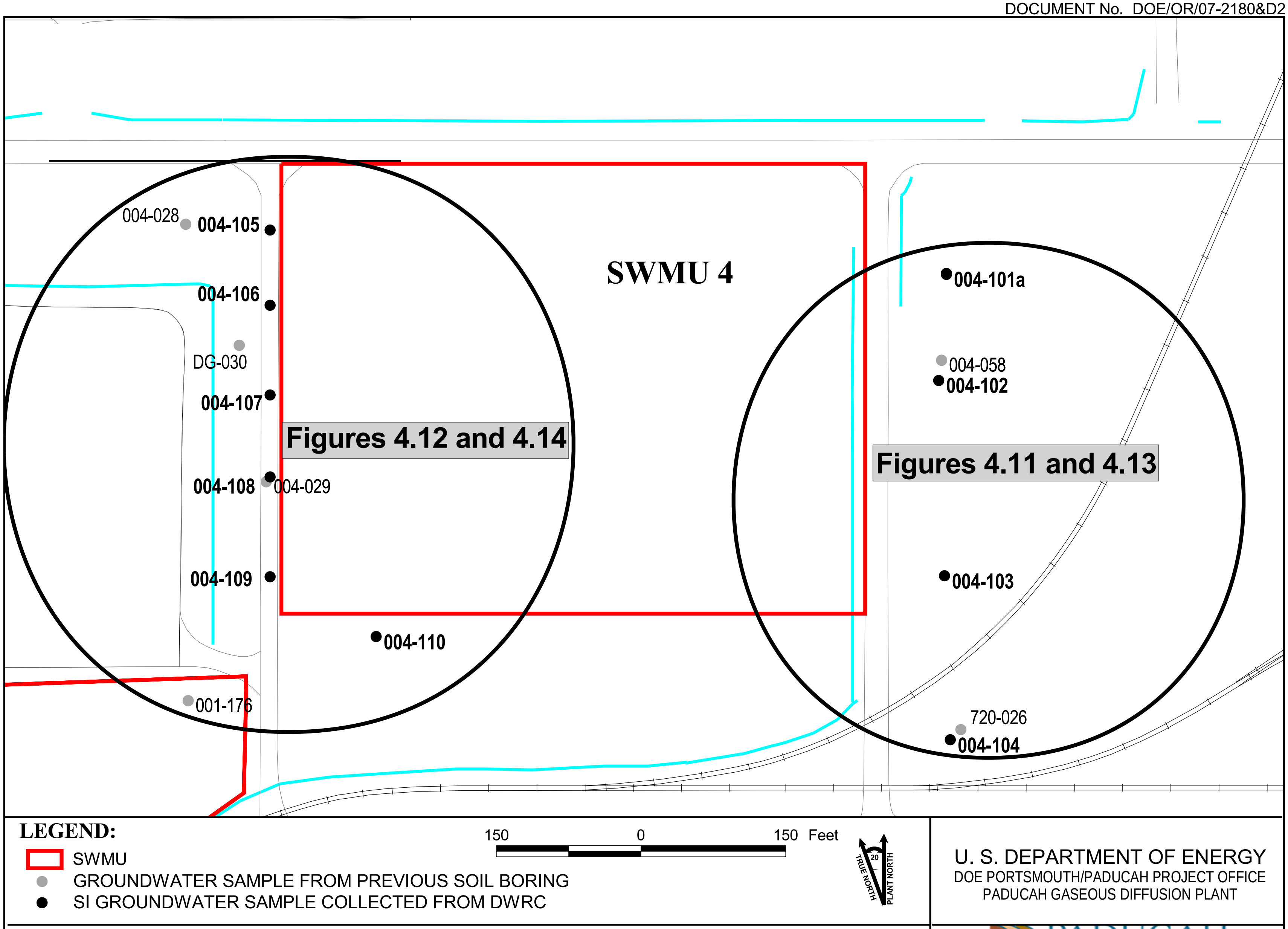
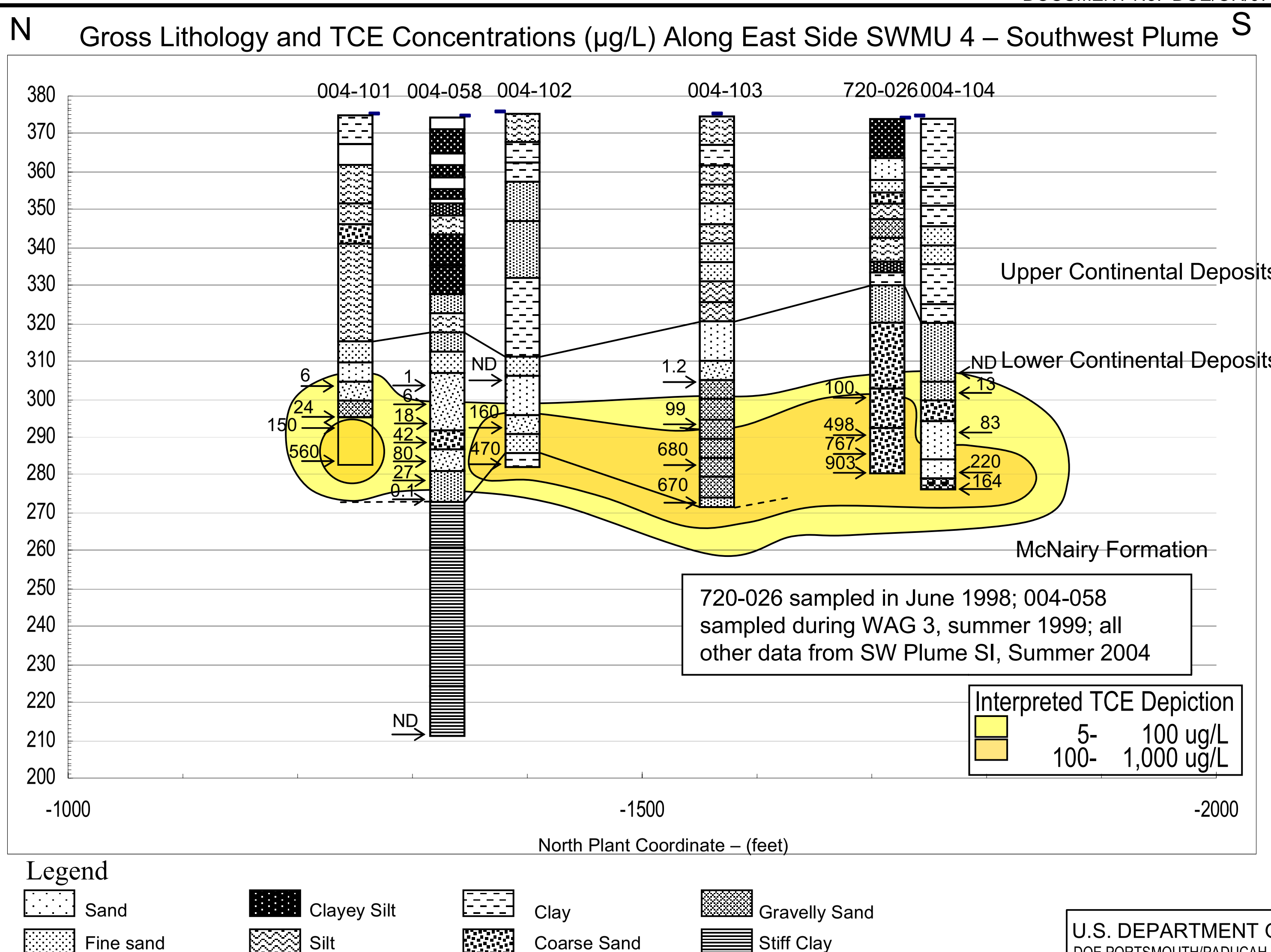


Fig. 4.10. SWMU 4 sample locations.

FIGURE No. swmu4modelr1.apr
DATE 03-06-06

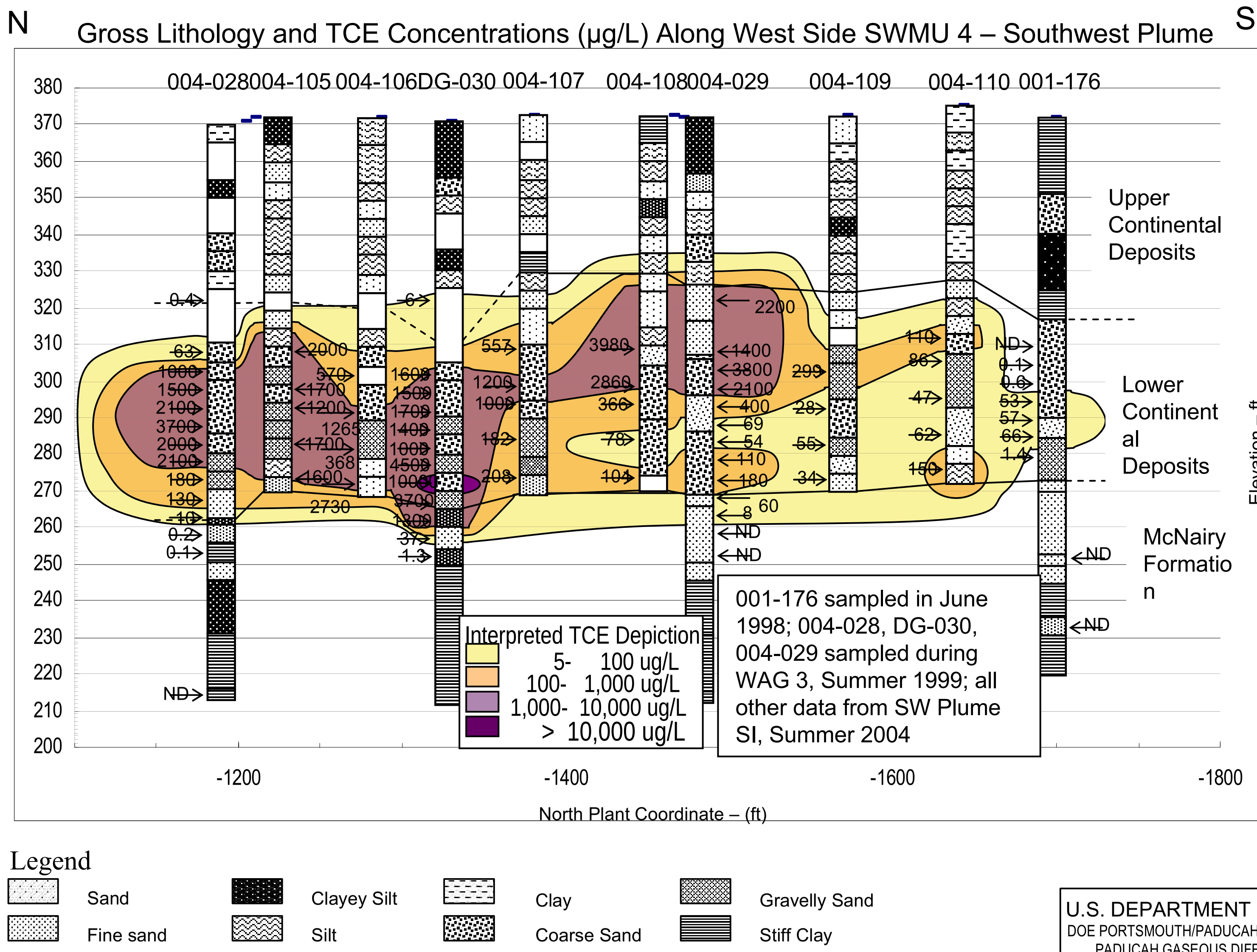


U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH Remediation Services
A Portage Shaw Joint Venture Company

Fig. 4.11. TCE distribution within the RGA upgradient of SWMU 4.

FIGURE No. Fig.11.r2.ppt
DATE 04-10-06

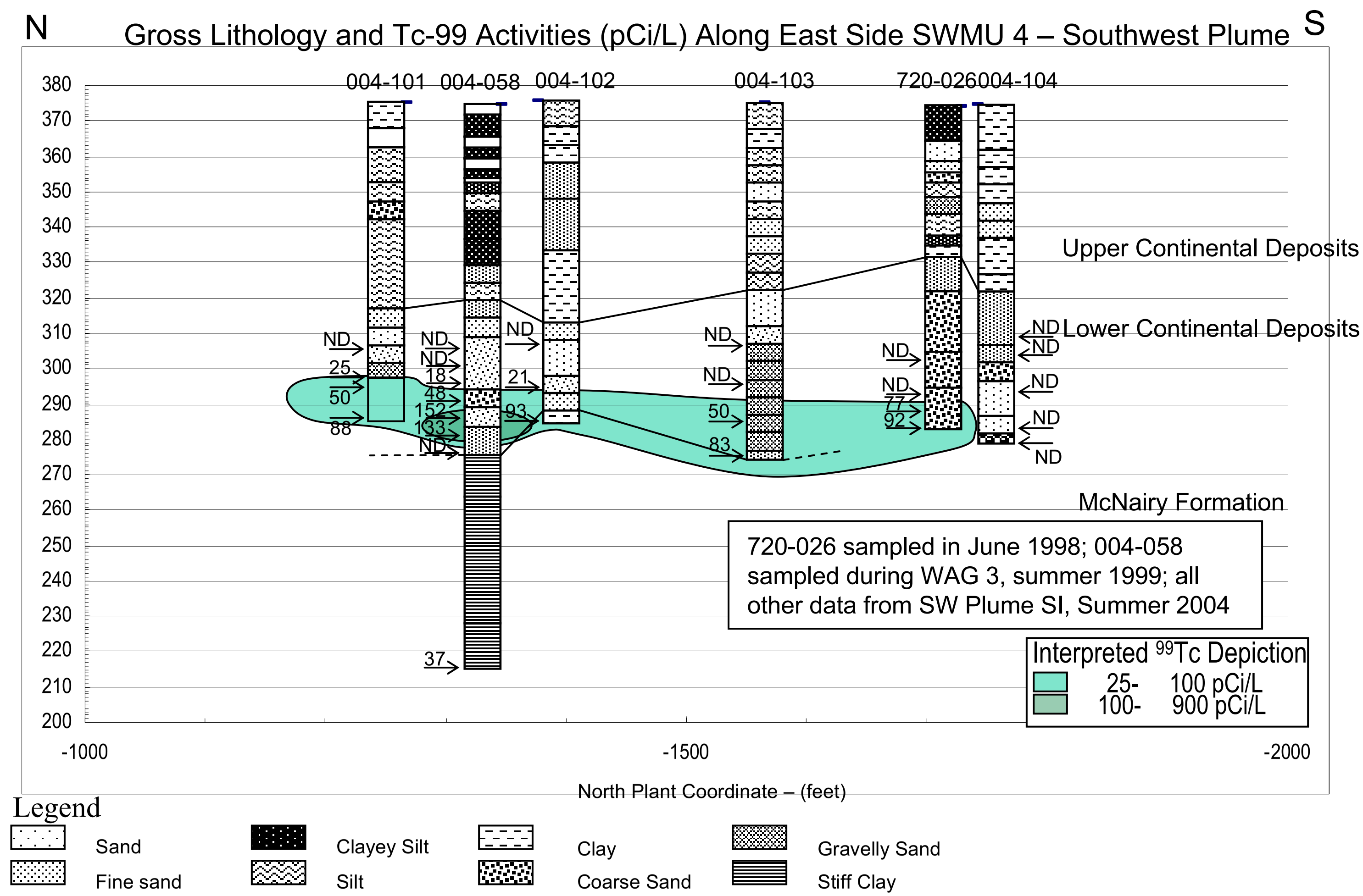


U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH Remediation Services
A Portage Shaw Joint Venture Company

Fig. 4.12. TCE distribution within the RGA downgradient of SWMU 4.

FIGURE No. Fig-12.r2.ppt
DATE 04-10-06

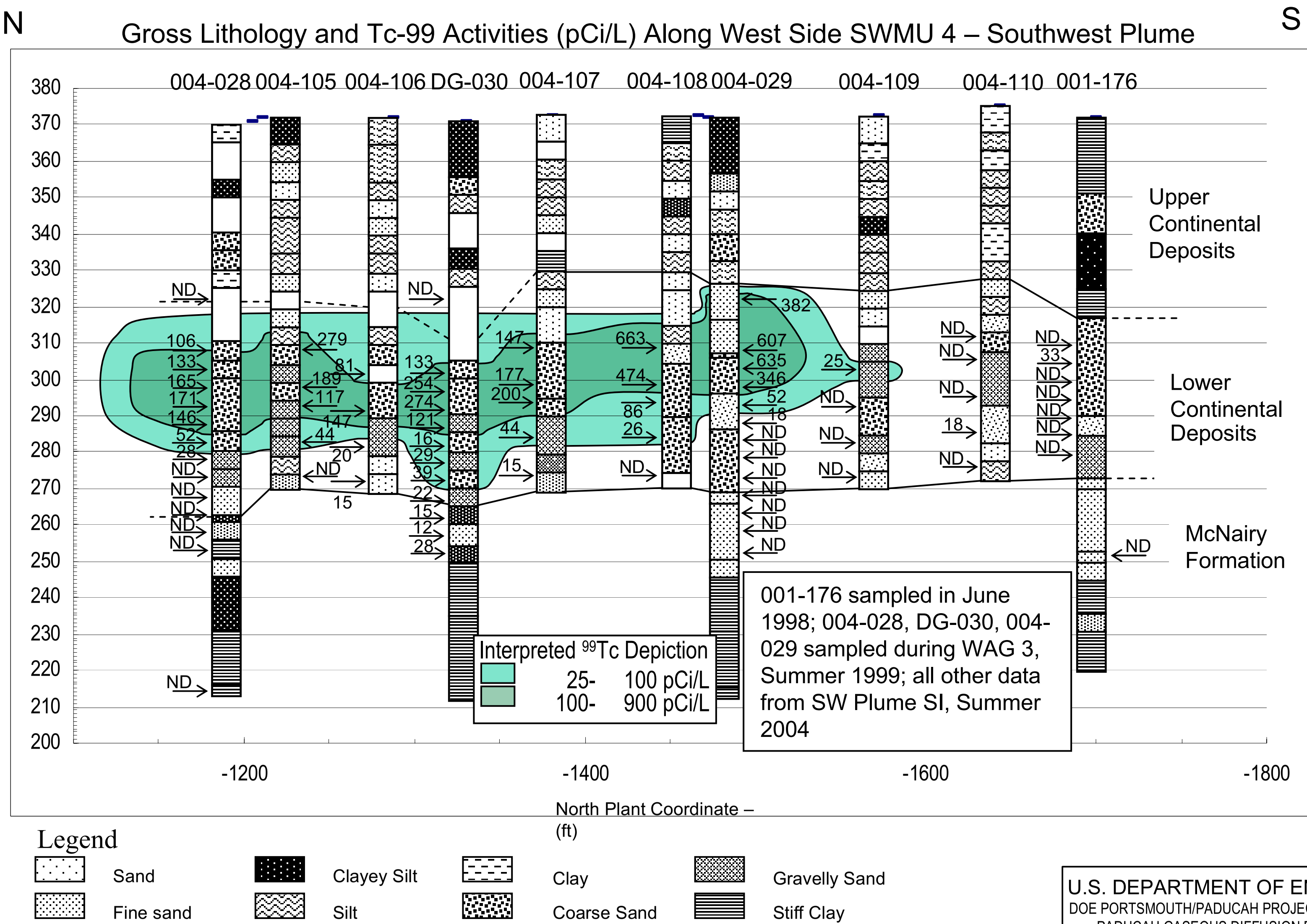


U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH Remediation Services
A Portage Shaw Joint Venture Company

Fig. 4.13. **^{99}Tc distribution within the RGA upgradient of SWMU 4.**

FIGURE No. Fig-13.r2.ppt
DATE 04-10-06



U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH Remediation Services
A Portage Shaw Joint Venture Company

Fig. 4.14. ^{99}Tc distribution within the RGA downgradient of SWMU 4.

FIGURE No. Fig-14.r2.ppt
DATE 04-10-06

throughout the 35-ft depth of the RGA at boring 004-105 (north end) and was high (2,730 μg/L) in the basal sample of adjacent boring 004-106. In the two north end borings (004-105 and 004-106), ^{99}Tc levels were above 100 pCi/L only in the upper and middle RGA.

The data illustrates that SWMU 4 is impacting the sample locations downgradient and west-southwest from the unit. Elevated concentrations of TCE and ^{99}Tc are more pronounced in the shallower intervals. This is inconsistent with the sample locations upgradient of the unit. Higher concentrations of TCE and ^{99}Tc were detected in the deeper intervals upgradient from the unit. It appears the locations upgradient from SWMU 4 are affected by releases from another source area.

4.3.5 Southwest Plume – SWMU 210

This investigation sampled within the known boundaries of the Southwest Plume and in areas possibly impacted by the plume to better define the sources of the plume and the extent of contamination. The investigation consisted of installation of ten temporary groundwater borings (210-001 through 210-010) (Fig. 2.5). Seven temporary groundwater borings (210-001 through 210-007) were completed just east of the west plant boundary and downgradient from the suspected sources to the plume. Three temporary groundwater borings (210-008 through 210-010) were placed in the area immediately west of the steam plant coal pile and the C-400 Building and upgradient of SWMU 4. Groundwater samples were collected every 10 ft from the top of the RGA to its base and analyzed for VOC and ^{99}Tc contamination to the aquifer. Results of analyses for TCE and ^{99}Tc at each location are provided in Figs. 4.15 and 4.16. For comparison, maps of the TCE and ^{99}Tc groundwater contamination of the Southwest Plume area for data collected through calendar year 2003 are presented as Figures 4.6 and 4.7. Figures 4.17 and 4.18 illustrate the sample analyses of borings 210-001 through 210-007 and geology in a cross section of the RGA along the west plant boundary.

Table 4.1 presents the analyses for TCE and its degradation products and ^{99}Tc for groundwater samples collected from MWs located within the boundaries of the Southwest Plume (Fig. 2.5). Appendix B contains results for other analyses of the samples from these wells.

As shown in Table 4.1, TCE concentrations in samples collected from MWs varied from nondetect (MW89 and MW329) to 430 μg/L (MW333), with the highest concentrations being from wells located near SWMUs 1, 2, and 4 and the C-720 area. Concentrations of the degradation product *cis*-1,2-DCE showed a similar pattern with the highest concentration (44 μg/L) being found in the sample from MW333. Neither, *trans*-1,2-DCE nor VC was detected in any sample. Note that low levels of *trans*-1,2-DCE and VC may have been present in some samples, but could not be detected because high levels of TCE masked the occurrence of other VOCs on the laboratory detectors.

Most ^{99}Tc results from samples from existing wells were nondetect. The highest activity detected (1240 pCi/g) was from a sample collected from MW204, which is the only existing well completed in the UCRS sampled during the SI. The highest levels seen in samples from wells completed in the RGA were 203 and 132 pCi/g from MW337 and MW226, respectively.

The RGA groundwater analyses provide a basis for updating the maps of the Southwest Plume. Figures 4.8, 4.9, 4.15, and 4.16 incorporate revised maps of TCE and ^{99}Tc distribution in the Southwest Plume. In general, the SI data supported a reduction in the size of areas with 1000 μg/L TCE. The vertical distribution of dissolved TCE concentrations in the RGA downgradient of SWMU 4 supports an interpretation that TCE as DNAPL remains in the SWMU 4 burial pits, or in the UCD below the burial pits, and may be present in the RGA below SWMU 4.

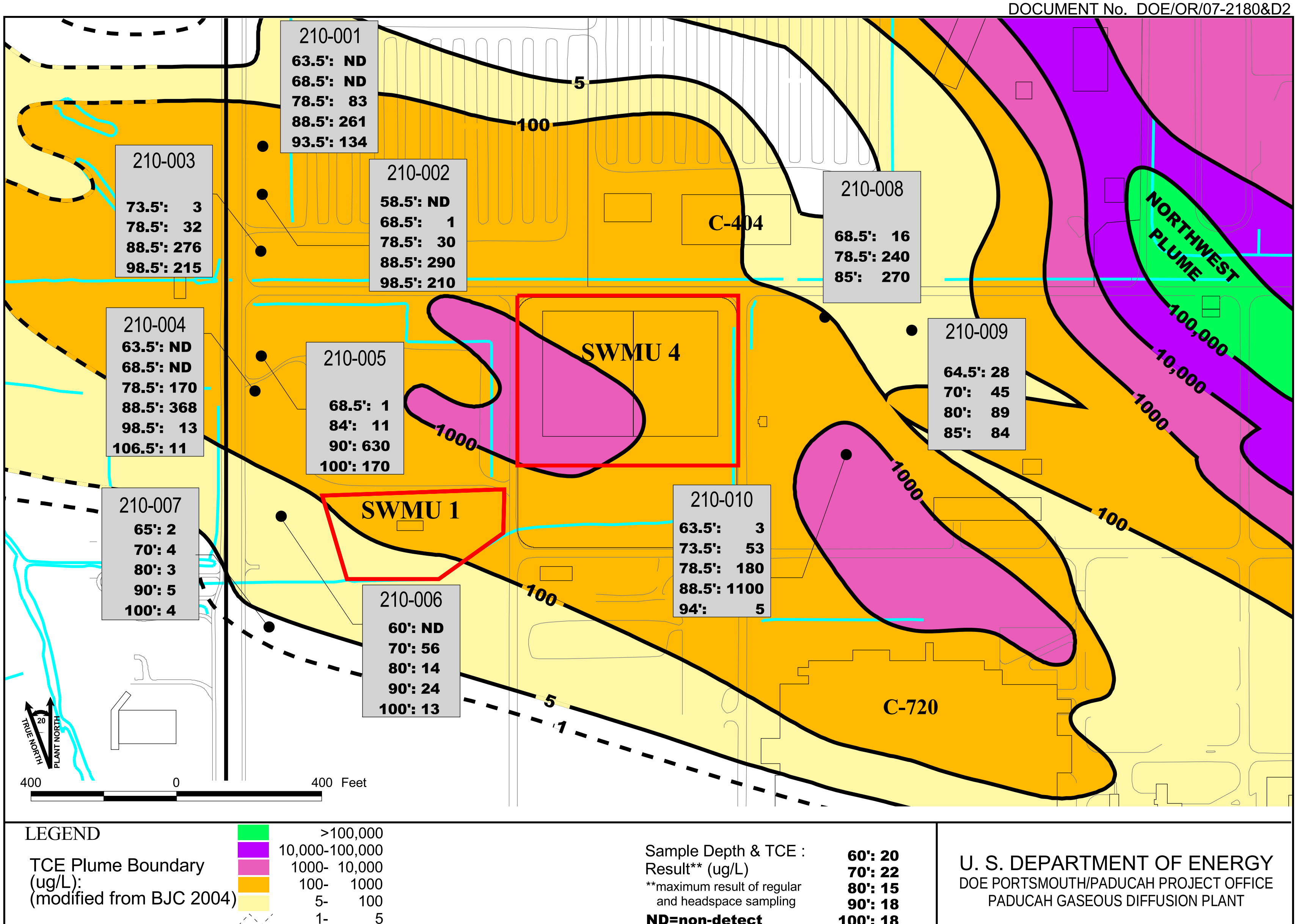
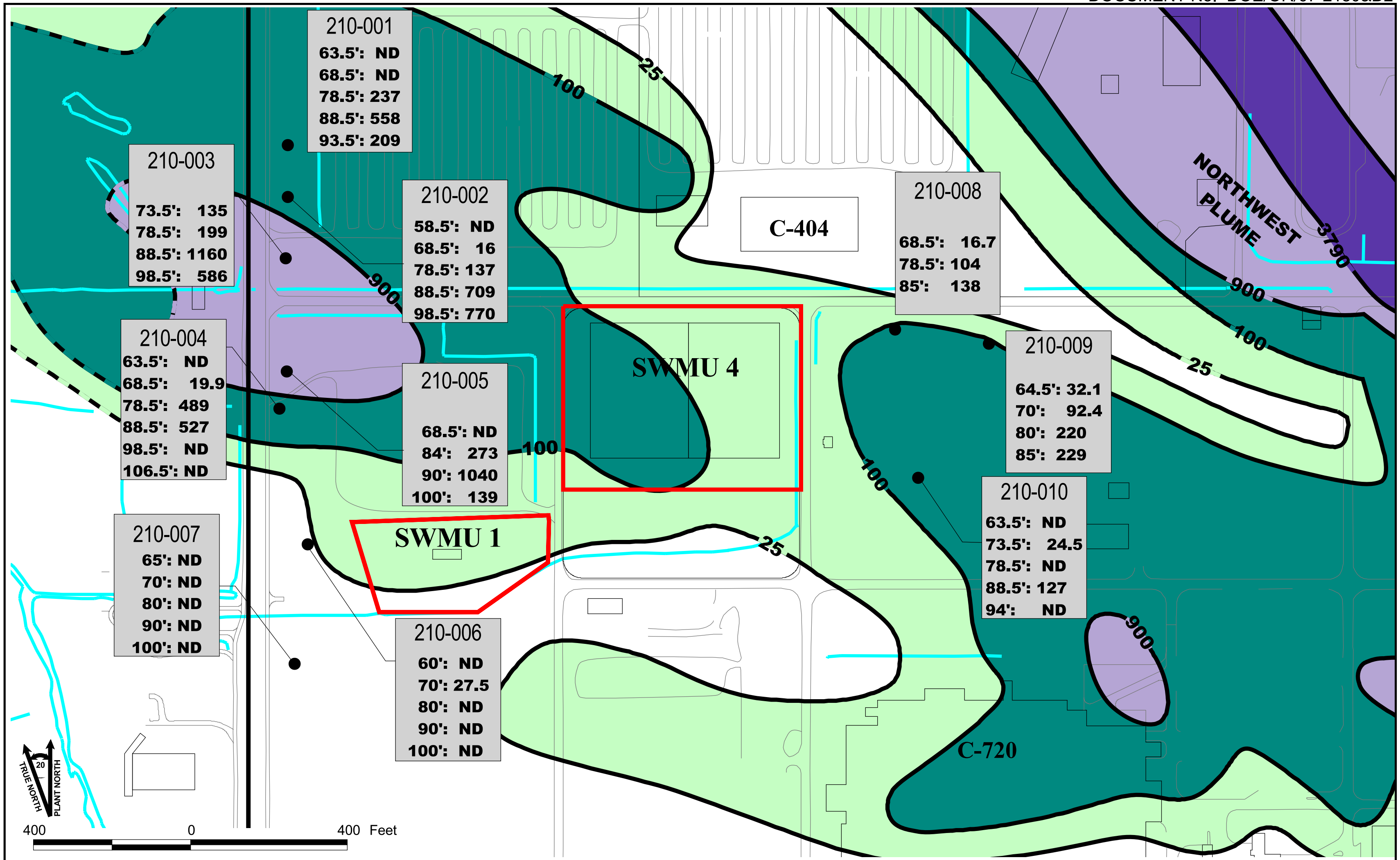


Fig. 4.15. TCE results from dissolved-phase SI sampling.

U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH Remediation Services
A Portage Shaw Joint Venture Company

FIGURE No. SW_Data_pres2.apr
DATE 04-10-06



LEGEND:

Tc-99 Plume Boundary : (modified from BJC 2004)

- 3,790 pCi/L
- 900 pCi/L
- 100 pCi/L
- 25 pCi/L

Sample Depth & ^{99}Tc : Result (pCi/L)

60': 20
70': 22
80': 15
90': 18
100': 18

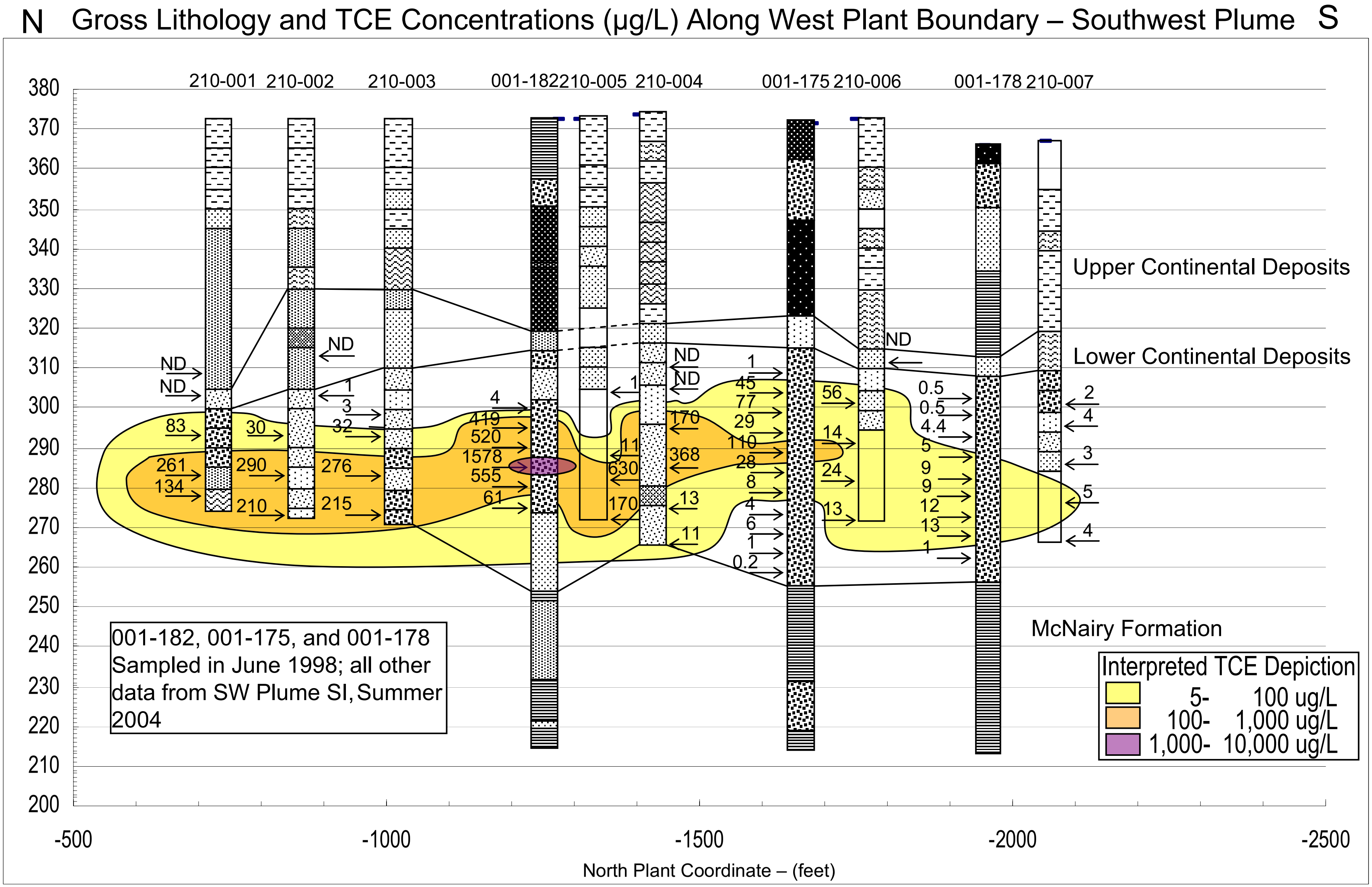
ND=non-detect

U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH Remediation Services
A Portage Shaw Joint Venture Company

Fig. 4.16. ^{99}Tc results from dissolved-phase SI sampling.

FIGURE No. SW_Data_pres2.apr
DATE 04-10-06



U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT
PADUCAH Remediation Services
A Portage Shaw Joint Venture Company

Fig. 4.17. Trichloroethene distributions within the RGA along the west plant boundary.

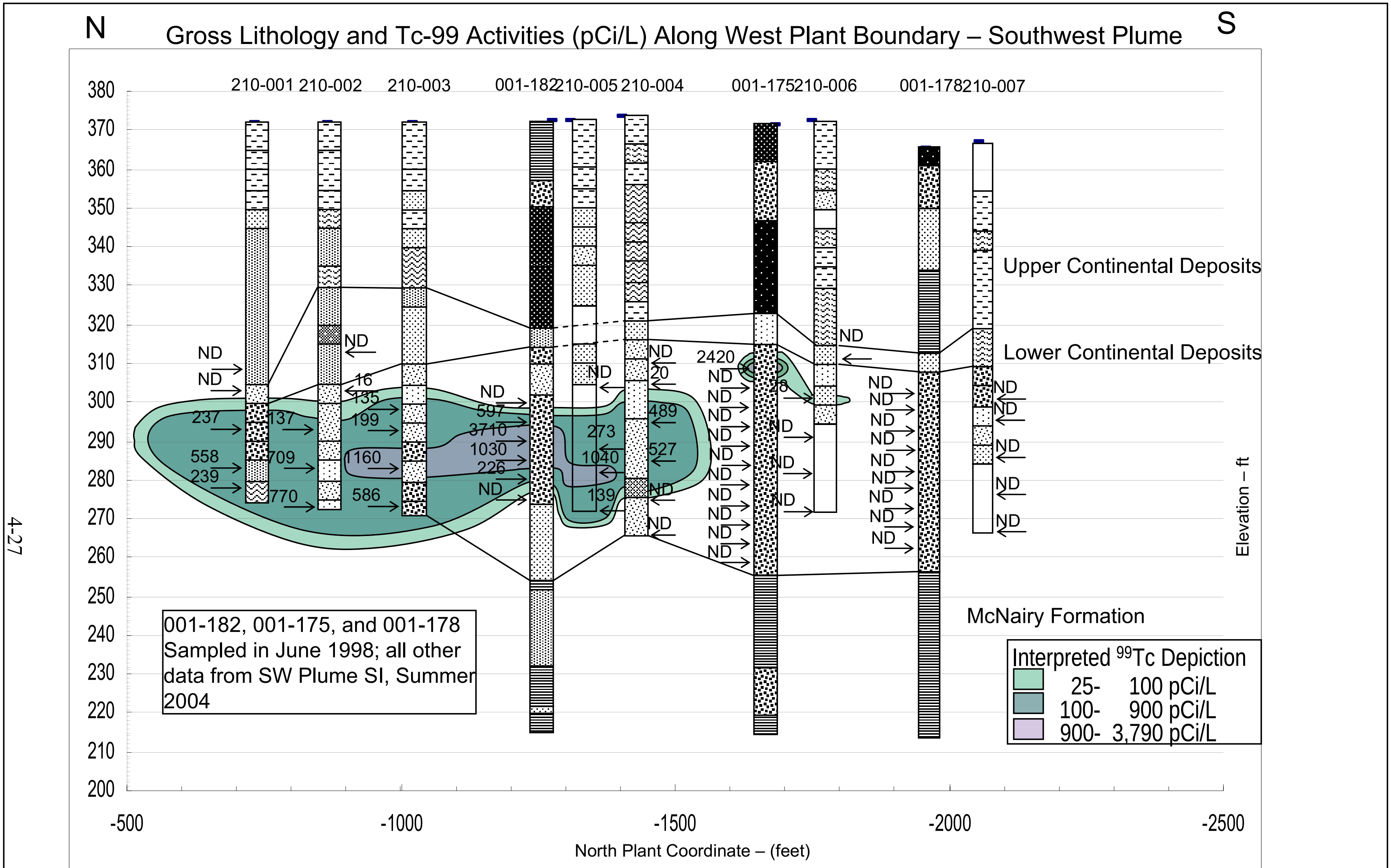


Fig. 4.18. ^{99}Tc distribution within the RGA along the west plant boundary.

Table 4.1. Results of TCE and its degradation products and ^{99}Tc in samples from existing MWs taken during the Southwest Plume SI

Monitoring well	Trichloroethene (µg/L)	*cis*-1,2-dichloroethene (µg/L)	*trans*-1,2-dichloroethene (µg/L)	Vinyl chloride (µg/L)	Technetium-99 (pCi/L)
MW84	140	5.1	ND	ND	ND
MW86	93	2.7	ND	ND	ND
MW87	13	ND	ND	ND	ND
MW89	ND	ND	ND	ND	ND
MW93	170	4.5	ND	ND	ND
MW95A	89	1.2	ND	ND	24.4
MW161	390	30	ND	ND	ND
MW188	1.6	ND	ND	ND	ND
MW203	99	11	ND	ND	35.5
MW204[a]	280	8.5	ND	ND	1240
MW226	340	ND	ND	ND	132
MW227	33	ND	ND	ND	ND
MW325	120	5.4	ND	ND	ND
MW326	Well not sampled due to pump malfunction.				
MW328	1.1	ND	ND	ND	ND
MW329	ND	ND	ND	ND	ND
MW330	4.7	ND	ND	ND	ND
MW333	430	44	ND	ND	ND
MW337	120	9	ND	ND	203
MW338	4.6	1.6	ND	ND	ND
MW354	1.2	ND	ND	ND	29.6
MW401-PRT4	90	2.9	ND	ND	42
MW402-PRT5	12	ND	ND	ND	31.5
MW403-PRT4	21	1	ND	ND	57.9
MW404-PRT5	94	ND	ND	ND	406

[a] Denotes an UCRS well. All other wells are RGA wells.

The maps of ^{99}Tc distribution required fewer revisions. Again, the SI data supported mapping smaller areas with highest contamination and separating the area of highest contamination now at the west PGDP plant boundary from SWMU 4. The ^{99}Tc distribution suggests that SWMU 4 likely is the source of the centroid of contamination now migrating through the plant boundary.

Contaminant levels (both TCE and ^{99}Tc) tend to be highest in the samples collected from the middle and lower depths from the temporary borings in both the upgradient (west of the steam plant and the C-400 Building and east of SWMU 4) and downgradient (adjacent to the west plant boundary) areas of the Southwest Plume. This trend suggests that neither area is located immediately downgradient of a primary source area.

In the transect formed by the three borings located west of the steam plant and the C-400 Building (upgradient of SWMU 4), the highest TCE concentration (1,100 µg/L), occurred in the sample near the base of the RGA in the southern boring (sample from 100 ft depth in boring 210-010). All other TCE concentrations in the middle and lower depths were between 84 and 270 µg/L. Levels of ^{99}Tc from the middle and lower samples ranged between 104 and 229 pCi/L, with the highest levels occurring in the middle boring (210-009).

The two southernmost locations (210-006 and 210-007) in the transect of temporary borings placed near the west plant boundary generally contained lower levels of contamination (2 to 56 µg/L TCE and only one detection of ^{99}Tc at 27.5 pCi/L). Each of the remaining five temporary borings (210-001 through 210-005) yielded middle and lower RGA water samples with TCE concentrations greater than 100 µg/L and ^{99}Tc levels greater than 100 pCi/L. The highest concentration of TCE (630 µg/L) was detected in the 90-ft sample from boring 210-005. Similarly, the highest levels of ^{99}Tc occurred in the 90-ft samples of adjacent borings 210-005 (1,040 pCi/L) and 210-003 (1,160 pCi/L).

4.4 SUMMARY

The results collected during the SI confirm that the Southwest Plume (SWMU 210) flows in a west-northwest direction from a source west of the steam plant and the C-400 Building and is composed of the co-mingling of contaminants from multiple source areas. The SI confirms that SWMU 1, SWMU 4, and the C-720 Building are sources to the plume and that the storm sewer is not a source to the plume. The significant increase in TCE and ^{99}Tc concentrations at the shallower depth intervals downgradient versus immediately upgradient from SWMU 4 indicates that SWMU 4 is a primary source of contamination to the Southwest Plume. Similarly, based upon the results of this investigation and previous studies, it is likely that the C-400 Building area is a lesser contributor to the Southwest Plume.

This SI did not include characterization of the McNairy Formation groundwater flow system found beneath the RGA. However, trends of contaminant levels with depth at the source units investigated as part of this SI are consistent with the results of previous remedial investigations of SWMU 4 (WAG 3 RI – DOE 2000b) and SWMU 1 and the C-720 area (WAG 27 RI – DOE 1999a). Both RIs concluded that contaminant transport from the RGA into the McNairy Formation is not a significant pathway leading to lateral migration of contamination.

THIS PAGE INTENTIONALLY LEFT BLANK

5. CONTAMINANT FATE AND TRANSPORT

5.1 INTRODUCTION

This section provides an overview of the fate and transport of the primary COCs defining the Southwest Plume and a summary of the fate and transport modeling performed for the two sources to the plume considered in the SI Report. The sources modeled are SWMU 1 and the C-720 area.[1] The storm sewer (i.e., part of SWMU 102) was not modeled because sampling results indicate that the storm sewer is not a source to the Southwest Plume. Vapor transport impacts at the SWMU 1 and C-720 sites and the plant and property boundaries from soil and groundwater contamination also were modeled.

Deleted: hree

Deleted: ,

Deleted: SWMU 4,

Deleted: also

5.2 CONCEPTUAL SITE MODEL

The conceptual site model for contaminant migration from SWMU 1 and the C-720 area is presented in detail in the WAG 27 RI Report. This information is briefly summarized here. In this summary, the focus is on the sources of the primary COCs defining the Southwest Plume and their migration pathways to potential POEs located along the PGDP plant boundary, property boundary, and in a groundwater well near the Ohio River.

Deleted: Similarly, the SWMU 4 conceptual site model for contaminant migration is presented in detail in the WAG 3 RI Report.

As discussed earlier, the sources of contamination to the Southwest Plume considered in this SI are the landfarm areas at SWMU 1, which were used to biodegrade waste oils, and releases through floor drains and surface spills at the C-720 area. Releases from these sources could directly impact soils below or adjacent to the source zone and, through vertical infiltration in soil, contaminate the groundwater underlying these sources. Subsequently, contaminated groundwater could migrate laterally and vertically, carrying the contaminants to the POEs.

Deleted: ; the burial areas at SWMU 4, where potentially contaminated trash and scrap were buried;

During contaminant migration, three HUs underlying the source zones at SWMU 1 and the C-720 area could have been impacted. These units, which control the flow of groundwater and contaminant migration, are, in descending order:

Deleted: s

Deleted: and 4

- UCRS – approximately 60 ft of silt and clay with discontinuous lenses of sand and gravel beneath an overlying loess deposit;
- RGA – approximately 40 ft of gravel, sand, and silt deposits that overlie the McNairy Formation; and
- McNairy Formation – approximately 225 ft of a silty and clayey sand that forms a lower confining unit to the RGA.

Because previous work has shown that groundwater flow in the UCRS is primarily vertical and that lateral groundwater flow in the McNairy Formation is significantly slower than that in the RGA, the primary contaminant pathway considered for the site-related contaminants is vertical migration through the UCRS followed by lateral migration in the RGA. For descriptions of the properties of each of the HUs and the impacts of these properties on contaminant migration considered in subsequent modeling, please see the WAG 27 RI Report and Appendix F of this SI Report.

Deleted: 3 and

Deleted: s

---

[1] The COCs modeled for SWMU 1 and the C-720 area are TCE, *cis*- and *trans*-1,2-DCE, and VC. The results of the previous modeling for SWMU 1 and the C-720 area are summarized in Appendices F and G.

Deleted: The COCs modeled for SWMU 4 area TCE, *cis*-1,2-DCE, VC, and carbon tetrachloride.

Deleted: , SWMU 4,

5.3 PROPERTIES OF SITE-RELATED CHEMICALS

The COCs identified as migrating from sources at SWMU 1 and the C-720 area and resulting in risks above *de minimis* levels[2] in the WAG 27 RI Report are TCE; *trans*-1,2-DCE; VC; and antimony. This section focuses on TCE and its degradation products because monitoring results document that TCE and its degradation products are the primary COCs that define the Southwest Plume. For the properties of other site-related chemicals found at SWMU 1 and the C-720-area, or elsewhere in the Southwest Plume, please see discussions in the WAG 27 RI Report.

Deleted: The COCs that were identified as migrating from sources at SWMU 4 and resulting in risks above *de minimis* levels in the WAG 3 RI Report are TCE; 1,2-DCE (mixed isomers); VC; 1,1-DCE; carbon tetrachloride; arsenic; cobalt; copper; iron; manganese; ^{237}Np; ^{239}Pu; ^{99}Tc; and ^{238}U.

Deleted: s

Deleted: 4,

Deleted: 3 and

Deleted: s

Generally, the fate and transport of TCE and its degradation products, which are organic compounds, are functions of both site characteristics and the physical and chemical interactions between the contaminants and the environmental media with which they come into contact. The physical and chemical properties of the contaminants that influence these interactions include, but are not limited to (1) their solubility in water, (2) their tendency to transform or degrade (usually described by an environmental half-life in a given medium), and (3) their chemical affinity for solids or organic matter (usually described by a partitioning coefficient K_d, K_{oc}, or K_{ow}). These aspects are discussed in this section.

5.3.1 TCE and Its Degradation Products

TCE and its degradation products may be degraded in the environment by various processes including hydrolysis, oxidation/reduction, photolysis, or biodegradation. Although degradation may reduce the toxicity of a chemical in some cases, in the case of TCE, degradation may result in more toxic degradation products, such as VC.

In the degradation of TCE, both aerobic and anaerobic degradation may occur. The anaerobic degradation pathway is as follows:

$$TCE \rightarrow cis\text{- and } trans\text{-}1,2\text{-}DCE \rightarrow VC \rightarrow Ethene$$

The anaerobic biodegradation of TCE, which initially forms *cis*-1,2-DCE, occurs under reducing conditions where sulfide- and/or methane-producing conditions exist. Such conditions occur primarily in the presence of other natural or anthropogenic carbon sources.

Both *cis*- and *trans*-1,2-DCE are indicators for this degradation pathway because they are not used as a pure product in industry, but are found solely as degradation products. Both *cis*- and *trans*-1,2-DCE may further degrade anaerobically to VC, but the rate is slower than the degradation rate of TCE, and the process may require stronger reducing conditions than those required for reduction of TCE.

Aerobic biodegradation of TCE may occur under certain conditions. For example, specialized microorganisms have been identified that aerobically degrade some of these solvents in the presence of ammonia, methane, and toluene. In aerobic settings, TCE degrades to epoxides, aldehydes, chlorinated oxides, and ethanols. Lower molecular weight chlorinated hydrocarbons, such as *cis*- and *trans*-1,2-DCE, undergo anaerobic degradation less readily than the higher molecular-weight chlorinated hydrocarbons, such as TCE, but undergo aerobic degradation more readily. The RGA is dominantly an aerobic environment. Low levels of TCE intermediate dechlorination products (produced by anaerobic degradation) are found in RGA groundwater in some on-site locations. These occurrences may be related to degradation of TCE in the UCRS, where anaerobic conditions are known to occur locally.

---

[2] The *de minimis* levels listed in the PGDP Risk Methods Document (DOE 2000a) are an ELCR = 1×10^{-6} and HI = 1). The ELCR value is the lower limit of EPA's acceptable risk range for site-related exposure (i.e., ELCR = 10^{-6} to 10^{-4}). The HI value equals the hazard limit established by EPA.

In a report entitled *Evaluation of Natural Attenuation Processes for Trichloroethylene and Technetium-99 in the Northeast and Northwest Plumes at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, KY/EM-113, (LMES 1997) biodegradation rates of 0.026 yr^{-1} to 0.074 yr^{-1} were estimated. Using the relationship

$t_{1/2} = (\ln 2)/\lambda$: where $t_{1/2}$ = half-life and λ = biodegradation rate,

these biodegradation rates correspond to TCE half-lives of 26.7 and 9.4 years, respectively. Idaho National Engineering and Environmental Laboratory (INEEL) is one of a few aerobic aquifer settings where the dissolved TCE degradation rate has been documented. *An Evaluation of Aerobic Trichloroethene Attenuation Using First-Order Rate Estimation* (Sorenson et al. 2000) determined that the TCE degradation half-life for INEEL ranged between 13 and 21 years, which compares favorably to the rates determined for PGDP.

Recently, as part of the development of response actions, DOE completed fate and transport modeling using revised biodegradation rates. The revised biodegradation rates were developed using regulatory accepted methods presented in *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water* (EPA 1998b) and data from the Northwest Plume, the most thoroughly characterized of the dissolved-phase plumes at the PGDP. Sampling results collected from the Northwest Plume indicate that TCE concentrations decrease with distance at a faster rate than selected inorganic contaminants (i.e., chloride and ^{99}Tc). Analyses using these inorganic tracers yielded a dissolved-phase TCE degradation factor with a range of 0.0614 to 0.2149 $year^{-1}$. This degradation factor corresponds to a TCE half-life of 11.3 to 3.2 years, respectively. Appendix F presents a detailed discussion of the derivation of this degradation rate.

The mobility of TCE and its degradation products, like all organic compounds, is affected by its volatility, its partitioning behavior between solids and water, water solubility, and concentration. The Henry's Law constant value (K_H) for a compound is the ratio of the compound's vapor pressure to its aqueous solubility. The K_H value can be used to make general predictions about the compound's tendency to volatilize from water. Substances with K_H values less than 1×10^{-7} atm/m^3/mol will generally volatilize slowly, while compounds with K_H greater than 1×10^{-3} atm/m^3/mol will volatilize rapidly (Lyman et al. 1982). Vapor pressure is a measure of the pressure at which a compound and its vapor are in equilibrium. The value can be used to determine the extent to which a compound would travel in air, as well as the rate of volatilization from soils and solution. In general, compounds with vapor pressures lower than 1×10^{-7} mm mercury will not be present in the atmosphere, soil gas, or air in significant amounts, while compounds with vapor pressures higher than 1×10^{-2} mm mercury will exist primarily in the air (Dragun 1988).

TCE and its degradation products have high vapor pressures and Henry's Law constants, indicating a potential for volatilization; therefore, they are not expected to persist in surface soils. The rate of loss from volatilization depends on the compound, temperature, soil gas permeability, and chemical-specific vapor pressure.

Water solubility and the tendency to adsorb to particles or organic matter can correlate with retardation in groundwater transport. In general, organic chemicals with high solubilities are more mobile in water than those that adsorb more strongly to soils. The following properties dictate an organic chemical's mobility within a specific medium.

- K_{oc}, the soil organic carbon partition coefficient, is a measure of the tendency for organic compounds to be adsorbed to the organic matter of soil and sediments. K_{oc} is expressed as the ratio of the amount of chemical adsorbed per unit weight of organic carbon to the chemical concentration in solution at equilibrium.

- K_{ow}, the octanol-water partition coefficient, is an indicator of hydrophobicity (the tendency of a chemical to avoid the aqueous phase) and is correlated with potential adsorption to soils. It is also used to estimate the potential for bioconcentration of chemicals into tissues.

- K_d, the soil/water distribution coefficient, is a measure of the tendency of a chemical to adsorb to soil or sediment particles. For organic compounds, this coefficient is calculated as the product of the K_{oc} value and the fraction of organic carbon in the soils. In general, chemicals with higher K_d values adsorb more strongly to soil/sediment particles and are less mobile than those with lower K_d values.

Release and transport mechanisms for TCE and its degradation products include vertical advective migration through unsaturated soils toward the water table, as well as gravity driven migration as a DNAPL. The range of K_{oc} values indicates that these chlorinated VOCs are mobile through soils as dissolved constituents and tend not to partition significantly from water to soil. However, some of these compounds are retained in pore spaces in the form of DNAPLs or DNAPL ganglia. A DNAPL migrates principally under the influence of gravity, not advection; therefore, a DNAPL will migrate vertically, fingering out among available pore space and continue downward. If a DNAPL is present in sufficient quantity, it may spread laterally along lower permeability zones it encounters and even pool there if a sufficiently large lower permeability zone exists. Residual DNAPL that remains as stringers in the soil as DNAPL migrates vertically are called "ganglia." This type of migration allows a DNAPL to take a highly variable path and be difficult to fully characterize in areas where the geology is spatially variable, such as in the UCRS at PGDP.

5.3.2 Other Site-Related Chemicals

Information about other site-related chemicals found at SWMU 1 and the C-720 area is presented in the WAG 27 RI Report.

Deleted: , SWMU 4,

Deleted: WAG 3 and

Deleted: s

5.4 FATE AND TRANSPORT MODELING FOR SWMU 1 AND THE C-720 AREA

Deleted: , SWMU 4,

As noted earlier, contaminant fate and transport modeling was conducted for SWMU 1 and the C-720 area in the WAG 27 RI Report. This modeling was completed using the Multimedia Environmental Pollutant Assessment Software (MEPAS) model (Battelle 1995). This modeling, which was performed assuming no actions are taken to mitigate contaminant migration and using conservative assumptions to ensure that all likely COCs that may migrate from source areas were identified, determined that TCE, TCE degradation products, and antimony are the COCs for the groundwater migration pathway for SWMU 1 and the C-720 area. Please see Appendix F of this SI Report for more details of the MEPAS modeling. This SI continued the modeling effort and used the newly collected information at SWMU 1 and the C-720 area to complete revised fate and transport modeling. The revised modeling was limited to TCE, *cis*- and *trans*-1,2-DCE, and VC at SWMU 1 and the C-720 area and also assumed that no actions are taken to mitigate contaminant migration.

Deleted: and for SWMU 4 in the WAG 3 RI Report

Deleted: In both reports,

Deleted: t

Deleted: For SWMU 4, the MEPAS modeling determined that several metals (i.e., arsenic, cobalt, copper, iron, manganese, nickel, and vanadium), VOCs, (i.e., 1,1-DCE; 1,2-DCE (mixed isomers); carbon tetrachloride; TCE; and VC), and radionuclides (i.e., ^{237}Np, ^{239}Pu, ^{99}Tc, and the uranium isotopes) are COCs for the groundwater migration pathway.

Deleted: , SWMU 4,

Deleted: and TCE, *cis*-1,2-DCE, VC, and carbon tetrachloride at SWMU 4

Consistent with the modeling matrix in the PGDP Risk Methods Document (DOE 2000a), the revised modeling used the Spatial Analysis and Decision Assistance (SADA), SESOIL, and AT123D models. These models and their implementation, which included a preliminary modeling effort that used fixed input parameters and a probabilistic modeling effort that allowed some input parameters to vary, are discussed in detail in Appendix F. Because additional source term data was included in the modeling, and because more sophisticated geospatial techniques were used to determine the source terms and model fate and transport, the results of the revised modeling differs from those resulting from earlier modeling.

The results of the preliminary modeling that used fixed input parameters for hypothetical POEs (Fig. 5.1) at the plant boundary, property boundary, and in a groundwater well near the Ohio River are presented in Table 5.1. As shown in Table 5.1, the predicted maximum concentrations of TCE at the plant boundary and property boundary POEs originating from current sources at the C-720 area and SWMU 1 exceed the maximum contaminant level (MCL) for TCE at all degradation rates, except at the C-720 area under the scenario that used a degradation half-life of 4.5 years. At the Ohio River POE (in a groundwater well), TCE from SWMU 1 (under the no degradation scenario) is predicted to exceed the MCL for TCE; however, TCE from the C-720 area is not predicted to exceed the MCL under any degradation scenario. None of the other COCs at SWMU 1 and the C-720 area are predicted to attain concentrations that exceed their respective MCLs at the POEs.

Deleted: ,

Deleted: , and SWMU 4

Deleted: and SWMU 4 (under all degradation scenarios)

Deleted: However, for the SWMU 4 source, *cis*-1,2-DCE is predicted to attain a concentration that exceeds its MCL at the plant boundary and property boundary POEs, and VC is predicted to attain a concentration that exceeds its MCL at the plant boundary POE.

Figures 5.2, and 5.3 show the predicted concentrations of TCE over time at the property boundary POE. In these figures, the predicted concentrations of TCE from the sources at SWMU 1, and the C-720 area, respectively, are shown. As depicted, TCE concentrations, assuming no degradation, are predicted to fall below the MCL within 95 and 55 years for the current sources at SWMU 1 and the C-720 area, respectively. Alternatively, TCE concentrations, assuming a site-specific half-life of 26 years, are predicted to fall below the MCL within 55, 85, and 25 years for the current sources at SWMU 1 and the C-720 area, respectively. For plots of concentrations at the other POEs, please see Appendix F.

Deleted: 5.3,

Deleted: 4

Deleted: , SWMU 4

Deleted: , but remain above the MCL after 100 years for the current source at SWMU 4.

Deleted: , SWMU 4,

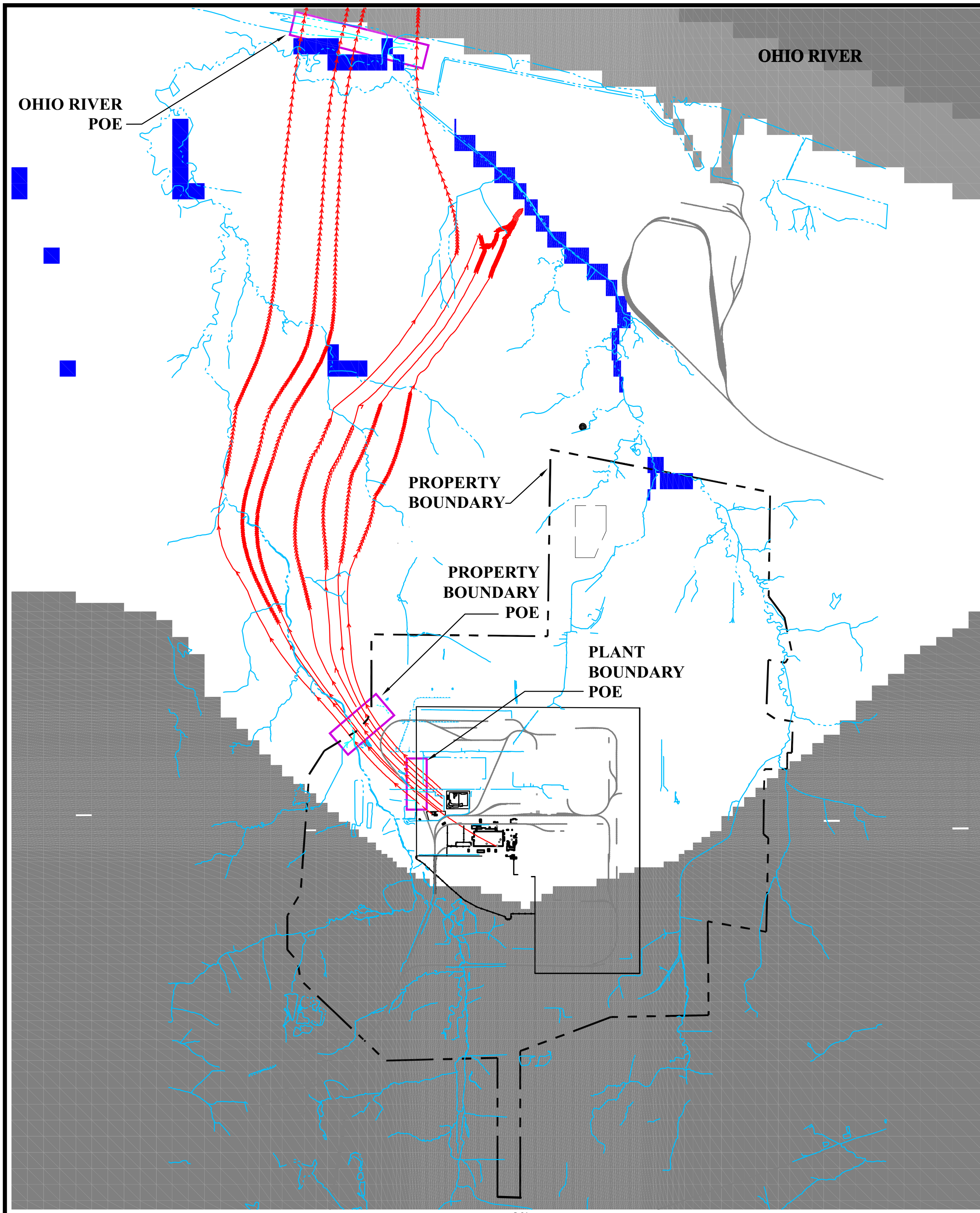
Table 5.2 presents a comparison between the predicted maximum concentration of TCE, *cis*-1,2-DCE, and VC in groundwater at the C-720 area and SWMU 1 and the current range of concentrations of these contaminants in RGA samples. As shown, the predicted values generally fall within the range of measured values and are of the same order of magnitude. However, the predicted values for TCE tend to be less than the measured values. This observation is expected because the modeled concentrations are predicted from contaminant source terms as they exist currently, while the current RGA contaminant concentrations are the result of migration from these same source terms as they existed in the past when source term concentrations were likely to have been greater.

Deleted: ,

Deleted: , and SWMU 4

Probabilistic modeling was performed for the TCE sources at SWMU 1 and the C-720 Building area in order to understand better the uncertainties in the fixed parameter transport modeling performed earlier, to estimate the likely TCE concentrations at the POEs using the most likely input parameters, and to determine the error bounds on the predicted TCE concentrations. This modeling was based upon the nature and extent discussion in the SI Report and the transport modeling results completed earlier. Additionally, the completion of probabilistic modeling was consistent with the Risk Methods Document, which allows for the use of more sophisticated modeling to understand better site modeling uncertainties.

Deleted: , SWMU 4,



LEGEND:

PARTICLE TRAVEL PATH

POE = POINT OF EXPOSURE

BASELINE CONDITIONS:

operating GDP

variable recharge: 6.6 to 26.3 in/yr

Ohio River level: 300 ft amsl

SOURCE:
Modified from DOE 1997b

0 2000 4000

SCALE: 1" = 4,000'

20°

TRUE NORTH

PADUCAH PLANT

U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

Fig. 5.1. Points of exposure used in SWMU 1, SWMU 4, and C-720 area fate and transport modeling.

PADUCAH Remediation Services
A Portage Shaw Joint Venture Company

FIGURE No. /04040/DWGS/U96PRT-1mod
DATE 12-16-04

Table 5.1. Preliminary modeling - predicted concentrations of the COCs in groundwater based on leaching from UCRS to RGA at SWMU 1 and the C-720 Building source area

Analyte	Predicted $C_{gw,max}$ at the plant boundary[a] (µg/L)	Predicted $C_{gw,max}$ at PGDP prop. boundary[a] (µg/L)	Predicted $C_{gw,max}$ in a well near Ohio River[a] (µg/L)	MCL (µg/L)
		C-720 Building Area		
TCE ($t_{1/2}$ infinity)	**18.6**	**9.86**	1.8	5
TCE ($t_{1/2}$ 26.6 years)	**11.6**	**5.5**	0.43	5
TCE ($t_{1/2}$ 4.5 years)	1.7	0.5	0.00069	5
cis-1,2-DCE ($t_{1/2}$ infinity)	3.2	2.1	0.00	70
trans-1,2-DCE ($t_{1/2}$ infinity)	0.15	0.07	0.00	100
VC ($t_{1/2}$ infinity)	0.08	0.04	0.00	2
		SWMU 1		
TCE ($t_{1/2}$ infinity)	**266**	**47.1**	**5.72**	5
TCE ($t_{1/2}$ 26.6 years)	**190**	**29.6**	1.59	5
TCE ($t_{1/2}$ 4.5 years)	**59.4**	**10.3**	1.21	5
cis-1,2-DCE ($t_{1/2}$ infinity)	16.1	3.1	0.00	70
trans-1,2-DCE ($t_{1/2}$ infinity)	20.4	3.6	0.00	100
VC ($t_{1/2}$ infinity)	0.16	0.03	0.00	2

Bold values indicate concentrations exceeding MCL values.
NA = not available
[a] The predicted maximum concentration in groundwater ($C_{gw,max}$) was calculated using AT123D model based on contaminant loading predicted by SESOIL.

In the probabilistic modeling, the TCE source terms developed for the preliminary modeling were used. However, the concentration in each source was allowed to vary over modeling runs by selecting a value from the range of concentrations representative of the source. Additionally, several input parameters used in SESOIL and AT123D were allowed to vary over their expected ranges. The SESOIL parameters allowed to vary, in addition to source concentration, were UCRS intrinsic permeability, UCRS organic carbon content, and rate of TCE degradation. The AT123D parameters allowed to vary were RGA hydraulic conductivity, RGA hydraulic gradient, RGA effective porosity, RGA organic carbon content, RGA thickness, and TCE biodegradation rate. In each case, the distributions of the input parameters were derived from site-specific information and approved after review by site experts. Please see Appendix F for additional information on parameter selection. Two probabilistic scenarios were run for both SWMU 1 and C-720. One scenario, referred to as the "variable degradation scenario," allowed all parameters specified previously to vary in the modeling runs. The second scenario, referred to as the "fixed degradation scenario," allowed all the variables specified to vary except for the degradation rates, which were fixed as 26.6 years in the UCRS and 0 years in the RGA. The dual TCE degradation scenarios of zero or no degradation modeling calculations, along with the variable TCE half-life coefficient modeling results for SWMU 1 and C-720, are provided in part due to the following facts:

Deleted: , SWMU 4,
Deleted: *SWMU 4*
Deleted: TCE ($t_{1/2}$ infinity)
Deleted: 570
Deleted: 233
Deleted: 32
Deleted: 5
Deleted: TCE ($t_{1/2}$ 26.6 years)
Deleted: 471
Deleted: 206
Deleted: 25.5
Deleted: 5
Deleted: TCE ($t_{1/2}$ 4.5 years)
Deleted: 236
Deleted: 112
Deleted: 12.4
Deleted: 5
Deleted: *cis*-1,2-DCE ($t_{1/2}$ infinity)
Deleted: 174
Deleted: 75
Deleted: 25.8
Deleted: 70
Deleted: *trans*-1,2-DCE ($t_{1/2}$ infinity)[b]
Deleted: NA
Deleted: NA
Deleted: NA
Deleted: NA
Deleted: VC ($t_{1/2}$ infinity)
Deleted: 3.7
Deleted: 1.6
Deleted: 0.2
Deleted: 2
Deleted: [b] Not modeled for SWMU 4 because it was not identified as a COC in the WAG 3 RI. Also, results of carbon tetrachloride are not shown because results at all POEs were an order of magnitude or more below the MCL.
Deleted: above
Deleted: above

- A current lack of data to support the existence of specific microbes/enzymes capable of breaking down TCE or to support existence of conditions that would sustain such microbes.

- Uncertainty tied to geochemical evidence cited as supporting the aerobic degradation hypothesis.

  — Observed CO_2 levels could be produced via abiotic processes occurring within the RGA and therefore may not necessarily be a byproduct of aerobic microbial degradation.

    1. Microbes living in the RGA producing CO_2, may not be capable of degrading TCE.

  — Elevated chloride levels may be attributable to past aerobic degradation within the RGA or anaerobic degradation within the UCRS or could be tied to industrial activities. Levels of chloride nearly as high as those seen in the outer portions of the Northwest Plume have been detected in monitoring wells located west of the plume.

  — Dissolved O_2 levels less than air saturated water and CO_2 levels greater than air saturated water levels are not necessarily indicative of biodegradation in the saturated zone. Instead, biodegradation within the overlying soils and sediments (UCRS) may be responsible for producing these differences.

  — There are potential problems associated with using the measured $\delta^{13}C$ isotopic ratio values in dissolved organic carbon as evidence of microbial degradation in the plume.

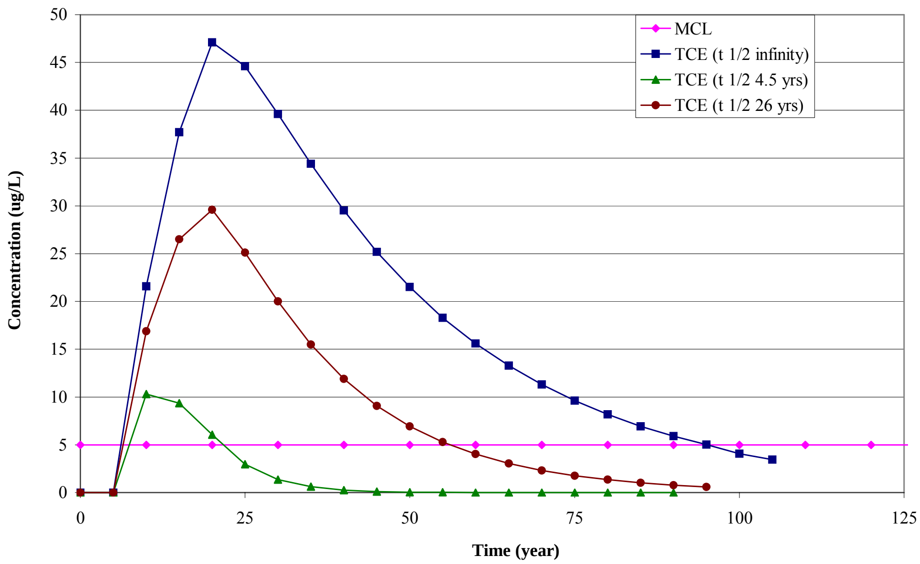


Fig. 5.2. Preliminary modeling - predicted TCE concentration in groundwater at the PGDP property boundary based on contaminant leaching from SWMU 1 source.

Deleted: **Fig. 5.3. Preliminary modeling - predicted TCE concentration in groundwater¶ at the PGDP property boundary based on contaminant leaching from SWMU 4 source.**

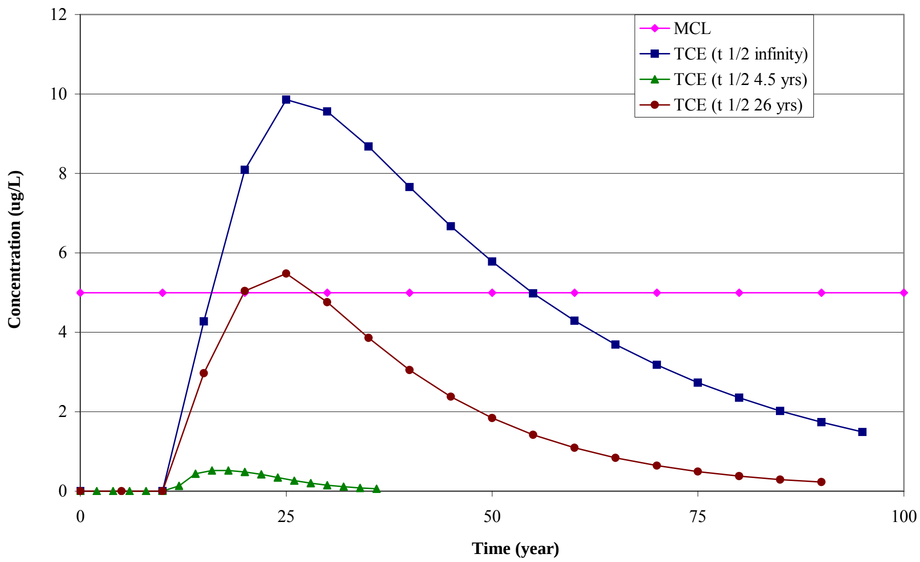


Fig. 5.3. Preliminary modeling - predicted TCE concentration in groundwater at the PGDP property boundary based on contaminant leaching from the C-720 area.

Table 5.2. Preliminary modeling - comparison between maximum predicted modeled concentrations of TCE, *cis*-1,2 DCE, and VC in the RGA at the C-720 area and SWMU 1 and the current range of measured concentrations of these contaminants from sampling at these areas

Analyte	Predicted concentration of TCE from transport modeling: Maximum (µg/L)	Predicted concentration of TCE from transport modeling: Time of maximum (years from present)	Range of TCE concentrations measured in RGA water samples: Minimum (µg/L)	Range of TCE concentrations measured in RGA water samples: Maximum (µg/L)	Range of TCE concentrations measured in RGA water samples: Mean of Detects (µg/L)
			C-720 Building Area		
TCE ($t_{1/2}$ infinity)	168	20	3.8	1,260	252
cis-1,2 DCE	30.1	20	0.3	31.0	6.98
trans-1,2 DCE	1.6	25	0.1	14.0	4.43
VC	0.73	30	2.1	2.1	2.10
			SWMU 1		
TCE ($t_{1/2}$ infinity)	592	15	0.1	780	182
cis-1,2 DCE	35.1	15	30.0	67.0	48.5
trans-1,2 DCE	46.6	15	ND	ND	ND
VC	0.34	15	ND	ND	ND

ND = not detected in a groundwater sample.
NA = modeling result not available.

Deleted: 4
Deleted: ,
Deleted: , and SWMU 4
Deleted: *SWMU 4*
Deleted: TCE ($t_{1/2}$ infinity)
Deleted: 956
Deleted: 5
Deleted: 0.1
Deleted: 67,000
Deleted: 1,850
Deleted: *cis*-1,2 DCE
Deleted: 336
Deleted: 5
Deleted: 0.1
Deleted: 12,000
Deleted: 372
Deleted: *trans*-1,2 DCE
Deleted: NA
Deleted: NA
Deleted: 0.2
Deleted: 110
Deleted: 10.1
Deleted: VC
Deleted: 0.15
Deleted: 5
Deleted: 0.2
Deleted: 400
Deleted: 22.1

In total, the SESOIL/AT123D model was run 100 times for each scenario [i.e., (1) variable degradation and (2) fixed degradation]; source (i.e., SWMU 1 and C-720); and POE (i.e., the plant boundary, property boundary, and in a groundwater well near the Ohio River). The 95% upper confidence limit (95% UCL) on the peak TCE median concentrations at each of the POEs predicted by these runs are in Table 5.3. These peak concentrations are the greatest median concentrations derived over the period modeled. As shown in Table 5.3, the peak concentrations for the variable degradation scenario are all below the TCE MCL, except for SWMU 1, at the plant boundary. The peak concentrations for the fixed degradation scenario exceed the TCE MCL at the plant boundary for both C-720 and SWMU 1 and the property boundary for the SWMU 1 source.

Table 5.3. Peak median TCE concentrations (95% UCL) at each POE predicted by probabilistic modeling

Source Area	Plant boundary		Property boundary		Near Ohio River	
	Time of peak concentration (yr)	Peak concentration (μg/L)	Time of peak concentration (yr)	Peak concentration (μg/L)	Time of peak concentration (yr)	Peak concentration (μg/L)
Variable Degradation Rate Scenario						
C-720 area	25	0.72	30	0.10	70	1.5E-06
SWMU 1	10	***29***	15	1.3	70	3.8E-05
Fixed Degradation Rate Scenario						
C-720 area	25	***6.2***	35	2.9	80	0.12
SWMU 1	15	***87.4***	20	***8.6***	85	0.42

[a] Results take from Appendix F. TCE results are the peak median concentrations (95% UCL)within time step predicted by the model. Concentrations exceeding the TCE MCL (5 μg/L) are highlighted in ***bold, italic font***.

For the variable degradation scenario, the peak concentrations based upon the median values did not exceed the TCE MCL at the property boundary POE for any source area. The peak 75% upper quartile concentrations for both SWMU 1 and the C-720 area were below the TCE MCL at all times (see Figs. 5.4 and 5.5).

Generally, the probabilistic modeling for the variable degradation scenario indicated that it is likely that SWMU 1 source may contribute TCE to the RGA at a rate that could result in exceedances of the TCE MCL at the plant boundary POE. However, at property boundary POE, migration from SWMU 1 is not likely to result in exceedances of the TCE MCL (see Table 5.3). These results also indicate that the source at the C-720 Building area is not likely to contribute TCE to the RGA at a rate that could result in exceedances of TCE MCL at these two POEs. None of the sources are likely to contribute TCE to the RGA at a rate that could result in exceedances of the TCE MCL in a groundwater well at the Ohio River.

For the fixed degradation scenario, the peak concentrations based upon the median values exceed the TCE MCL at the property boundary POE for the SWMU 1 source area. The peak 75% upper quartile concentrations for both SWMU 1 and the C-720 area were above the TCE MCL at all times (see Figs. 5.6 and 5.7).

The probabilistic modeling for the fixed degradation scenario indicated that it is likely that SWMU 1 may contribute TCE to the RGA at a rate that could result in exceedances of the TCE MCL at the plant boundary POE. At property boundary POE, migration from SWMU 1 may result in exceedances of the TCE MCL (see Table 5.3). The results also indicate that the source at the C-720 Building area is not likely to contribute TCE to the RGA at a rate that could result in exceedances of TCE MCL at the property boundary. None of the sources are likely to contribute TCE to the RGA at a rate that could result in exceedances of the TCE MCL in a groundwater well at the Ohio River.

Deleted: (

Deleted:)

Deleted: there

Deleted: from SWMU 1 and SWMU 4 sources are predicted to exceed the TCE MCL at the plant boundary. However, the peak median concentrations at the property boundary or in a groundwater well near the Ohio River from each of the three sources are predicted to be below the TCE MCL. Peak concentrations from the C-720 area source are predicted to be below the TCE MCL at all POEs.

Formatted: Table Title, Left

Deleted: SWMU 4

Deleted: 10

Deleted: ***50***

Deleted: 15

Deleted: ***4.7***

Deleted: 60

Deleted: 3.5E-04

Deleted: While

Deleted: T

Deleted: t

Deleted: , the 75% upper quartile of the distribution of concentrations at years 10 through 30 for SWMU 4 exceeded the TCE MCL (peak 12 μg/L; see Fig. 5.5).

Deleted: 6

Deleted: 7

Deleted: both the

Deleted: and SWMU 4

Deleted: s

Deleted: neither

Deleted: nor SWMU 4

Deleted: below

Deleted: variable

Deleted: both the

Deleted: and SWMU 4 sources

Deleted: is likely to

5.5 VAPOR TRANSPORT MODELING FOR SWMU 1 AND THE C-720 AREA

Vapor transport modeling was conducted to evaluate the potential air concentrations in a residential basement for soil contamination at the SWMU 1 and C-720 areas and at the plant and property POEs. The Johnson and Ettinger model (1991) coded into spreadsheets by EPA (2004) was used to assess the potential migration of VOCs into a basement. Please see Appendix F for additional information on parameter selection. The results of the vapor transport model are presented in Table 5.4 and were used as the predicted household air concentrations for estimating excess lifetime cancer risk (ELCR) and hazard for the rural resident.

Formatted: Table Title, Left

Deleted: .

Table 5.4. Basement air concentrations based on vapor transport modeling results for each source and POE

Source Area	Contaminant	On-Site Air concentration (mg/m^3)	Plant boundary Air concentration (mg/m^3)	Property boundary Air concentration (mg/m^3)
SWMU 1	TCE	0.15	3.14E-07	4.45E-08
	cis-1,2-DCE	0.015	3.09E-05	2.60E-05
	trans-1,2-DCE	0.057	9.12E-05	1.66E-05
	Vinyl Chloride	0.008	2.66E-06	5.11E-07
C-720 Area	TCE	0.019	2.55E-08	1.02E-08
	cis-1,2-DCE	0.004	6.15E-06	4.16E-06
	trans-1,2-DCE	0.001	6.71E-07	3.23E-07
	Vinyl Chloride	0.0002	1.33E-06	6.82E-07

Deleted: C-720 area

Deleted: SWMU 1

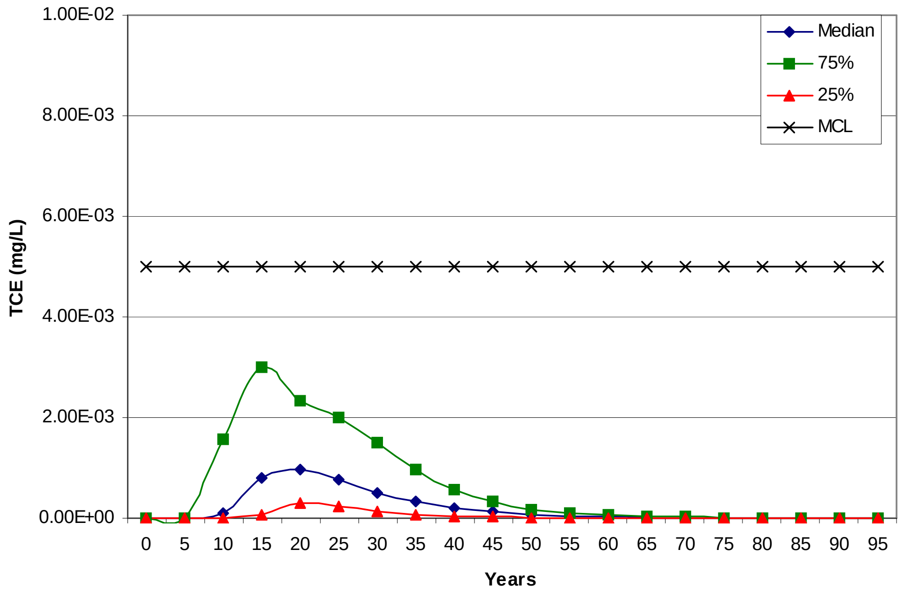


Fig. 5.4. SWMU 1 median and 25% and 75% quartiles TCE concentrations predicted at the property boundary POE for the variable degradation scenario.

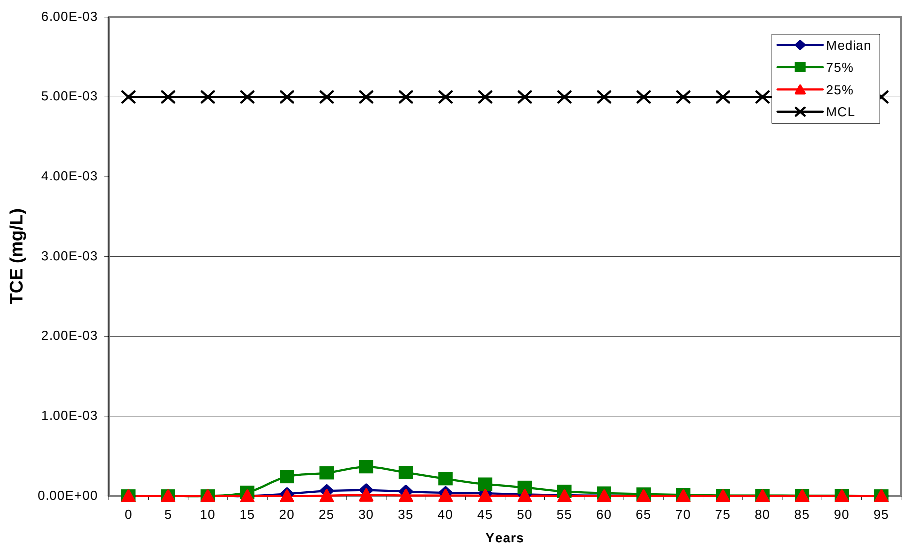
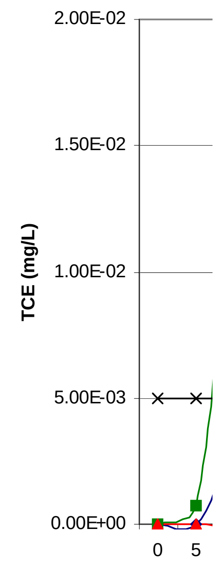


Fig. 5.5. C-720 Building area median and 25% and 75% quartile TCE concentrations at the property boundary POE for the variable degradation scenario.



Deleted:
¶
Fig. 5.5. SWMU 4 median and 25% and 75% quartile TCE concentrations predicted for the property boundary POE.

Deleted: 6

Deleted: for

Deleted: 7

Deleted:

Deleted: for

Deleted: .

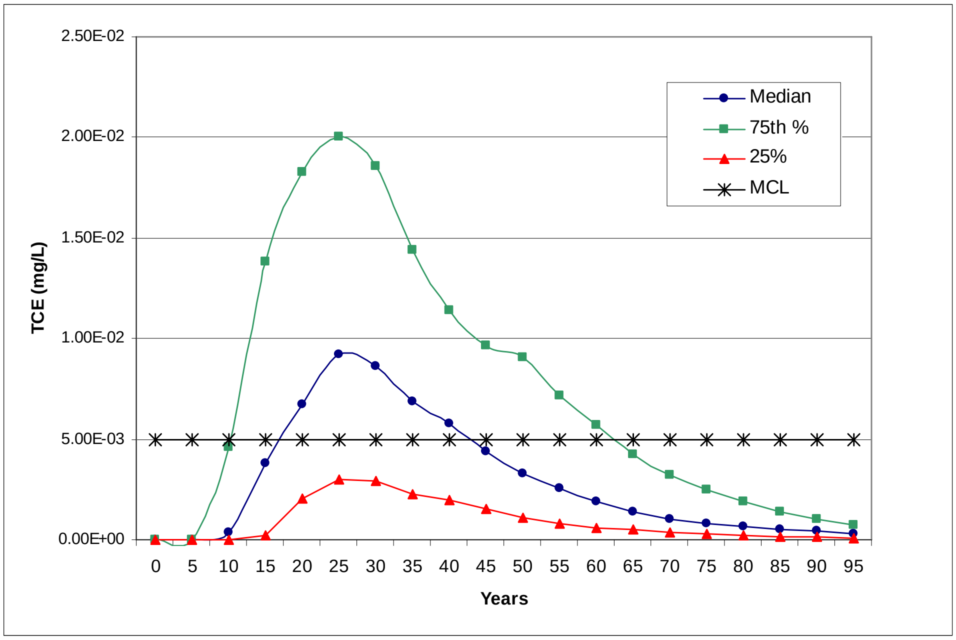
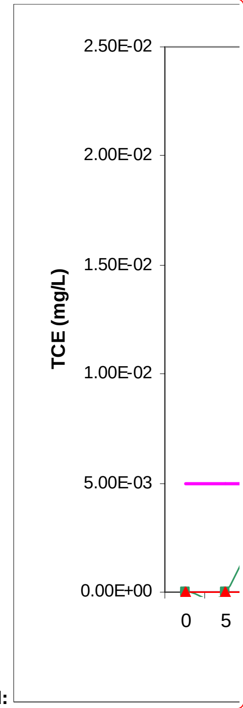


Fig. 5.6. SWMU 1 median and 25% and 75% quartiles TCE concentrations predicted at the property boundary POE.



Deleted:

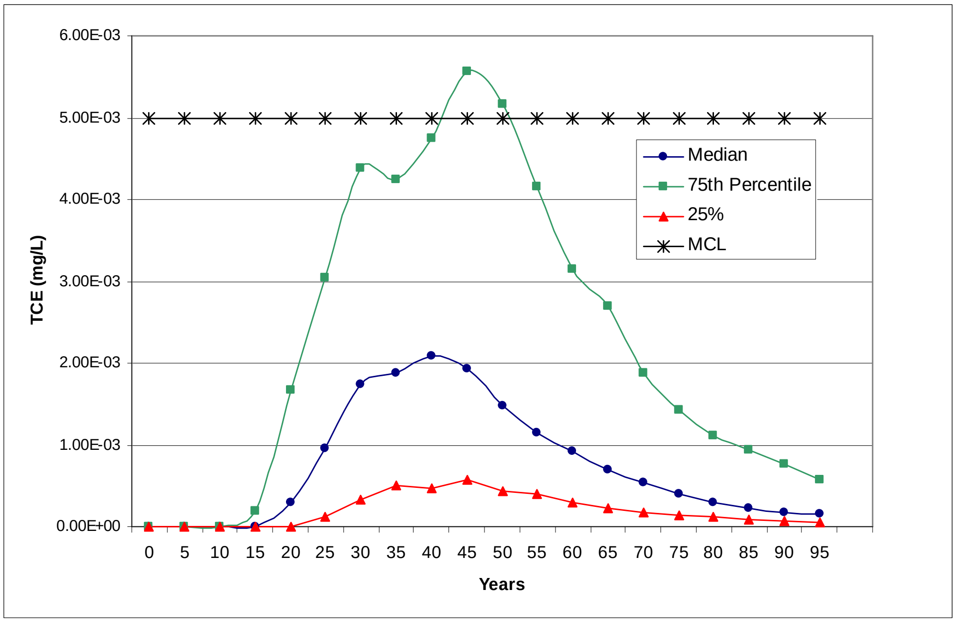
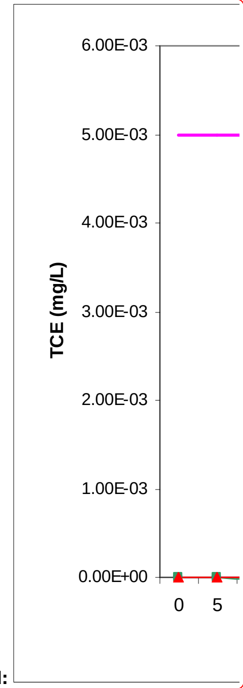


Fig. 5.7 C-720 Building area median and 25% and 75% quartile TCE concentrations predicted at the property boundary POE.

Deleted:



6. RESULTS OF BASELINE RISK ASSESSMENT

This section presents the results of the BRA conducted for the Southwest Plume and potential sources. This BRA was prepared in two parts, as discussed in Appendix G. These parts are the baseline human health risk assessment (BHHRA; Part 1) and the screening ecological risk assessment (SERA; Part 2). In these assessments, information collected during the recently completed SI of the Southwest Plume and its potential sources and during completion of several previous risk assessments were used to characterize the baseline risks posed to human health and the environment resulting from contact with contaminants in soil and groundwater. In addition, the BRA used results of fate and transport modeling to estimate the baseline risks that might be posed to human health and the environment through contact with groundwater that has been impacted by contaminants and that is migrating from the potential source areas. Methods used to complete the fate and transport modeling and the results of this modeling are summarized in Section 5 of the SI and presented in detail in Appendix F.

Because data collected during the SI focused on the collection of subsurface soil and groundwater data to delimit the potential sources of contamination to the Southwest Plume, the new material developed in the BHHRA and SERA is limited to risks posed by contaminants migrating from potential source areas to RGA groundwater and with direct contact with contaminated groundwater in the source areas. Risks from direct contact with other media at the potential sources (e.g., surface and subsurface soil, sediment, surface water, and McNairy Formation groundwater) are taken from the following assessments and studies.[1]

- *Results of the Public Health and Ecological Assessment, Phase II, at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* Vol. 6, in *Results of the Site Investigation, Phase II, at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, April (CH2M HILL 1992).

- *Residual Risk Evaluation for Waste Area Grouping 23 and Solid Waste Management Unit 1 of Waste Area Grouping 27 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1999c).

- *Remedial Investigation Report for Waste Area Grouping 27 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1999a).

- *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 2001).

- *Contaminant Migration from SWMU 1 and the C-720 Area at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (BJC 2003).

Deleted: <#>*Remedial Investigation Report for Waste Area Grouping 3 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 2000b).¶

Consistent with regulatory guidance and agreements contained in the approved PGDP Risk Methods Documents (DOE 2000a), the BHHRA reports risks for scenarios that encompass current use and several hypothetical future uses. The scenarios discussed in the BHHRA are as follows.

- Current on-site industrial use[2] – direct contact with surface soil (soil found 0 to 1 ft bgs), sediment, and surface water. Risk results presented in the BHHRA for this scenario were taken from assessments completed earlier.

- Future on-site industrial use – direct contact with surface soil, sediment, and surface water. Risk results presented in the BHHRA for this scenario were taken from assessments completed earlier.

---

[1] Baseline risks taken from earlier reports are presented without modification in Section 2 of the BHHRA and in the SERA. Updated revisions of these risk estimates are presented in this section and in Section 7 of the BHHRA. Reasons for revising risk estimates are discussed in the BHHRA and include updated toxicity values and regulatory guidance.

[2]As noted earlier, the current industrial land use scenario assessed in the WAG 27 RI Report did not include or take into account existing DOE controls on worker exposures, such as controls on access to areas containing contaminated soils or sediment or the use of personal protective equipment.

Deleted: and 3

Deleted: s

- Future on-site excavation – direct contact with surface and subsurface soil (soil 0 to 16 ft bgs). Risk results presented in the BHHRA for this scenario were taken from assessments completed earlier.

- Future on-site recreational user – direct contact with sediment and surface water and consumption of game exposed to contaminated surface soil. Risk results presented in the BHHRA for this scenario were taken from assessments completed earlier.

- Future off-site recreational user – direct contact with surface water impacted by contamination migrating from sources and consumption of game exposed to this surface water. Risk results presented in the BHHRA for this scenario were taken from assessments completed earlier.

- Future on-site rural resident – direct contact with surface soil at and use of groundwater drawn from the RGA and McNairy at source areas, including consumption of vegetables that are posited to be raised in these areas. Risk results presented in the BHHRA for use of RGA groundwater in the home as well as vapor intrusion into basement are newly derived. Risk results presented in the BHHRA for other media were taken from assessments completed earlier.

- Future off-site rural resident – use in the home of groundwater drawn from the RGA as well as vapor intrusion into basements at the DOE plant boundary, the DOE property boundary, and in a groundwater well at the Ohio River. Risk results for this receptor are newly derived in the BHHRA; however, risks estimated in earlier assessments for this receptor also are presented in the BHHRA.

Also consistent with regulatory guidance and agreements contained in the approved PGDP Risk Assessment Methods Documents (DOE 2000a), the SERA reports the potential risks under both current and potential future conditions to several receptors that may come into contact with contaminated media at the potential source areas associated with the Southwest Plume. Because all new data collected during the SI were from soil samples collected below 15 ft bgs or were groundwater samples, all results presented in the SERA are taken from earlier baseline ecological risk assessments (BERAs).

6.1 CONCLUSIONS

For two of the three potential sources discussed in the BHHRA (i.e., SWMU 1 and C-720 area), the cumulative human health ELCRs and systemic toxicity (i.e., hazard) exceed the accepted standards of KDEP and EPA for one or more scenarios. (Please see the BHHRA for a discussion of exposure assumptions used in these scenarios.) Additionally, risks from household use of groundwater by hypothetical on-site residents also exceeded these standards. The land uses and media assessed for ELCR and hazard to human health for each potential source area are presented in Table 6.1. Table 6.1 also indicates the scenarios and media, which have their risk results taken from earlier assessments. As shown, only results for groundwater use and vapor intrusion by the hypothetical future on- and off-site residents were newly derived in the BHHRA.

Deleted: hree

Deleted: four

Deleted: ,

Deleted: , and SWMU 4

Table 6.1. Land uses and media assessed for each source area included in the SI for the Southwest Plume

Scenario	Location: SWMU 001	C-720 Building	SWMU 102
Current On-site Industrial Worker			
Surface Soil	P	NA	NA
Sediment[a]	P	NA	NA
Surface Water	NA	NA	NA
Future On-site Industrial Worker			
Soil	P	NA	NA
Sediment[a]	P	NA	NA
Surface Water	NA	NA	NA
Future On-site Excavation Worker			
Surface and Subsurface Soil	P	P	NA
Future On-site Recreational User			
Game (Soil)	P	NA	NA
Sediment[a]	P	NA	NA
Surface Water	NA	NA	NA
Future Off-site Recreational User			
Surface Water	P	NA	NA
Game	NA	NA	NA
Future On-site Rural Resident			
Soil	P	NA	NA
Groundwater[b]	X	X	X
Vapor Intrusion[d]	X	X	NA
Future Off-site Rural Resident			
Groundwater[c]	X	X	X
Vapor Intrusion[d]	X	X	NA
Future On-site Terrestrial Biota			
Soil	P	NA	NA
Sediment[a]	P	NA	NA
Surface Water	NA	NA	NA

Notes: Scenarios that were assessed in the SI BRA are marked with an X. Scenarios assessed in previous BRAs are marked with a P. Scenarios not assessed because the scenario is not applicable, or for which the medium is not present, are marked with an NA.

[a] Sediment considered in earlier assessments was in ditches surrounding the source area.

[b] The earlier BHHRAs assessed risks from use of water drawn from the RGA separately from use of water drawn from the McNairy Formation. The risks assessed in the SI BRA are for use of water drawn from the RGA.

[c] Modeling results were used to assess risk to the off-site rural resident. Points of exposure are at the PGDP plant boundary, at the PGDP property boundary, and in a groundwater well at the Ohio River. These POEs are presented in Fig. 5.1.

[d] Vapor intrusion was modeled for residential basements for TCE, 1,2-DCE, and VC only, as these COCs and antimony are identified in the WAG 27 RI Report as migrating from sources at SWMU 1 and the C-720 area and result in risks above *de minimis* levels. Monitoring results document that TCE and its degradation products are the primary COCs that define the Southwest Plume. Antimony was not included in vapor intrusion modeling because it is not a volatile compound.

Deleted: SWMU 4

Deleted: ¶ P¶ NA¶ NA

Deleted: ¶ P¶ NA¶ NA

Deleted: ¶ P

Deleted: ¶ P¶ NA¶ NA

Deleted: ¶ P¶ NA

Deleted: ¶ P¶ X

Deleted: ¶ X

Deleted: ¶ P¶ NA¶ NA

Deleted: ¶

Deleted: Trichloroethene, cis-1,2-Dichloroethene, trans-1,2-Dichloroethene and Vinyl Chloride only.

The scenarios for which risk exceeds *de minimis* levels [i.e., a cumulative ELCR of 1 × 10^{-6} or a cumulative hazard index (HI) of 1 as defined in DOE 2000a] are summarized in Table 6.2. This information is taken from a series of risk summary tables presented at the end of this section (i.e., Tables 6.3 through 6.5), which present cumulative risk values for each scenario, the COCs, and the pathways of concern (POCs).

Deleted: 6

As discussed in the SERA, which used results taken from the BERA completed as part of the WAG 27 RI Report, lack of suitable habitat in the industrial setting at SWMU 1 and the C-720 area precludes exposures of ecological receptors under current conditions; therefore, it was determined during problem formulation in these BERAs that an assessment of potential risks under current conditions was unnecessary. However, these BERAs did include an assessment of potential risks due to exposure to contaminants in surface soil, if the industrial infrastructure were removed, as a point of reference that can

Deleted: s

Deleted: and 3

Deleted: s

Deleted: s

Deleted: and 4

be used in future risk management decisions. Results from these earlier BERAs are summarized in Table 6.7, which presents the chemicals of potential ecological concern (COPECs). As shown there, no results are available for the portion of SWMU 102 investigated during the SI or C-720. Results are not

Table 6.2. Scenarios for which human health risk exceeds *de minimis* levels[a]

Scenario	Location: SWMU 1	Location: C-720 Building	Location: SWMU 102
Results for excess lifetime cancer risk:			
Current On-site Industrial Worker			
Exposure to Soil	NA	NA	NA
Exposure to Sediment	X	NA	NA
Exposure to Surface Water	NA	NA	NA
Future On-site Industrial Worker			
Exposure to Soil	NA	NA	NA
Exposure to Sediment	X	NA	NA
Exposure to Surface Water	NA	NA	NA
Future On-site Excavation Worker			
Exposure to Soil	X	---	NA
Future On-site Recreational User			
Exposure to Game	---	NA	NA
Exposure to Sediment	X	NA	NA
Exposure to Surface Water	NA	NA	NA
Future Off-site Recreational User			
Exposure to Surface Water	---	NA	NA
Exposure to Game	---	NA	NA
Future On-site Rural Resident			
Exposure to Soil	---	NA	NA
Exposure to Groundwater[b]	X	X	X
Vapor Intrusion[e]	X	X	NA
Future Off-site Rural Resident			
Exposure to Groundwater[d]	X	X	---
Vapor Intrusion[e]	---	---	NA
Results for systemic toxicity[c]:			
Current On-site Industrial Worker			
Exposure to Soil	NA	NA	NA
Exposure to Sediment	X	NA	NA
Exposure to Surface Water	NA	NA	NA
Future On-site Industrial Worker			
Exposure to Soil	NA	NA	NA
Exposure to Sediment	X	NA	NA
Exposure to Surface Water	NA	NA	NA
Future On-site Excavation Worker			
Exposure to Soil	X	X	NA
Future On-site Recreational User			
Exposure to Game	---	NA	NA
Exposure to Sediment	X	NA	NA
Exposure to Surface Water	NA	NA	NA
Future Off-site Recreational User			
Exposure to Surface Water	---	NA	NA
Exposure to Game	---	NA	NA
Future On-site Rural Resident			
Exposure to Soil	---	NA	NA
Exposure to Groundwater[b]	X	X	---
Vapor Intrusion[e]	X	X	NA
Future Off-site Rural Resident			
Exposure to Groundwater[d]	---	---	---
Vapor Intrusion[e]	---	---	NA

Deleted: 7
Deleted: SWMU 4
Deleted: ¶ X¶ NA¶ NA
Deleted: ¶ X¶ NA¶ NA
Deleted: ¶ X
Deleted: ¶ ---¶ NA¶ NA
Deleted: ¶ ---¶ ---
Deleted: ¶ X¶ X
Deleted: E
Deleted: ¶ X
Deleted: E
Deleted: ¶ X¶ NA¶ NA
Deleted: X¶ NA¶ NA
Deleted: X
Deleted: ---
Deleted: NA
Deleted: NA
Deleted: ---
Deleted: ---
Deleted: X
Deleted: X
Deleted: E
Deleted: X
Deleted: ---

Notes: Scenarios where risk exceeds *de minimis* levels are marked with an X. Scenarios where risk did not exceed *de minimis* levels are marked with a ---. NA indicates that the scenario/land use combination was not assessed because the scenario is not applicable, or the medium is not present.

[a] Consistent with the PGDP Risk Methods Document (DOE 2000a), the *de minimis* levels used are a cumulative ELCR of 1×10^{-6} and a cumulative Hazard Index (HI) of 1.

[b] The BHHRA assessed risks from use of water drawn from the RGA separately from use of water drawn from the McNairy Formation. The value reported here is for use of water from the RGA.

[c] Systemic toxicity results summarized here for the resident and recreational user are for the child. The off-site POE considered is the property boundary.

[d] Based on results of preliminary deterministic and probabilistic contaminant transport modeling. The POE is the property boundary. X indicates that the location contains a source of unacceptable off-site contamination, and --- indicates that the location is not a source of off-site contamination (see Tables G.72 and G.73). [e] Vapor intrusion was modeled for residential basements for TCE, 1,2-DCE, and VC only, as these COCs and antimony are identified in the WAG 27 RI Report as migrating from sources at SWMU 1 and the C-720 area and result in risks above *de minimis* levels. Monitoring results document that TCE and its degradation products are the primary COCs that define the Southwest Plume. Antimony was not included in vapor intrusion modeling because it is not a volatile compound.

Deleted: ¶

Deleted: richloroethene, cis-1,2-Dichloroethene, trans-1,2-Dichloroethene and Vinyl Chloride only

Table 6.3. Summary of risk characterization for SWMU 1[a]

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs	% Total HI
Current industrial worker at current concentrations[b] (soil)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future industrial worker at current concentrations[b] (soil)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Current industrial worker at current concentrations (sediment)	3.4×10^{-5}	Arsenic Cesium-137 Neptunium-237 Uranium Uranium-235	27 11 48 6 3	Ingestion of sediment Dermal contact External exposure	5 26 69	1.7	Chromium Iron Manganese Vanadium	16 23 25 23	Dermal contact	99
Future industrial worker at current concentrations (sediment only)	3.4×10^{-5}	Arsenic Cesium-137 Neptunium-237 Uranium Uranium-238	27 11 48 6 3	Ingestion of sediment Dermal contact External exposure	5 26 69	1.7	Chromium Iron Manganese Vanadium	16 23 25 23	Dermal contact	99

Deleted: Section Break (Next Page)

Table 6.3. Summary of risk characterization for SWMU 1[a] (continued)

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs	% Total HI
Future child rural resident at current concentrations (RGA groundwater only)	NA	NA	NA	NA	NA	99	Arsenic Barium Cobalt Iron Manganese Nickel Chloroform Trichloroethene *cis*-1,2-Dichlroethene	1 <1 <1 1 11 <1 11 71 3	Ingestion of groundwater Dermal contact Inhalation while showering Inhalation household use Vapor Intrusion	23 2 644 22
Future child rural resident at current concentrations[c] (McNairy groundwater)	NA	NA	NA	NA	NA	20	Aluminum Arsenic Barium Beryllium Chromium Iron Manganese Nickel Uranium Vanadium Trichloroethene	2 5 1 <1 2 58 9 <1 12 6 2	Ingestion of groundwater Dermal contact Inhalation household use	96 2 2
Future adult rural resident at current concentrations (RGA groundwater only)	6.8×10^{-4}	Arsenic 1,1-Dichloroethene Chloroform Trichloroethene Technetium-99	18 2 2 74 <1	Ingestion of groundwater Dermal contact Inhalation while showering Inhalation household use Vapor Intrusion	43 4 5 36 11	26	Arsenic Barium Iron Manganese Nickel Chloroform Trichloroethene *cis*-1,2-Dichloroethene	2 <1 2 18 <1 9 64 3	Ingestion of groundwater Dermal contact Inhalation while showering Inhalation household use Vapor Intrusion	37 4 5 36 18
Future adult rural resident at current concentrations[c] (McNairy groundwater)	1.4×10^{-3}	Arsenic Trichloroethene Americium-241 Cesium-137 Uranium-235 Uranium-238	9 <1 42 <1 <1 47	Ingestion of groundwater Inhalation household use	100 <1	8.2	Aluminum Arsenic Barium Chromium Iron Manganese Uranium Vanadium Trichloroethene	2 5 1 2 58 9 12 6 1	Ingestion of groundwater Dermal contact	97 3
Future child rural resident at	NA	NA	NA	NA	NA	0.4	Trichloroethene	56	NE	

Deleted: ¶ NA ... [2]
Deleted: ¶ Future child rural resident at current concentrations (RGA groundwater)
Deleted: ¶ 30¶ 2¶ 8¶ 59
Deleted: ¶ Ingestion of groundwater¶ Dermal contact¶ Inhalation while showering¶ Inhalation household use
Deleted: ¶ Arsenic¶ Barium¶ Cobalt¶ Iron¶ Manganese¶ Nickel¶ Chloroform¶ ... [3]
Deleted: .0
Deleted: ¶ ... [4]
Deleted: ... ... [5]
Deleted: .1
Deleted: ¶ ... [6]
Deleted: ¶ ... [7]
Deleted: ... ... [8]
Deleted: ¶ ... [9]
Deleted:
Deleted: ¶ ... [10]
Deleted: ¶ ... [11]
Deleted: o
Deleted: ¶ ... [12]
Deleted: ¶ ... [13]
Deleted: ¶ ... [14]

Table 6.3. Summary of risk characterization for SWMU 1[a] (continued)

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs	% Total HI
modeled concentrations (RGA groundwater drawn at property boundary variable degradation)							*cis*-1,2-Dichloroethene	29		NE
Future child rural resident at modeled concentrations (RGA groundwater drawn at property boundary fixed degradation)	NA	NA	NA	NA	NA	1.4	Trichloroethene *cis*-1,2-Dichloroethene	83 10	NE	NE
Future adult rural resident at modeled concentrations (RGA groundwater drawn at property boundary variable degradation)	1.4×10^{-6}	Trichloroethene Vinyl chloride	39 61	Not determined	---	0.1	NE	NE	NE	NE
Future adult rural resident at modeled concentrations (RGA groundwater drawn at property boundary fixed degradation)	6.1×10^{-6}	Trichloroethene Vinyl chloride	87 14	Not determined	---	0.2	NE	NE	NE	NE
Future child recreational user at current concentrations (soil)	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE
Future child recreational user at current concentrations (sediment)	NA	NA	NA	NA	NA	3.4	Aluminum Arsenic Chromium Iron Manganese Vanadium	7 4 19 28 10 28	Dermal contact	98
Future teen recreational user at current concentrations (soil)	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE
Future teen recreational user at current concentrations (sediment)	NA	NA	NA	NA	NA	2.2	Aluminum Chromium Iron Manganese	6 19 28 10	Dermal contact	99

Deleted: ¶ NE

Deleted: ¶ NE

Deleted: ¶ NE

Deleted: ¶ Future child rural resident at modeled concentrations (RGA groundwater drawn at property boundary)[d]

Deleted: 1

Deleted: ¶ 1.4×10^{-6}

Deleted: ¶ Not determined

Deleted: ¶ 0.1

Deleted: ¶ NE

Deleted: ¶ NE

Deleted: ¶ NE

Deleted: ¶ NE

Deleted: ¶ Trichloroethene

Deleted: ¶ 77

Deleted: ¶ Future adult rural resident at modeled concentrations (RGA groundwater drawn at property boundary)[d]

Deleted: 2

Table 6.3. Summary of risk characterization for SWMU 1[a] (continued)

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs	% Total HI
							Vanadium	28		
Future adult recreational user at current concentrations (soil)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future adult recreational user at current concentrations (sediment)	1.9×10^{-5}	Arsenic Neptunium-237	78 10	Ingestion of sediment Dermal contact External exposure	9 74 13	0.5	NE	NE	NE	NE
Future excavation worker at current concentrations	1.3×10^{-4}	Arsenic PAHs Bis(2-chloroethyl)ether Dieldrin Heptachlorodibenzofuran Hexachlorobenzene N-Nitroso-di-n-propylamine PCBs Trichloroethene Vinyl chloride Cobalt-60 Uranium	18 25 1 1 3 2 12 9 2 12 1 5	Ingestion of soil Dermal contact Inhalation of VOCs and particulates External exposure	24 54 6 6	1.9	Arsenic Chromium Manganese Vanadium 2-Nitroanaline PCBs Trichloroethene *cis*-1,2-dichloroethene	7 16 14 14 12 7 6 7	Ingestion of soil Dermal contact Inhalation of VOCs and particulates	17 74 9

Note: NA = ELCR not applicable to child and teen cohorts. ELCR for adult is for lifetime exposure and takes into account exposure as child and teen.

NE = Land use scenario not of concern or land use not evaluated because contact with medium is not possible.

[a] Total ELCR and total HI columns reflect values from BHHRAs completed earlier and as part of the Southwest Groundwater Plume SI.

[b] A response action for SWMU 1 has addressed PCBs and dioxins surface soil. Please see the BHHRA for additional information.

[c] In the earlier assessments, ELCR and hazard from exposure to groundwater water drawn from the RGA and McNairy were assessed. In the SI BHHRA, results for use of water drawn from the RGA were reassessed, and the results for use of water drawn from the McNairy were recalculated.

[d] Based on results of preliminary deterministic and probabilistic contaminant transport modeling (see Tables G.72 and G.73).

[e] Vapor intrusion was modeled for residential basements for TCE, 1,2-DCE, and VC only, as these COCs and antimony are identified in the WAG 27 RI Report as migrating from sources at SWMU 1 and the C-720 area and result in risks above *de minimis* levels. Monitoring results document that TCE and its degradation products are the primary COCs that define the Southwest Plume. Antimony was not included in vapor intrusion modeling because it is not a volatile compound.

Deleted:

Deleted: ¶

Deleted:

Deleted: Vapor intrusion was modeled for residential basements for Trichloroethene, cis-1,2-Dichloroethene, trans-1,2-Dichloroethene and Vinyl Chloride only.

Table 6.4. Summary of risk characterization for C-720 Building[a]

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs	% Total HI
Current industrial worker at current concentrations[b] (soil)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future industrial worker at current concentrations[b] (soil)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Current industrial worker at current concentrations[b] (sediment)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future industrial worker at current concentrations[b] (sediment)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future child rural resident at current concentrations (RGA groundwater only)	NA	NA	NA	NA	NA	102	Arsenic Barium Iron Manganese Nickel 1,1-Dichloroethene Trichloroethene *cis*-1,2-Dichlroethene *trans*-1,2 Dichloroethene	1 <1 7 12 2 2 73 1 <1	Ingestion of groundwater Dermal contact Inhalation while showering Inhalation household use Vapor Intrusion	43 2 7 48 5
Future child rural resident at current concentrations[c] (McNairy groundwater)	NA	NA	NA	NA	NA	64.4	Aluminum Arsenic Barium Beryllium Chromium Iron Manganese Nickel Uranium Vanadium 1,1-Dichloroethene Trichloroethene	9 <1 <1 <1 3 73 6 <1 <1 6 <1 <1	Ingestion of groundwater Dermal contact Inhalation during household use	97 2 <1

- Deleted: NA
- Deleted: NA
- Deleted: NA
- Deleted: NA
- Deleted: NA
- Deleted: 72.8
- Deleted: Future child rural resident at current concentrations (RGA groundwater)
- Deleted: Ingestion of groundwater; Dermal contact; Inhalation while showering; Inhalation household use
- Deleted: 1; <1; 10; 17; 3; 3; 64; 2; <1
- Deleted: -
- Deleted: Arsenic; Barium; Iron; Manganese; Nickel; 1,1-Dichloroethene; Trichloroethene; *cis*-1,2-Dichlroethene; *trans*-1,2-Dichloroethene

051706

Table 6.4. Summary of risk characterization for C-720 Building[a] (continued)

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs	% Total HI
Future adult rural resident at current concentrations (RGA groundwater only)	1.8×10^{-3}	Arsenic 1,1-Dichloroethene Trichloroethene Vinyl chloride Technetium-99	7 64 24 5 <1	Ingestion of groundwater Dermal contact Inhalation while showering Inhalation household use Vapor Intrusion	53 2 5 38 2	23	Arsenic Barium Iron Manganese Nickel 1,1-Dichloroethene Trichloroethene *cis*-1,2-Dichlroethene	2 <1 12 22 4 2 53 2	Ingestion of groundwater Dermal contact Inhalation while showering Inhalation household use Vapor Intrusion	56 4 4 31 3
Future adult rural resident at current concentrations[c] (McNairy groundwater)	2.2×10^{-3}	Arsenic 1,1-Dichloroethene Trichloroethene Vinyl chloride Americium-241 Cesium-137 Neptunium-237 Technetium-99 Uranium-235 Uranium-238	2 12 <1 1 24 <1 14 <1 6 40	Ingestion of groundwater Dermal contact Inhalation while showering Inhalation household use	54 2 5 39	26.7	Aluminum Arsenic Barium Beryllium Chromium Iron Manganese Nickel Uranium Vanadium Trichloroethene	9 <1 <1 <1 3 73 6 <1 <1 6 <1	Ingestion of groundwater Dermal contact	97 3
Future child rural resident at modeled concentrations (RGA groundwater drawn at property boundary variable degradation)	NA	NA	NA	NA	NA	<0.1	NE	NE	NE	NE
Future child rural resident at modeled concentrations (RGA groundwater drawn at property boundary fixed degradation)	NA	NA	NA	NA	NA	0.3	Trichloroethene *cis*-1,2-Dichloroethene	69 30	NE	NE
Future adult rural resident at modeled concentrations (RGA groundwater drawn at property boundary variable degradation)	1.1×10^{-6}	Vinyl chloride	>95	Not determined	---	<0.1	NE	NE	NE	NE
Future adult rural resident at modeled concentrations (RGA groundwater drawn	2.4×10^{-6}	Trichloroethene Vinyl chloride	51 48	Not determined	---	0.2	Trichloroethene *cis*-1,2-Dichloroethene	82 11	NE	NE

Deleted: 1.8 × 10^{-3}

Deleted: 22.1

Deleted: Future adult rural resident at current concentrations (RGA groundwater)

Deleted: Arsenic 1,1-Dichloroethene Trichloroethene Vinyl chloride Technetium-99

Deleted: Ingestion of groundwater Dermal contact Inhalation while showering Inhalation household use ... [15]

Deleted: 7 65 24 3 <1

Deleted: Ingestion of groundwater Dermal contact Inhalation while showering ... [16]

Deleted: Arsenic ... [17]

Deleted: NA ... [18]

Deleted: e

Deleted: Future child rural resident at mod ... [19]

Deleted: e

Deleted: 1.1 × 10^{-6} ... [20]

Deleted: e

Deleted: Future adult rural resident at mod ... [21]

Table 6.4. Summary of risk characterization for C-720 Building[a] (continued)

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs	% Total HI
at property boundary fixed degradation)										
Future child rural resident at current concentrations[b] (soil)	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE
Future adult rural resident at current concentrations[b] (soil)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future child recreational user at current concentrations[b] (soil)	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE
Future child recreational user at current concentrations[b] (sediment)	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE
Future teen recreational user at current concentrations[b] (soil)	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE
Future teen recreational user at current concentrations[b] (sediment)	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE
Future adult recreational user at current[b] concentrations (soil)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future adult recreational user at current concentrations[b] (sediment)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future excavation worker at current concentrations	1.5×10^{-5}	Arsenic Vinyl chloride	59 33	Ingestion of soil Dermal contact Inhalation of VOCs and particulates	37 46 12	0.4	NE	NE	NE	NE

Note: NA = ELCR not applicable to child and teen cohorts. ELCR for adult is for lifetime exposure and takes into account exposure as child and teen.
NE = Land use scenario not of concern or land use not evaluated because contact with medium is not possible.
[a] Total ELCR and total HI columns reflect values from BHHRAs completed earlier and as part of the Southwest Groundwater Plume SI.
[b] The area around the C-720 Building in covered by gravel and cement; therefore, contact with surface soil is not possible. Please see the BHHRA for additional information.

Deleted: e

[c] In the earlier assessments, ELCR and hazard from exposure to groundwater water drawn from the RGA and McNairy were assessed. In the SI BHHRA, only results for use of water drawn from the RGA were reassessed, and the results for use of water drawn from the McNairy were recalculated.

[d] Based on results of preliminary deterministic and probabilistic contaminant transport modeling (see Tables G.72 and G.73).

Deleted: **Table 6.5. Summary of risk characterization for SWMU 4[a]¶ Receptor** ... [22]

051706

Table 6.5. Summary of risk characterization for SWMU 102[a]

Deleted: 6

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs	% Total HI
Current industrial worker at current concentrations[b] (soil)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future industrial worker at current concentrations[b] (soil)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Current industrial worker at current concentrations[b] (sediment)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future industrial worker at current concentrations [b] (sediment)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future child rural resident at current concentrations[c] (RGA groundwater)	NA	NA	NA	NA	NA	0.6	NE	NE	NE	NE
Future child rural resident at current concentrations[c] (McNairy groundwater)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future adult rural resident at current concentrations[c] (RGA groundwater)	7.9×10^{-6}	1,1-Dichloroethene Trichloroethene	27 73	Ingestion of groundwater Inhalation household use	41 48	0.2	NE	NE	NE	NE

Table 6.5. Summary of risk characterization for SWMU 102[a] (continued)

Deleted: 6

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs	% Total HI
Future adult rural resident at current concentrations[c] (McNairy groundwater)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future child rural resident at modeled concentrations[d] (RGA groundwater drawn at plant boundary)	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE
Future adult rural resident at modeled concentrations[d] (RGA groundwater drawn at plant boundary)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future child rural resident at current concentrations[b] (soil)	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE
Future adult rural resident at current concentrations[b] (soil)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future child recreational user at current concentrations[b] (soil)	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE
Future child recreational user at current concentrations[b] (sediment)	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE
Future teen recreational user at current concentrations[b] (soil)	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE
Future teen recreational user at current concentrations[b] (sediment)	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE

051706

Deleted: 6

Table 6.5. Summary of risk characterization for SWMU 102[a] (continued)

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs	% Total HI
Future adult recreational user at current[b] concentrations (soil)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future adult recreational user at current concentrations[b] (sediment)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future excavation worker at current concentrations[b]	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

Note: NA = ELCR not applicable to child and teen cohorts. ELCR for adult is for lifetime exposure and takes into account exposure as child and teen.
NE = Land use scenario not of concern or land use not evaluated because contact with medium is not possible.
[a] Total ELCR and total HI columns reflect values from the BHHRA completed as part of the Southwest Groundwater Plume SI.
[b] Only results for subsurface soil collected below 10 ft bgs were available for SWMU 102. Please see the BHHRA for additional information.
[c] In the SI BHHRA, only results for use of water drawn from the RGA were calculated.
[d] Information collected during the SI indicates that SWMU 102 is not a source of contamination to the Southwest Plume.

Table 6.6. Summary of hazard quotients for chemicals[a] posing potential future risks[b,c] to nonhuman receptors

Deleted: 7

		Chemicals of Potential Ecological Concern				
Location	**Receptor**	**Cr**	**Cu**	**Ni**	**V**	**Zn**
SWMU 1	Plant	16.8	–	–	–	1.3
Ditch soil	Worm	42.0	–	–	–	–
	Shrew	–	–	–	–	–
	Mouse	–	–	–	–	–
	Deer	–	–	–	–	–
C-720 area	Plant	NE	NE	NE	NE	NE
	Worm	NE	NE	NE	NE	NE
	Shrew	NE	NE	NE	NE	NE
	Mouse	NE	NE	NE	NE	NE
	Deer	NE	NE	NE	NE	NE
SWMU 102	Plant	NE	NE	NE	NE	NE
	Worm	NE	NE	NE	NE	NE
	Shrew	NE	NE	NE	NE	NE
	Mouse	NE	NE	NE	NE	NE
	Deer	NE	NE	NE	NE	NE

Deleted: SWMU 4¶
Surface soil

Deleted: Plant¶
Worm¶
Shrew¶
Mouse¶
Deer

Deleted: 296¶
740¶
4.4¶
–¶
NE

Deleted: –¶
1.0¶
–¶
–¶
NE

Deleted: 5.1¶
–¶
–¶
–¶
NE

Deleted: 23.9¶
–¶
–¶
–¶
NE

Deleted: 1.45¶
–¶
–¶
–¶
NE

Notes: Cr = chromium; Cu = copper; Ni = nickel; V = vanadium; Zn = zinc.

"–" indicates that the hazard quotient for the chemical/receptor combination did not exceed 1 or the chemical was below background in that sector.

"NE" indicates that no evaluation was done. For the C-720 area and SWMU 102, no evaluation was done because surface soil results were not available due to current ground cover and no data were available, respectively.

Deleted: . For SWMU 4, results for deer were not available in the WAG 3 RI Report BERA.

[a] The table includes values for those chemicals with a maximum concentration above background (or no background available) and at least one hazard quotient > 1.0. If the hazard quotient was less than one or the maximum concentration was less than background, then the hazard quotient is not presented. Analytes for which ecological benchmarks were not available are shown in the SERA in Appendix G.

[b] Values in this table are hazard quotients estimated by dividing the dose to the receptor by the benchmark dose.

[c] These results are for the assessment of potential risks due to exposure to contaminants in surface soil, if the industrial infrastructure were to be removed. These results are a point of reference that can be used in future risk management decisions.

available for the portion of SWMU 102 investigated because the data set for this area does not contain results for surface soil samples. Results are not available for C-720 because contamination in this area is restricted to subsurface soils that lie below gravel- or cement-covered areas, which makes direct contact with this contamination unlikely.

6.2 OBSERVATIONS

Specific observations of the BHHRA and SERA are presented here. Consistent with current and likely future land use, observations for source areas focus on risks posed under industrial land use, and observations from the SERA focuses on potential future risks. Similarly, observations for off-site areas focus on risks from use of groundwater at the PGDP property boundary, the first location where future residential use is possible.

6.2.1 Observations from the BHHRA

The current land use scenario[1] and most plausible future use scenario, industrial use, have risks above *de minimis* levels at SWMU 1. At SWMU 1, the exposure routes driving ELCR and systemic toxicity are external exposure and dermal contact, respectively. Risks under industrial use at C-720 and SWMU 102 were below *de minimis* levels because ground cover prevents contact with contaminated soil.

Deleted: s
Deleted: and 4
Deleted: s
Deleted: and 4

The dermal contact with soil exposure route poses considerable systemic toxicity, predominantly from dermal contact with metals in soil. This results from using dermal absorption factors (ABS values) in the calculation of hazard that exceed gastrointestinal (GI) absorption values. This observation indicates that the hazard estimates for metals from the dermal exposure route may be unrealistic and greatly exceed the real hazard posed by this route. Although chemical-specific ABS values were used when available, default ABS values were used for most chemicals because chemical-specific values are lacking. Because of this uncertainty, response action decisions based on risks from metals in soil should include additional evaluation of the dermal exposure route.

Risks calculated for consumption of groundwater drawn from the RGA by a hypothetical resident exceeded *de minimis* levels for each of the three source areas and for the area of the Southwest Plume. Additionally, risks derived for the hypothetical resident using results from individual wells and borings also exceeded *de minimis* levels. "Priority COCs" for ELCR and HI in RGA water at the locations were as follows.

Deleted: four

- Southwest Plume – iron; manganese; uranium; benzene; carbon tetrachloride; chloroform; 1,2-DCA; 1,1-DCE; *cis*-1,2-DCE; TCE; and VC.
- SWMU 1 – arsenic, iron; manganese; chloroform; *cis*-1,2-DCE; and TCE.
- C-720 – arsenic; iron; manganese; nickel; 1,1-DCE; *cis*-1,2-DCE; and TCE.
- SWMU 102 – None.

Deleted: <#>SWMU 4 – iron; manganese, benzene; bromomethane; carbon tetrachloride; chloroform; 1,1-DCE; 1,2-DCA; *cis*-1,2-DCE, TCE, and VC.¶

"Priority COCs" are identified in this section as an aid to risk managers during decision making.

---

[1] As noted earlier, the current industrial land use scenario assessed in the WAG 27 RI Report did not include or take into account existing DOE controls on worker exposures, such as controls on access to areas containing contaminated soils or sediment or the use of personal protective equipment.

Deleted: and 3
Deleted: s

Risks to a hypothetical resident from use of groundwater contaminated by contaminants migrating from source areas and drawn from wells completed in the RGA at the plant boundary and property boundary exceeded *de minimis* levels. The source with the greatest impact over the three sources modeled was SWMU 1 followed by the C-720 Building area. In addition to TCE, the other COCs were *cis*-1,2-DCE and VC. Based on the previous and current modeling results, neither metals nor radionuclides are COCs for contaminant migration from the source at the C-720 area or SWMU 1.

Deleted: four

Deleted: SWMU 4, which was an important source of TCE. Of the remaining sources,

Deleted: had the next greatest impact

Deleted: inyl

Deleted: holoride

Deleted: ??

Deleted: ; however, based on modeling in the WAG 3 RI, these contaminants may be COCs for contaminant migration from the source at SWMU 4.

Risks to a hypothetical resident from inhalation of volitiles as a result of vapor intrusion into home basements exceeded *de minimis* levels from the source at the C-720 area and SWMU 1. These results are based on predicted concentrations from vapor transport modeling using a one-dimensional analytical solution to convective and diffusive vapor transport. The model relates the vapor concentration in the indoor space to the vapor concentration in the soils/groundwater directly beneath or in close proximity to the indoor space. The model is a screening level model with a limited number of parameter inputs. The resulting risks calculated from the predicted vapor concentrations may be unrealistic as an infinite source was used to calculate the vapor concentrations, the predicted vapor concentrations were used as steady-state exposure concentrations over the entire exposure period, and default parameters used in the risk calculations do not account for differences in air exchange rates throughout the home and associated residence times. Because of this uncertainty, response action decisions based on risks from inhalation of volatiles as a result of vapor intrusion should include additional evaluation of this exposure route.

6.2.2 Observations from the SERA

As noted earlier, a new ecological assessment was not performed for this SI because additional data relevant to the assessment of ecological risks were not collected. Results from earlier assessments presented in the WAG 27 (SWMU 1) RI Report (1999a) are summarized below and in Table 6.6.

Deleted: and WAG 3 (SWMU 4)

Deleted: s

Deleted: and 2000b, respectively

Deleted: 7

In the BERA for SWMU 1, two inorganic chemical COPECs, chromium and zinc, were identified. However, chromium was found at a maximum concentration similar to its background concentration. Neither organic compound nor radionuclide COPECs were identified.

Deleted: In the BERA for SWMU 4, five inorganic chemical COPECs, chromium, copper, nickel, vanadium, and zinc were identified. Of these, vanadium and zinc were found at concentrations slightly greater than background (i.e., 1.3×) at only one sampling station. As with SWMU 1, neither organic compound, nor radionuclide COPECs were identified.¶

7. SUMMARY AND CONCLUSIONS

This section presents the summary and conclusions of the Southwest Plume SI and reviews the problem statements and principal study questions developed in the SI Work Plan. In addition, the decision rules presented in the SI Work Plan are reviewed. The conclusions presented are drawn from previous investigations and from Sections 3 through 6 of this SI Report.

7.1 MAJOR FINDINGS OF CONTAMINANT DISTRIBUTION

The following are the major contaminant distribution findings for the four sources investigated in the Southwest Plume SI.

- Environmental media have been impacted by releases of contaminants at the C-720 area and at SWMUs 1 and 4.

- Metals contamination was detected at the C-720 area and at SWMU 1, but soils contaminated with metals generally are confined to the upper 20 ft of the UCD soils.

- TCE and TCE degradation products are the primary site-related contaminants and are the primary contaminants in soils at the C-720 area and at SWMU 1.

- Concentrations of TCE at the C-720 area and SWMU 1 indicate that discrete areas of ganglia of free phase TCE may be present in UCD soil. Concentrations of TCE at SWMU 4 suggest that ganglia of free phase TCE may be present in the RGA.

- Leaching of TCE and degradation products from source zones at the C-720 area and SWMUs 1 and 4 has impacted the RGA groundwater. The low concentration of TCE in soil at SWMU 102 indicates that this area is not a source of RGA groundwater contamination.

- SWMUs 1 and 102 do not appear to be the source of ^{99}Tc found in RGA groundwater at these units. A source of ^{99}Tc to the UCRS appears to be present in the C-720 area. However, the C-720 area source does not result in ^{99}Tc levels in the RGA that exceed the EPA-derived ^{99}Tc MCL (900 pCi/L) at the plant boundary or property boundary POEs. SWMU 4 does appear to be a source of ^{99}Tc contamination in RGA groundwater.

- Contaminant migration from the RGA into the underlying McNairy Formation flow system is negligible and is not expected to increase in the future.

- To present a range of pontential risk resulting from the source areas and to support the selection of remedial actions as necessary two scenarios were evaluated for the probabilistic transport modeling, 1) a variable degredation scenario in which the degradation rate for TCE was allowed to vary over the potential range of values, and 2) a fixed degradation scenarnio in which the TCE degradation half-life was held constant at 26.6 yr for the UCRS and 0 years for the RGA. All other parameters in the probabilistic analysis werer allowed to vary for both scenarios. The variable degradation scenario indicates that TCE migrating from the SWMU 1 source is not likely to result in exceedances of the TCE MCL at the property boundary or the Ohio River POEs (based on the 95% UCL peak median concentrations); however, the modeling did indicate that exceedances of the TCE MCL may occur at the plant boundary POE. The fixed degradation scenario indicates that TCE migrating from the SWMU source is likely to results in exceedances of the TCE MCL at the plant and property

Deleted: s

Deleted: and 4

Deleted: a

Deleted: and to waste at SWMU 4

Deleted: s

Deleted: and 4

Deleted: in both the UCD soil and

Deleted: that may result in exceedances of the EPA-derived ^{99}Tc MCL at the plant boundary POE

Deleted: T

boundaries, but not at the Ohio River POE. The variable degradation scenario indicates that TCE migrating from the C-720 building area source is not likely to result in exceedances of the TCE MCL at any POE. The fixed degradation scenario indicates that TCE migrating from the C-720 building area source is likely to results in exceedances of the TCE MCL at the plant boundary, but not at the property or Ohio River POEs.

- Review of TCE levels in sources at SWMU 1, SWMU 4, and the C-720 area and in the Southwest Plume, as illustrated in the annually updated TCE plume maps for the PGDP and in the revised Southwest Plume map presented in the SI, shows that past and possibly current releases from sources at SWMU 1, SWMU 4, and the C-720 area are related to TCE occurrences at the plant boundary.

- Modeling indicates that antimony (the only metal previously identified at SWMU 1 and the C-720 area in modeling in the WAG 27 RI as possibly exceeding health-based levels) is not expected to attain concentrations greater than its MCL at the PGDP plant boundary and property boundary POEs.

The following are the major contaminant distribution findings for the Southwest Plume (SWMU 210).

- SWMUs 1 and 4 and the C-720 area are sources of the TCE and TCE degradation products found in the Southwest Plume.

- Data from previous investigations and on-going groundwater monitoring indicate that the Southwest Plume extends approximately 2000 ft west-northwest of the PGDP plant boundary but does not extend beyond the property boundary.

- At the PGDP plant boundary, higher TCE concentrations are found at deeper depth intervals.

Deleted: <#>Modeling performed for the SI indicates that the 95% UCL peak median TCE concentrations from source areas at SWMUs 1 and 4 may exceed the MCL for TCE at the PGDP plant boundary, but fall below the MCL at the property boundary. The concentrations reached at the property boundary depend in part on the amount of degradation of TCE that may occur over time. Modeling indicates that the 95% UCL peak median TCE concentration from the C-720 Building source area does not exceed the MCL at the plant or property boundaries.¶

Deleted: Results of preliminary transport modeling for SWMU 4 indicates that TCE and *cis*-1,2-DCE levels may exceed MCLs at the PGDP plant boundary and property boundary POEs. Probabilistic transport modeling predicts that the 95% UCL on the median TCE concentration will exceed its MCL at the plant boundary only. Extrapolation determines that *cis*-1,2-DCE levels will not exceed their MCL at either POE.

7.2 SI-SPECIFIC DQO QUESTIONS

The primary DQO study questions developed during project scoping and presented in the SI Work Plan are reviewed in this section. In addition, the problem statement and decision rules for each area are summarized.

7.2.1 SWMU 1 – C-747-C Oil Landfarm

The problem statement for SWMU 1 contained in the SI Work Plan is as follows:

> *Hazardous substances, primarily TCE, have been detected above the MCL in a groundwater MW immediately north of SWMU 1. During the previous investigations, hazardous substances, including TCE, were detected in the subsurface soils within the boundaries of the unit. Decisions regarding remediation require further characterization of the magnitude of the existing levels of TCE and its degradation products and the extent of the zone of highest contaminated soils.*

The principal study question for SWMU 1 and its answers are as follows:

> *What is the magnitude and the extent of the high-concentration zone of TCE, its degradation products and other VOCs at SWMU 1?*

Sampling indicates that the extent of the high-concentration zone of TCE and other VOCs matches that defined in the earlier WAG 27 RI Report. The lateral extent of the source term developed for modeling was approximately 0.2 acres, but varied with depth[1]. The thickness of the contaminated mass within the UCRS was estimated to be 55 ft, or to the top of the RGA. Average TCE concentrations within this source varied from 5.74 mg/kg at 50 to 55 ft bgs to 110.8 mg/kg at 10 to 20 ft bgs. Concentrations of all other VOCs are smaller and are confined to the upper portions of the UCRS.

The decision rules related to the principal study question and their outcomes are as follows:

> *If the combined concentration of TCE, its degradation products, and other VOCs is greater than 10,000 μg/kg outside the VOC high concentration zone defined by the WAG 27 RI in 1998, then further define the magnitude and extent of contamination.*

As noted above, sampling confirmed the source zone defined in the WAG 27 RI.

> *If Borings 001-201, 001-203, or 001-205 encounter total VOC concentrations greater than 10,000 μg/kg, then a contingency DPT/MIP boring will be installed 25 ft east, west, or south of Borings 001-201, 001-203, or 001-205, respectively, to determine the lateral extent of contamination.*

The trigger level of 10,000 μg/kg was not attained in Borings 001-201, 001-203, and 001-205; therefore, no contingency borings were installed.

> *If total VOC levels exceeding 10,000 μg/kg are discovered in one of the 3 planned contingency borings, then DOE will contact the KDEP and EPA to agree upon the scope of additional investigation for SWMU 1.*

The trigger level of 10,000 μg/kg was not attained, and no contingency borings were installed.

7.2.2 C-720 Area

The problem statement for the C-720 area contained in the SI Work Plan is as follows:

> *Temporary borings from previous investigations and MWs have encountered hazardous substances above background levels in the soils and groundwater in the vicinity of the C-720 Building. The extent and magnitude of two areas of contamination near the east end of building are not known*

The principal study questions for the C-720 area and their answers are as follows:

> *What is the magnitude and the extent of the areas of contamination near the east end of the C-720 Building?*

Sampling indicates that the extent of contamination at the two source areas at the east end of the C-720 Building are similar in size to that defined in the earlier WAG 27 RI Report. The lateral extent of the source term developed for modeling was approximately 0.3 acres, but varied with depth. The thickness of the contaminated mass within the UCRS was estimated to be 60 ft, or to the top of the RGA. Average TCE concentrations within this source varied from 0.1 mg/kg at 50 to 60 ft bgs to 11.9 mg/kg at 20 to 30 ft bgs. Concentrations of all other VOCs are smaller and are confined to the upper portions of the UCRS.

---

[1] As discussed in Appendix F, the modeling required normalization of layer area. In the modeling for SWMU 1, the areas were normalized to 0.07 acre, which was the area of the layer with the greatest TCE concentrations.

What is the concentration of the VOCs, metals, and radionuclides in the soils below the parking lot at the northeast and southeast corners of the C-720 Building?

The average concentrations of VOCs, metals, and radionuclides in the UCRS source areas at the northeast and southeast corners of the C-720 Building are as follows:

Northeast Corner. The maximum concentration of TCE from a soil sample collected as part of the SI was 0.98 mg/kg at Location 720-105. Samples from Locations 720-103 and 720-106 had maximum concentrations of TCE of 0.63 and 0.60 mg/kg, respectively. Concentrations of TCE from other locations that were sampled as part of the SI were much lower (0.01 to 0.06 mg/kg). Concentrations of degradation products of TCE were less than the TCE results. Other VOCs detected in samples from the Northeast corner were PCE; carbon tetrachloride; 1,2-DCA; 1,1-DCE; and chloroform; however, most concentrations of these VOCs were below 0.100 mg/kg. Only beryllium, at 0.80 mg/kg, chromium, at 45.4 mg/kg, and cobalt, at 33.7 mg/kg, exceeded background values for subsurface soil, as presented in the WAG 27 RI Report (DOE 1999a). No radionuclides exceeded background values.

Southeast Corner. The concentrations of TCE detected in samples from the two locations sampled as part of the SI were very low (maximum values of 0.2 and 0.046 mg/kg for Locations 720-107 and 720-108, respectively). Additionally, neither sample had detectable TCE degradation products. Concentrations from a sample collected within the source area during the earlier WAG 27 RI varied from 0.037 mg/kg at 5 to 8 ft bgs to 68 mg/kg at 20 to 21 ft bgs. No metals or radionuclides had levels that exceeded background values for subsurface soil, per the WAG 27 RI screening values (DOE 1999a).

The decision rule related to the principal study question for both the northeast and southeast corners of the C-720 Building and its outcome is as follows:

At C-720, TCE and its degradation products are expected to be a significant component of the contaminants wherever soil contamination occurs. If the combined concentration of TCE, and its degradation products is greater than 10,000 μg/kg in any planned investigation borings, then further define the magnitude and extent of contamination.

The combined concentration of TCE and its degradation products was less than 10,000 μg/kg; therefore, no contingency borings were installed.

7.2.3 SWMU 102 – Storm Sewer

The problem statement for SWMU 102 contained in the SI Work Plan is as follows:

Processes associated with the C-400 Building are documented sources of subsurface soil and groundwater contamination. The subject storm sewer collects storm water runoff from the C-400 area. Additionally, the storm sewer may have captured liquids from C-400 processes. It is not known if the storm sewer has transported contamination or if contaminants have leaked from the storm sewer to the surrounding soils.

The principal study questions for SWMU 102 and their answers are as follows:

What is the current structural integrity of the storm sewer?

The storm sewer video investigation indicates that the current structural integrity of the storm sewer is good.

> *Are there contaminants in the backfill material of the storm sewer and the adjacent soils that may act as sources of contamination for the Southwest Plume?*

Low levels of contaminants were found in the backfill materials. These low levels indicate that the storm sewer backfill material is not a source of contamination to the Southwest Plume.

The decision rules related to the principal study question and their outcomes are as follows:

> *If the video camera survey detects holes or fractures in the bottom half of the storm sewer, then plan a DPT/MIP boring for each location to sample for contamination.*

The investigation borings were located to ensure collection of samples near suspected holes and fractures where they occurred.

> *If more than 15 holes or fractures are found in the bottom half of the storm sewer, then place priority on the 15 holes or fractures located closest to the C-400 and C-720 Buildings.*

No additional holes or fractures were identified in the bottom half of the storm sewer; therefore, no contingency borings were installed.

> *If no VOC contamination is found in the 15 baseline borings, then place up to 15 additional borings at identified holes or fractures along the storm sewer west of the initial study area.*

As noted above, borings were located to ensure collection of samples near the few apparent and suspected holes and fractures.

> *If VOC contamination is found in one or more of the 15 baseline borings, then use one or more additional borings to determine the area and vertical extent of the contamination.*

VOC contamination in samples collected along the storm sewer was minor with TCE results ranging from 0.0028 to 0.220 mg/kg; therefore, no contingency borings were installed to determine the areal and vertical extent of contamination.

7.2.4 SWMU 4 – C-747 Contaminated Burial Yard

The problem statement for SWMU 4 contained in the SI Work Plan is as follows:

> *Hazardous substances, including VOCs and radionuclides, have been detected above MCLs in …groundwater within and immediately adjacent to the boundaries of SWMU 4. It is unknown if or how much contamination is entering the RGA from this unit.*

The principal study questions for SWMU 4 and their answers are as follows:

> *What are the VOCs and their concentration in the RGA upgradient (east) of SWMU 4?*

TCE concentrations in samples collected upgradient at 60 to 70 ft bgs ranged from 1.2 to 24 μg/L. Concentrations of TCE in samples collected deeper (90, 95, and 100 ft bgs) had higher concentrations that ranged from 140 to 680 μg/L. Other VOCs detected in upgradient RGA water samples were 1,1-DCE; benzene; carbon tetrachloride; chloroform; *cis*-1,2-DCE; dibromochloromethane; and PCE. (The suspected laboratory contaminants 2-butanone and acetone also were detected in RGA water samples.)

What are the VOCs and their concentrations in the RGA downgradient (west) of SWMU 4?

TCE concentrations in samples collected downgradient from SWMU 4 were greater than those collected upgradient. For example, Location 004-108 had TCE concentrations of 3200, 2500, 360, 61, and 95 μg/L in samples collected at 60, 70, 80, 90, and 100 ft bgs, respectively. Similarly, Location 004-106 had TCE concentrations of 570, 1200, 360, and 2700 in samples collected at 70, 80, 90, and 100 ft bgs, respectively. Other VOCs detected in downgradient RGA water samples were 1,1-DCA; 1,2-DCA; carbon tetrachloride; chloroform; and *cis*-1,2-DCE. (The suspected laboratory contaminants 2-butanone and methylene chloride also were detected in RGA water samples.)

What are the ^{99}Tc activities in the RGA upgradient (east) of SWMU 4?

The ^{99}Tc activities measured in samples from the RGA collected upgradient from SWMU 4 ranged from nondetect to 93.2 pCi/L. These detected levels were less than the EPA-derived ^{99}Tc MCL of 900 pCi/L. The higher activities were found in samples collected in the lower RGA.

What are the ^{99}Tc activities in the RGA downgradient (west) of SWMU 4?

The ^{99}Tc activities in samples from the RGA collected downgradient from SWMU 4 were greater than those collected upgradient. Results for downgradient samples ranged from 14.6 to 663 pCi/L. These detected levels were less than the EPA-derived ^{99}Tc MCL of 900 pCi/L. The higher activities were found in samples collected in the upper and middle RGA.

The decision rules related to the principal study questions and their outcomes are as follows:

If concentrations in the RGA for individual VOCs are higher by 20% or more on the downgradient side of SWMU 4 than on the upgradient side, then the unit is contributing VOC contamination to the RGA

The differences between upgradient and downgradient VOC concentrations in the RGA indicate that SWMU 4 is a source of TCE. Generally, the increase in concentrations was more than 20%.

If ^{99}Tc activities in the RGA are higher by 20% or more on the downgradient side of SWMU 4 than on the upgradient side, then the unit is contribution ^{99}Tc contamination to the RGA.

The difference between upgradient and downgradient ^{99}Tc concentrations in the RGA indicates that SWMU 4 is a source of ^{99}Tc contamination of the RGA. Generally, the increase in ^{99}Tc concentrations was more than 20%.

7.2.5 SWMU 210 – Southwest Plume

The problem statement for SWMU 210 contained in the SI Work Plan is as follows:

Hazardous substances, primarily VOCs and ^{99}Tc, have been detected above the MCL in groundwater MWs west of the C-400 Building and south of the groundwater contamination areas identified as the Northwest Plume. This area of groundwater contamination has been named the Southwest Plume. The existing MWs are not located such that the types and levels of contaminations migrating beyond the plant boundary can be monitored. There is no information available to determine if the C-400 Building is a contributor to the Southwest Plume.

The principal study questions for SWMU 210 and their answers are as follows:

What VOCs are present in the RGA groundwater where the RGA groundwater passes below the west plant boundary? What are the concentrations of VOCs in the RGA groundwater where the RGA groundwater passes below the west plant boundary?

Generally, TCE concentrations in water samples collected along the west plant boundary increased with depth. TCE concentrations were also greater in samples from borings located further north along the plant boundary. The furthest north location (210-001) had TCE concentrations of 83, 250, and 110 μg/L in samples collected at 80, 90, and 100 ft bgs, respectively; and the furthest south sample (210-007) had TCE concentrations of 3, 5, and 4 μg/L at depths of 80, 90, and 100 ft bgs, respectively. The highest TCE concentrations in a sample collected along the plant boundary were 11, 630, and 170 μg/L at depths of 80, 90, and 100 ft bgs, respectively, from Location 210-005. This location is several hundred feet due west of SWMU 4. Other VOCs found in samples collected along the plant boundary and their detected concentration ranges were 1,1-DCE (3 to 10 μg/L); chloroform (1 to 8 μg/L); *cis*-1,2-DCE (1 to 28 μg/L), and bromodichloromethane (detected once at 1 μg/L). In addition, the suspected laboratory contaminants 2-butanone, acetone, and methylene chloride were detected at low concentrations.

What are the ^{99}Tc activities in the RGA groundwater where the RGA groundwater passes below the west plant boundary?

Concentrations of ^{99}Tc found in samples collected along the plant boundary mirrored the results for TCE with higher ^{99}Tc concentrations being found at depth and further north along the plant boundary. The furthest north location (210-001) had ^{99}Tc concentrations of 237, 558, and 209 pCi/L in samples collected at 80, 90, and 100 ft bgs, respectively; and the furthest south sample (210-007) had no detected ^{99}Tc in any sample. The highest ^{99}Tc concentrations in a sample collected along the plant boundary were 273, 1040, and 139 pCi/L at depths of 80, 90, and 100 ft bgs, respectively, from Location 210-005. As noted above, this location is several hundred feet due west of SWMU 4.

Is the C-400 Building contributing VOCs or ^{99}Tc to the RGA groundwater in the Southwest Plume?

The information collected during the SI indicates that the C-400 Building area may contribute VOC contaminants and ^{99}Tc to the Southwest Plume, but is not a primary source of either VOC or ^{99}Tc contamination found in the Southwest Plume. This conclusion is best supported by the concentration gradients seen between the upgradient and downgradient RGA samples collected at SWMU 4 and the sampling results collected during the investigation of the storm sewer (SWMU 102).

7.3 RESULTS OF THE BRA

This section summarizes the major results and conclusions of the Southwest Plume SI BRA. Consistent with the BRA, this summary includes results from earlier BRAs for media not addressed as part of the Southwest Plume SI.

BHHRA

- The current industrial land use scenario[2] and most plausible future use scenario, industrial use, have risks above *de minimis* levels at SWMU 1. At SWMU 1, the exposure routes driving ELCR and systemic toxicity are external exposure and dermal contact, respectively. Risks under industrial use at C-720 and SWMU 102 were below *de minimis* levels because ground cover prevents contact with contaminated soil.

- The dermal contact with soil exposure route poses considerable systemic toxicity, predominantly from dermal contact with metals in soil; however, this result is uncertain due to lack of chemical-specific dermal absorption (ABS) values.

- Risks calculated for consumption of groundwater drawn from the RGA by a hypothetical resident using the average concentration of contaminants in data from each of the four source areas and the average concentration using data from all samples taken within the boundary of the Southwest Plume exceeded *de minimis* levels. Priority COCs for ELCR and HI at the locations were as follows.

  – Southwest Plume – iron; manganese; uranium; benzene; carbon tetrachloride; chloroform; 1,2-DCA; 1,1-DCE; *cis*-1,2-DCE; TCE; and VC.

  – SWMU 1 – arsenic, iron; manganese; chloroform; *cis*-1,2-DCE; and TCE.

  – C-720 – arsenic; iron; manganese; nickel; 1,1-DCE; *cis*-1,2-DCE; and TCE.

  – SWMU 102 – None.

  "Priority COCs" are identified in this section as an aid to risk managers during decision making.

- Risks to a hypothetical resident from use of contaminated groundwater migrating from source areas and drawn from wells completed in the RGA at the plant boundary and property boundary exceeded *de minimis* levels. SWMU 1 has the greatest impact followed by the C-720 Building area. (SWMU 102 was determined to not be a source.). For the modeled POEs, the COCs for SWMU 1 are TCE; *cis*-1,2-DCE; *trans*-1,2-DCE; and VC. The COCs for the C-720 Building area are TCE; *cis*-1,2-DCE; and VC. Of these, only TCE has a HI or ELCR greater than 1 or 1 × 10^{-4} and is, therefore, a "priority COC" for contaminant migration at SWMU 1. The C-720 Building does not have any "priority COCs." Based on the previous and current modeling results, neither metals nor radionuclides are COCs for contaminant migration from the sources at the C-720 area or SWMU 1.

- Risks to a hypothetical resident from the inhalation of volitiles as a result of vapor intrusion into home basements exceeded *de minimis* levels from the source at the C-720 area and SWMU 1.

Deleted: s
Deleted: and 4
Deleted: s
Deleted: and 4
Deleted: <#>SWMU 4 – iron; manganese, benzene; bromomethane; carbon tetrachloride; chloroform; 1,2-DCA; 1,1-DCE; *cis*-1,2-DCE, TCE, and VC.¶
Deleted: The source with the greatest impact was SWMU 4, which was the primary source of TCE. Of the remaining sources,
Deleted: d
Deleted: next
Deleted: and SWMU 4
Deleted: For SWMU 4, TCE; *cis*-1,2-DCE; and VC are "priority COCs."
Deleted: ; however, SWMU 4 may be a source of these contaminants

[2] As noted earlier, the current industrial land use scenario assessed in the WAG 27 Report did not include or take into account existing DOE controls on worker exposures, such as controls on access to areas containing contaminated soils or sediment or the use of personal protective equipment.

Deleted: and 3 RI
Deleted: s

Because of uncertainties associated with the vapor intrusion modeling and resultant risk calculations, response action decisions based on risks from inhalation of volatiles as a result of vapor intrusion should include additional evaluation of this exposure route.

BERA

- In the BERA for SWMU 1, two inorganic chemical COPECs, chromium and zinc, were identified. However, chromium was found at a maximum concentration similar to its background concentration. Neither organic compound nor radionuclide COPECs were identified.

-

Deleted: In the BERA for SWMU 4, five inorganic chemical COPECs, chromium, copper, nickel, vanadium, and zinc were identified. Of these, vanadium and zinc were found at concentrations slightly greater than background (i.e., 1.3×) at only one sampling station. As with SWMU 1, neither organic compound nor radionuclide COPECs were identified.

7.4 CONCLUSIONS

This section presents the overall conclusions for three of four potential source areas and the Southwest Plume. Additionally, remaining data gaps that may increase the uncertainty when selecting among possible response actions, if any, in the future are summarized.

Overall Conclusions

- The results of probabilistic modeling and extrapolations from the modeling predict that TCE is the only VOC potentially migrating from source areas at SWMU 1 and the C-720 area at a rate that may result in exceedances of the MCL at the hypothetical PGDP plant boundary POE. Modeling indicates no VOCs are expected to attain concentrations greater than their MCL at the property boundary or at the Ohio River POEs. Transport modeling in previous RI reports also indicates that neither metals nor radionuclides are migrating from current sources at SWMU 1 and the C-720 area at rates that would result in exceedances of MCLs for these contaminants at the POEs.

Deleted: , SWMU 4,

Deleted: . However, based on the results of screening-level modeling, metals and radionuclide contaminants may be migrating from SWMU 4 at rates that could result in exceedances of MCLs at the POEs.

- While the C-720 area contributes ^{99}Tc to the RGA, neither SWMU 1 nor the C-720 area will result in exceedances of the EPA-derived ^{99}Tc MCL at downgradient POEs considered in transport modeling.

- The geospatial analysis used to develop the current source terms used in transport modeling indicates that the source sizes at SWMU 1 and the C-720 area are similar to those identified in the earlier RI reports. The lateral extent of the source areas developed in the transport model was 0.2 and 0.3 acres, respectively. The vertical extent was to the top of the RGA (approximately 55 to 60 ft bgs), with higher concentrations being found nearer the surface at SWMU 1 and the C-720 area. Additional analyses may further refine the sizes of these source areas.

Deleted: , SWMU 4

Deleted: , 1.8,

Deleted: , but not at SWMU 4

- Sampling results indicate that the storm sewer, part of SWMU 102, is not a source of contamination to the RGA that would exceed the MCL at any POE.

- Review of the current TCE concentration distribution of sources at SWMU 1 and the C-720 area and in the Southwest Plume, as illustrated in the annually updated groundwater plume maps and in the revised Southwest Plume map presented in the SI report, shows that the Southwest Plume flows in a west-northwest direction from sources located west of the C-400 Building and the steam plant. This review also shows that releases from sources at SWMU 1 and the C-720 area are related to TCE occurrences at the plant boundary.

Deleted: , SWMU 4,

Deleted: , SWMU 4,

- While the primary contaminant defining the plume is TCE, the plume also contains several other VOCs and ^{99}Tc that originate at multiple sources. Three of the sites investigated during the SI (i.e., SWMU 1, SWMU 4, and the C-720 area) appear to be sources of TCE to the plume.; however, only SWMU 4 appears to be an important source of ^{99}Tc. SWMU 4 also appears to be a source of other VOCs and several metals. The other site investigated directly with soil sampling during the SI, the storm sewer, is not a source of TCE or other VOCs.

- Because TCE contamination in RGA groundwater upgradient of SWMU 4 was identified, it is likely the C-400 Building area (a primary source to the Northwest and Northeast Groundwater Plumes at the PGDP) is a contributing source to the Southwest Groundwater Plume.

Uncertainties

Although all activities planned in the SI work plan were successfully completed, the following data gaps will need to be considered in subsequent Comprehensive Environmental Response, Compensation, and Liability Act analyses.

- While it is likely that the C-400 Building area is a source contributing TCE contamination to the Southwest Groundwater Plume, some uncertainty remains as to (1) whether, and the extent to which, the C-400 Building area is a contributing source of TCE contamination to the Southwest Groundwater Plume, and (2) the impact that the response at the C-400 area will have on the Southwest Groundwater Plume.

- At plant shutdown, water flow in the RGA, and the migration of dissolved contamination, is expected to change[3]. These changes may affect both the rate and direction of the migration of the Southwest Groundwater Plume.

- A volume of RGA groundwater contaminated by ^{99}Tc, contiguous to the Southwest Groundwater Plume, occurs east of the C-720 Building. The direction of migration remains undefined. (It may commingle with the main body of the Southwest Groundwater Plume or may migrate eastward and dissipate into the Northeast Groundwater Plume).

Additional work is needed to validate the degradation rate or rate range for TCE that will be used to support future fate and transport RGA groundwater modeling. The current rate range was utilized to provide the high and low bounds of the contamination expected at the POE. By reducing the range of the degradation factor(s) utilized, the uncertainty also is reduced for the risk managers in selecting response actions.

Deleted: CERCLA

Deleted: <#>For purposes of the Burial Grounds OU Remedial Investigation, the nature and extent of contamination at SWMU 4 have been adequately characterized. The transport modeling in the Southwest Plume SI assumed that the TCE DNAPL in waste areas at SWMU 4 exists as residual ganglia. There is a possibility that the waste areas include buried containers with TCE-contaminated material and that have not leaked. This uncertainty may be addressed during the Burial Grounds OU Feasibility Study and subsequent treatability studies (if required). (See *Work Plan for the Burial Grounds Operable Unit Remedial Investigation/Feasibility Study at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-2179&D2 [DOE 2005c].)¶

Deleted: DOE is awaiting the outcome of the KRCEE TCE Degradation Study that will feed into the Burial Grounds Operable Unit. The possibility that TCE sourced from SWMU 4 may exceed its MCL at the assumed Property Boundary POE will need to be further assessed in the BGOU RI Report.

Deleted: ¶

[3] At plant shutdown, water losses from plant utilities no longer will contribute recharge to groundwater. Leakage to groundwater from plant ditches and lagoons will be lessened. In response, groundwater gradients should decline, slowing the flow of groundwater and dissolved contaminations. Without the influence of groundwater mounding due to leakage from plant utilities and ditches and lagoons, groundwater flow paths may reorient. It is possible that groundwater flow may take more direct flow paths to discharge points at and near the Ohio River.

8. REFERENCES

Battelle (Battelle Memorial Institute) 1995. Multimedia Environmental Pollutant Assessment System (MEPAS) Application Guideline, PNL-10395. Prepared by Pacific Northwest Laboratory.

BJC 2003. *Contaminant Migration from SWMU 1 and the C-720 Area at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, BJC/PAD-506, Bechtel Jacobs Company LLC, Paducah, KY.

CH2M HILL 1991. *Results of the Site Investigation, Phase I, at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, KY/ER-4, CH2M HILL, Southeast, Inc., Oak Ridge, TN, March.

Deleted: BJC 2004. *Trichloroethene and Technetium-99 Groundwater Contamination in the Regional Gravel Aquifer for the Calendar Year 2003 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, BJC/PAD-169/R4, Bechtel Jacobs Company LLC, Paducah, KY, May. ¶

CH2M HILL 1992. *Results of the Site Investigation, Phase II, at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, KY/SUB/13B-97777CP-03/1991/1, April.

DOE 1998. *Final Remedial Action Report for Waste Area Grouping (WAG) 23 and Solid Waste Management Unit 1 of WAG 27 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1737&D0, Primary Document, U. S. Department of Energy, Paducah, KY, June.

DOE 1999a. *Remedial Investigation Report for Waste Area Grouping 27 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1777&D2, U.S. Department of Energy, Paducah, KY, June.

DOE 1999b. *Remedial Investigation Report for Waste Area Grouping 6 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR-07-1727&D2, U.S. Department of Energy, Paducah, KY, May.

DOE 1999c. *Residual Risk Evaluation for Waste Area Grouping 23 and Solid Waste Management Unit 1 of Waste Area Grouping 27 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1781&D1.

DOE 2000a. *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky, Volume 1.Human Health and Volume II. Ecological*, DOE/OR/07-1506&D2/V1&V2/R0, U. S. Department of Energy, Paducah, KY, December.

DOE 2000b. *Remedial Investigation Report for Waste Area Grouping 3 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1895&D1, U. S. Department of Energy, Paducah, KY.

DOE 2000c. *Data Report for the Sitewide Remedial Evaluation for Source Areas Contributing to Off-Site Groundwater Contamination at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1845/D1, U.S. Department of Energy, January. (also known as Data Gaps document).

DOE 2001. *Feasibility Study for the Groundwater Operable Unit at Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/OR/07-1857&D2, U.S. Department of Energy, Paducah, Kentucky, August.

DOE 2003. *Final Report, Six-Phase Heating Treatability Study at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-2113&D1, Secondary Document, U.S. Department of Energy, Paducah, KY, December.

DOE 2004. *Site Investigation Work Plan for the Southwest Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-2094&D2, U. S. Department of Energy, Paducah, KY, February.

DOE 2005a. *Site Management Plan, Paducah Gaseous Diffusion Plant, Paducah, Kentucky, Annual Revision-FY 2005*, DOE/OR/07-2197&D2, U. S. Department of Energy, Paducah, KY, April.

DOE 2005b. *Record of Decision for Interim Remedial Action for the Groundwater Operable Unit for the Volatile Organic Compound Contamination at the C-400 Cleaning Building at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-2150&D2/R2, U. S. Department of Energy, Paducah, KY, August.

DOE 2005c. *Work Plan for the Burial Grounds Operable Unit Remedial Investigation/ Feasibility Study at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-2179&D2, U. S. Department of Energy, Paducah, KY

Dragun, J. 1988. *The Soil Chemistry of Hazardous Material, Hazardous Materials Control Research Institute*, Silver Springs, MD.

EPA 1991. *Standard Operating Procedures and Quality Assurance Manual*. Region IV Environmental Sciences Division, Athens, Georgia, February.

EPA 1998a. *Federal Facility Agreement for the Paducah Gaseous Diffusion Plant*, U. S. Environmental Protection Agency, Region 4, Atlanta, GA, February 13.

EPA 1998b. *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water*, EPA/600/R-98/128, U.S. Environmental Protection Agency, Washington DC, September.

EPA 1999. *A Guide to Preparing Superfund Proposed Plans, Records of Decision and Other Remedy Selection Documents*, OSWER Directive 9200.1-23P, Office of Solid Waste and Emergency Response, Washington, DC, July.

EPA 2001. *Handbook of Groundwater Protection and Cleanup Policies for RCRA Corrective Action*, EPA/530/R-01/015, Office of Solid Waste and Emergency Response, Washington, DC, September.

EPA 2004. *Handbook of Groundwater Protection and Cleanup Policies for RCRA Corrective Action*, EPA/530/R-04/030, Office of Solid Waste and Emergency Response, Washington, DC, April.

Johnson, P.C. and R.A. Ettinger 1991. "Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapors into Buildings," *Environmental Science and Technology*, 25, 1445-1452.

LMES (Lockheed Martin Energy Systems) 1997. *Evaluation of Natural Attenuation Processes for Trichloroethylene and Technetium-99 in the Northeast and Northwest Plumes at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* KY/EM-113.

Lyman, W., Reehl, W. F., Rosenblatt, D. H., Eds. 1982. *Handbook of Chemical Property Estimation Methods--Environmental Behavior of Organic Compounds*, McGraw-Hill, New York.

Sorenson, K.S., Jr., L.N. Peterson, R.L. Ely, and R.E. Hinchee 2000. *An Evaluation of Aerobic Trichloroethene Attenuation Using First-Order Rate Estimation*, Appendix E of the "Field Demonstration Report, Test Area North Final Groundwater Remediation, Operable Unit 1-07B" (DOE/ID-10718), Idaho National Engineering and Environmental Laboratory, March 27.

APPENDIX A

TECHNICAL MEMORANDUM FOR THE SOUTHWEST PLUME SITE INVESTIGATION

THIS PAGE INTENTIONALLY LEFT BLANK.

CONTENTS

THIS PAGE INTENTIONALLY LEFT BLANK.

ACRONYMS

bgs	below ground surface
DPT	direct-push technology
DSITMS	direct sampling ion-trap mass spectrometer
DWRC	dual-wall reverse circulation
Eh	oxidation reduction potential
GC/MS	gas chromatograph/mass spectrometer
LCD	lower continental deposits
MCL	maximum contaminant level
MIP	membrane interface probe
MW	monitoring well
PGDP	Paducah Gaseous Diffusion Plant
pH	hydrogen-ion concentration notation
PID	photoionization detector
PVC	polyvinyl chloride
RGA	Regional Gravel Aquifer
RI	Remedial Investigation
SI	Site Investigation
SWMU	Solid Waste Management Unit
^{99}Tc	technetium-99
TCE	trichloroethene
UCD	upper continental deposits
VOC	volatile organic compound

THIS PAGE INTENTIONALLY LEFT BLANK.

A.1 INTRODUCTION

The Southwest Groundwater Plume, hereafter called the Southwest Plume, refers to an area of groundwater contamination at the Paducah Gaseous Diffusion Plant (PGDP) in the Regional Gravel Aquifer (RGA) that is found south of the Northwest Plume and west of the C-400 Building. The plume was identified during the Waste Area Grouping (WAG) 27 Remedial Investigation (RI) in 1998. Additional work to characterize the plume was performed as part of the WAG 3 RI and the Data Gaps Investigation, both in 1999. The primary contaminants characterizing the plume are trichloroethene (TCE) with lesser amounts of other volatile organic compounds (VOCs) and the radionuclide technetium-99 (^{99}Tc). This Site Investigation (SI) focused on the Southwest Plume and four potential source areas of contamination to the Southwest Plume. The four potential source areas being investigated are these areas.

- C-747-C Oil Landfarm (Solid Waste Management Unit [SWMU] 1)
- C-720 Building, specifically areas near the northeast and southeast corners
- Storm sewer between the south side of the C-400 Building and Outfall 008 (part of SWMU 102)
- C-747 Contaminated Burial Yard (SWMU 4)

This technical memorandum presents the basic strategies and procedures (Table A1) that applied to the fieldwork, soil sampling, and groundwater sampling conducted as part of the Southwest Plume SI. The primary focus of the sampling strategy was to collect sufficient data to resolve data gaps for each of the units.

Table A1. Procedures used in the Site Investigation of the Southwest Plume

Procedures	
	Administrative
BJC-OS-1001	Document Control Including Records Management
ERWM-/ER-P2213	Data Validation Plans for Environmental Restoration Projects
ES-A-2209	Radiochemical Data Verification and Validation
ES-A-3005	Developing, Implementing, and Maintaining the Data Management Implementation Plan
ES-B-0808	Environmental Measurements Verification and Validation
ES-B-0810	Volatile and Semivolatile Data Verification and Validation
ES-B-0812	Inorganic Data Verification and Validation
FTP-1220	Documenting and Controlling Field Changes to Approved Work Plans
FTP-650	Labeling, Packaging, and Shipping of Environmental Field Samples
PMSA-1102	Sample Tracking, Laboratory Coordination, and Sample Handling
PMSA-2002	Sample Chain-of-Custody
PQ-A-1220	Occurrence Notification and Reporting
PQ-A-1610	Price Anderson Amendments Act (PAAA) Noncompliance Determination and Reporting
QAAP 10.1	Inspections
QAAP 12.1	Control of Measuring and Testing Equipment
QAAP 13.1	Handling, Storage, and Shipping
QAAP 16.1	Corrective Action
QAAP 17.1	Records Management
QAAP 18.3	Surveillances
QAAP 18.4	Client Assessments
QAAP 2.1	Indoctrination and Training
QAAP 2.2	Readiness Review
QAAP 2.3	Project Kickoff Checklist
QAAP 3.1	Document Review
QAAP15.1	Control of Nonconforming Items and Services
RAAS-002	Paducah Records Management

Table A1. Procedures used in the Site Investigation of the Southwest Plume (continued)

Procedures	
RAAS-004	Archival of Environmental Data
RAAS-005	Quality Assured Data
RAAS-006	Data Management Coordination
TP-DM-300-06	Data Package Receipt and Verification
TP-DM-300-12	Handling and Control of Sample Documentation
TP-DM-300-2	Data Entry
	Field Operations
FTP-1215	Use of Field Logbooks
FTP-370	Water Level Measurements
FTP-625	Chain-of-Custody
FTP-880	Field Measurement Procedures: pH, Temperature, Salinity, and Conductivity
FTP-955	Field Measurement Procedures: Dissolved Oxygen
PA-2012	Paducah Excavation/Penetration Program
QAAP 12.1	Control and Calibration of Measuring and Testing Equipment
RAAS-001	Groundwater Sampling Procedures
RAAS-013	Filter Pack and Screen Selection
RAAS-024	Lithologic Logging
RAAS-026	Monitoring Well Development
RAAS-027	Monitoring Well Installation
RAAS-030	Powered Industrial Trucks
RAAS-034	Handling, Transporting, and Relocating Waste Containers
TP-DM-300-10	Analytical Laboratory Interface
	Membrane Interface Probe Sample Collection - Work Instruction
	Waste Management
BJC-PAD-215	Profiling and Qualifying Low Level Waste Streams from Paducah for Disposal at the Nevada Test Site
BJC-PAD-437	Waste Disposition Characterization Plan at PGDP
FTP-400	Equipment Decontamination
FTP-405	Cleaning and Decontaminating Sample Containers and Equipment
PA-3011	Certification of Low Level Waste from Paducah for Disposal at the Nevada Test Site
PA-3012	Procurement and Inspection of Direct-Ordered Item Critical to the Paducah Project
PA-3013	Off-Site Shipment Management Review Process at Paducah
PA-3015	Preparation and Inspection of Waste Packages for Release from Paducah
PA-3021	Preparation and Inspection of Documents for Waste Shipments from PGDP
RAAS-007	Identification and Management of Waste from non-Radiological Management Area
RAAS-008	Waste Generator Responsibilities for On-Site Temporary Storage of Waste
RAAS-011	Pumping Liquid Wastes into Tankers
RAAS-012	Collection of Sediment/Sludge Samples
RAAS-014	Off-Site Decontamination Pad Operating Procedures
RAAS-016	Sampling Containerized Waste
RAAS-017	Opening Containerized Waste
RAAS-018	Identification and Safe Handling of Pressurized Waste
SAIC EC&HS-20	Hazardous Waste Operations

Activities addressed in this technical memorandum include the following:

- membrane interface probe (MIP),
- drilling activities,
- groundwater sampling,
- boring abandonment,
- monitoring well (MW) sampling,

- lithologic description, and
- fieldwork/sampling procedures.

At SWMU 1, the C-720 Area, and along the Outfall 008 storm sewer, VOC contamination in the shallow soils of the upper continental deposits (UCD) were profiled using direct-push technology (DPT) combined with a MIP. Discrete depth soil samples were collected and sent to a lab for VOC, metals, and radionuclide analysis. Temporary borings were used to collect discrete depth groundwater samples from the RGA at SWMU 4 and in the dissolved-phase plume. These samples were analyzed for VOC and ^{99}Tc contamination. Existing RGA MWs within the area of the plume also were sampled for VOCs, metals, and radionuclides. Four MWs were installed to monitor the migration of contamination within the plume downgradient of SWMU 4.

A.2 MEMBRANE INTERFACE PROBE

The MIP is not a drilling method, but a real-time VOC profiling and sampling method. MIP sampling uses a heating element and gas permeable membrane. The element heats the material surrounding the probe, causing the VOCs contained in the material to vaporize. Vapors enter the probe through a gas permeable membrane and are transported through tubing to the surface by an inert carrier gas. The sample then is analyzed in the field with equipment appropriate to the needs of the investigation. If just the detection of VOCs is important, then a simple photoionization detector (PID) is all that is required. As in the case of this SI, if a qualitative estimate of VOC concentration with depth is needed, then an electron capture detector system is deployed. When quantitative analysis of individual VOC species is needed, the surface analytical equipment consists of a gas chromatograph/mass spectrometer (GC/MS), direct sampling ion-trap mass spectrometer (DSITMS), or photo acoustic analyzer.

A.3 DRILLING ACTIVITIES

The following sections briefly describe each of the drilling methods used for the investigation of the Southwest Plume. Dual Wall Reverse Circulation (DWRC) was used to install the temporary borings and to collect groundwater samples from the RGA. Rotary Sonic was used for the installation of the MWs. Both systems added water during the drilling process. The source of the water was PGDP’s potable water supply, obtained at the C-752-C decontamination facility.

Dual-Wall Reverse Circulation

DWRC is an air rotary drilling method using two concentric strings of drill pipe. In traditional air rotary drilling, the air travels through the center of the drill pipe, exits the bit, and returns to the surface by way of the annulus between the borehole wall and the drill pipe. The DWRC method is different from air rotary drilling in that the air used to lift the drill cuttings to the surface goes down the annulus between the two strings of drill pipe, exits at or near the drill bit, and returns to the surface through the center of the drill pipe. The drill bit is only slightly larger in diameter than the outer diameter of the outer drill string, resulting in almost no annular space between the drill pipe and the borehole wall. This minimal annular space and the reverse circulation of air that prevents contact of the air with the wall of the boring results in little opportunity for cross-contamination.

The upward velocity of the air returning to the surface with the drill cuttings was on the order of 100 ft per second, which means that drill cuttings that were caught at the outlet of the air discharge cyclone were representative of the sediments at the face of the drill bit. To prevent oil contamination of the air stream, a filter was placed at the outlet side of the air compressor.

When an interval for water sampling was identified, rotary drilling stopped, but air circulation was maintained for a brief period to clear the hole of cuttings. After air circulation stopped, water from the sample interval entered the drill pipe through the bit, allowing collection of the water sample in the protected environment of the drill pipe. The speed at which water entered the drill pipe and reached a static water level was an indication of the hydraulic conductivity of the interval being sampled. The faster the water level stabilized, the greater was the hydraulic conductivity. Because some warm air entered the interval being sampled, sample intervals were purged prior to sampling. Water temperature and dissolved oxygen, in particular, were monitored during purging. When they returned to *in situ* values, water samples were collected.

Waste generation consisted of drill cuttings and water. Drill cutting volumes were near theoretical borehole size, since the air circulation did not erode the borehole wall. The volume of water produced was dependent on the productive capacity of the sediments. Aquifers capable of producing large volumes of water resulted in significant wastewater volumes.

DWRC drilling had been used for groundwater characterization at PGDP in the Phase IV Investigation; the Northeast Plume Interim Remedial Action; the WAG 6, WAG 27, WAG 28, and WAG 3 RIs; and the “Data Gaps” investigation. DWRC was the drilling method used in the investigation of the Southwest Plume. This investigation experienced drilling problems associated with the sampling of the RGA. Standard drill bits were inadequate for drilling the RGA where sand predominated. The drill bit was modified to increase drill rate penetration and decrease wear on the bit. DPT was used to collect groundwater samples, in addition to DWRC, at depths where sands prevented drilling (boring 210-005 at depths of 84 ft, 90 ft, and 100 ft; boring 210-006 at depths of 90 ft and 100 ft; and boring 210-007 at depths of 90 ft and 100 ft).

Flowing sands within the RGA created problems during sampling. When air circulation was cut off at the sampling depth, the flowing sands would enter the drill string with the groundwater flow and made placement of the sampling pump very difficult. The sand also created accelerated wear on the sampling pump. A modified drill bit, with a bladder that engaged when the air circulation ceased, was utilized to prevent flowing sands from entering the drill string while still allowing the entrance of groundwater.

Rotary Sonic

Like DWRC, rotary sonic drilling uses two or more concentric strings of drill pipe with a drill bit designed to create minimal annular space between the drill pipe and borehole wall. Like DWRC, this configuration virtually eliminates vertical cross-contamination. Water sampling, using the same methodology, also takes place within the protected environment of the drill pipe where water from the interval being sampled enters the drill pipe through the drill bit. The primary differences are the method by which the drill string is advanced and the removal of the drill cuttings.

Rotary sonic drilling uses a combination of rotational movement and sonic resonance, which vibrates the drill string down through the sediments. The vibratory motion displaces the sediments laterally. The sediments near the outside of the drill string are pushed to the side of the borehole, while the sediments nearer the center of the drill string are captured as a core in a sleeve in the inner string of drill pipe. This drilling method results in a continuous core of sediments from the surface to the total depth of the hole as a natural by-product of the drilling process, rather than as an extra step requiring special equipment.

Rotary sonic drilling was used to install larger diameter MWs without requiring the installation of protective casing from the surface to the top of the RGA. This was because the inner drill pipe could be withdrawn prior to well installation, leaving the outer drill pipe in place as a temporary protective casing. The MW then was built inside the outer drill pipe, as the outer drill pipe was withdrawn from the hole. A smaller hole diameter was required and less well material was required, compared to wells installed using hollow stem augers.

Waste generation consisted of the soil core and water. Drill cutting volumes were near the theoretical hole size since only the soils in the core sleeve were recovered at the surface. Potable water often was used while drilling above the water table to reduce friction and to help displace drill cuttings and then was returned to the surface as wastewater. The volume of purge water produced was dependent on how much water was used during drilling and how quickly groundwater parameters returned to *in situ* conditions after drilling stopped.

A.4 DIRECT PUSH TECHNOLOGY

DPT has become a standard method for collecting soil and groundwater samples from shallow sediments. Simply, a vehicle-mounted hydraulic ram is used to push and hammer steel drill rods through the sediments. At selected depths, the steel drive point is removed, allowing the collection of a soil sample when the drill rod is advanced. The soil sample is recovered and the hole then is advanced to the next sample point. The method is relatively fast and generates a minimum amount of waste. At PGDP, DPT has been used successfully in the upper 50 to 60 ft of sediments. Soils were collected every 5 ft for lithologic description using DPT methods at SWMU 1, the C-720 area, and along the Outfall 008 storm sewer extending from the C-400 area.

The DWRC/DPT combination was used to allow the use of DPT-type water sampling probes within the RGA at depths where flowing sands prevented sampling (generally below 70 ft). The DWRC drill rod remained at depth while the DPT was advanced through the drill rod. The drive-point water sampler was pushed or driven below the bottom of the drill rods, permitting collection of a relatively undisturbed water sample with minimal cross-contamination. The small inner diameter of the drive-point sampler limited the types of pumps that could be used with this system. When the drive-point sampler had reached the target depth, groundwater was pumped to the surface using a mechanical bladder pump. Since sampling took place immediately after drilling ceased, there was no stagnant water to remove from the boring and, therefore, no minimum purge volume. The water sample was collected after sufficient water had been purged to allow geochemical parameters (i.e., pH, dissolved oxygen, conductivity, and temperature) to stabilize within the boring.

The vehicle-mounted DPT unit could not be used at four of the locations associated with the investigation of part of SWMU 102 due to low overhead energized power lines. PGDP processes required the lines to remain active. Temporary shielding could not cover enough of the lines to satisfy Health and Safety requirements. A jackhammer equipped with a Geoprobe sampler was used to collect the sample at these locations.

A.5 GROUNDWATER SAMPLING

The general groundwater sampling strategy for the SI focused on the collection of groundwater samples from multiple discrete depths within the RGA using temporary borings at SWMU 4 and within the dissolved-phase plume. Water sampling began at the top of the RGA (approximately 60 ft below ground surface [bgs]) and then continued every 10 ft until the base of the RGA was reached (approximately 100 ft bgs). In the event a groundwater sample could not be collected on the 10 ft interval, additional attempts were made every 5 ft. This strategy resulted in three to six water samples from each boring.

DWRC drilling allowed collection of the water sample inside the drill pipe from the sediments at the face of the drill bit. In most cases in the RGA, water readily entered the drill pipe. Where water levels were slower to recover, a water-level indicator was placed in the hole, and the water level monitored. The purpose was to determine how fast the water level returned to equilibrium. The faster the water level stabilized, the more permeable the interval being sampled and the greater the potential for the interval to be a preferred pathway for contaminant migration. After the groundwater level stabilized, the sampling pump was lowered into the boring and the sample collection process began.

The first step was to purge the drill pipe. Purging was required to eliminate the impact of the drilling medium (air for DWRC) on the interval being sampled. A submersible pump was used to purge the boring and to collect water samples.

Since sampling took place immediately after drilling ceased, there was no stagnant water to remove from the boring and, therefore, no minimum purge volume. The groundwater flow was diverted through an in-line flow cell mounted with a Horiba™ and an oxidation reduction potential (Eh) probe. The water sample was collected after sufficient water had been purged to allow geochemical parameters (i.e., negative logarithm of the hydrogen-ion concentration [pH], dissolved oxygen, conductivity, Eh, and temperature) to stabilize within the boring and to return to original aquifer conditions, as measured in existing MWs in the area. The geochemical parameters were considered stabilized when the following criteria were met:

- At least three measurements taken three minutes apart had consistent readings for temperature, conductivity, and pH;
- Temperature measurements agreed within 1° C;
- Conductivity measurements agreed within 10%; and
- pH measurements agreed within 0.5 units.

There was some natural variance across the area, so values from existing wells were used as indicators of aquifer conditions, but not as specific reference values to determine stabilization within an individual boring. The pH value was the most useful indicator since the pH of RGA groundwater was around 6.5 units, while the pH of the PGDP potable water used during drilling was 7.5 to 8 units.

When the geochemical parameters had stabilized, the flow rate of the sampling pump was adjusted to 200 ml/minute or less for sampling. Groundwater samples were collected for analysis for VOCs, including TCE and its degradation products, and ^{99}Tc. During each sampling event, the field parameters of depth to water, groundwater temperature, pH, specific conductance, Eh, and dissolved oxygen were collected. After sampling was completed, the sample tubing and pump were removed from the boring and decontaminated in accordance with approved procedures prior to the next use. Groundwater samples for analysis of metals and radionuclides other than ^{99}Tc were not collected from the temporary borings, because the results would not represent actual groundwater conditions due to the possible presence of suspended silts and clays in the water sample and the metals and radionuclides that may be sorbed onto them as a result of drilling.

A.6 BORING ABANDONMENT

After the sampling in each boring was completed, the boring was plugged and abandoned. Boring abandonment was consistent with Commonwealth of Kentucky requirements and approved site procedures. The following bullets are a synopsis of the process.

- As the drill pipe or DPT rod was withdrawn from the hole, high solids (at least 25%) bentonite grout was added to the hole by tremie pipe or through the DPT rods, to within 18 inches of the ground surface.

- Once the rig was moved off the hole, the area around the boring was roped off or properly covered for safety.

- After 24 hours, the grout level was checked and additional grout was added, if necessary.

- When the grout level had stabilized, the remaining 18 inches of the hole was filled with soil or asphalt or cement to ground level, and a stake was placed with the boring number so that the location of the boring could be surveyed.

A.7 MONITORING WELL SAMPLING

Several existing MWs were sampled in conjunction with this investigation. In addition to the data collected from the temporary borings, results from the sampling of the existing MWs were incorporated into the evaluation of groundwater contamination in the Southwest Plume area. The analytes of interest were VOCs, metals, and radionuclides. The MWs were sampled in accordance with approved procedures and work guides. Field parameters of depth to water, groundwater temperature, pH, specific conductance, Eh, and dissolved oxygen were collected.

A.8 LITHOLOGIC DESCRIPTION

The description of the physical appearance of the soils sampled was a basic piece of information acquired with each new boring. Depth, color, grain size, and texture helped develop a three-dimensional picture of the subsurface sediments. Several methods were available for collecting samples for description, each dependent on the drilling method being used.

At PGDP, DPT has been used successfully in the upper 50 to 60 ft of sediments. Soils were collected every 5 ft for lithologic description using DPT methods at SWMU 1, the C-720 area, and along the Outfall 008 storm sewer extending from the C-400 area. Simply, a vehicle-mounted hydraulic ram was used to push and hammer steel drill rods through the sediments. At selected depths, the steel drive point was removed, allowing the collection of a soil sample when the drill rod was advanced. The soil sample was recovered in a Lexan tube, the tube was cut open, and the soil described. The hole then was advanced to the next sample point. The method was relatively fast and generated a minimum amount of waste.

Rotary drilling methods have proven the most effective in drilling through the gravels of the RGA. These methods include DWRC and rotary sonic. DWRC drilling was used to drill through the gravels of the RGA to sample water and soil. Soil cuttings were collected every 5 ft from the outlet of the cyclone separator for soil description at SWMU 4 and the dissolved-phase plume borings. The SI installed MWs using rotary sonic drilling. This method yielded a soil core for each 10-ft interval that was described as part of the well log.

A.9 UTILITY SURVEY

Video systems for inspecting underground utilities are a relatively common and proven technology. Prior to final location of the borings along the storm sewer from the C-400 Area west to Outfall 008, the storm sewer was inspected for holes and cracks that could serve as exit pathways for contaminants that may have been carried by the storm sewer (see Appendix D). A remote operated video camera, a mechanism for moving the camera through the pipe, and a video recorder on the surface were utilized to inspect the storm sewer.

A.10 SAMPLING PROCEDURES

Soil samples from preplanned depth intervals were collected from the UCD using DPT at SWMU 1, the C-720 Area, and along the storm sewer extending from the C-400 Area to Outfall 008. The MIP initially was used to profile potential VOC contamination within the vadose zone. Sampling intervals were modified to reflect this profile. DPT was used to collect continuous 5 ft sample cores in a Lexan tube. The VOC samples were first collected as quickly as possible to limit potential for release to the environment and placed in 125 ml jars directly out of the tube prior to homogenization. The soil sample was packed as firmly as possible to limit headspace in the container. Soil from the remainder of the tube was homogenized in a stainless steel bowl prior to containerization. Samples were immediately placed on ice to maintain a 4º C constant temperature.

The intent of the groundwater sampling was to collect a sample at the interface of the UCD and lower continental deposits (LCD), intervals every 10 ft from that point, and at the interface of the LCD and the McNairy Formation. In the event a groundwater sample could not be collected on the 10 ft interval, additional attempts were made every 5 ft. Attempts were made to collect groundwater samples within the intervals at 60 ft, 70 ft, 80 ft, 90 ft, and 100 ft. The borehole was completed when the McNairy Formation silt/clay was encountered.

When the sampling depth had been determined, a sampling pump was lowered to the bottom of the borehole. The groundwater flow was diverted through an in-line flow cell mounted with a Horiba™ water quality meter and an Eh probe. Geochemical parameters were monitored to ensure stabilization of the groundwater sample and a return to original aquifer conditions. Documented parameters included depth to water, pH, dissolved oxygen, specific conductance, Eh, and temperature. When the geochemical parameters were considered stabilized, the groundwater flow was diverted away from the in-line flow cell through clean tubing and a sample was collected. VOC samples were collected in 40 ml vials with no headspace and were followed by the remaining samples. Samples were immediately placed on ice to maintain a 4º C constant temperature.

A.11 WELL CONSTRUCTION AND DEVELOPMENT

The SI constructed two well clusters, each consisting of an upper RGA well and a lower RGA well, on the west (downgradient) side of the C-747 Contaminated Burial Yard (SWMU 4). These wells provide for continuing assessment of SWMU 4 as part of PGDP's groundwater monitoring program. No samples were collected from these wells as part of the SI.

Each well was constructed in a separate borehole, drilled with a Versa-Sonic rotary sonic drill rig. The rotary sonic system provided excellent drill core that allowed the accurate identification of the depths of the top and bottom of the RGA, the primary criteria that determined the well screen depths. Appendix E includes the lithologic logs and construction diagrams for each of the wells. Because the drill string creates a minimal annular space that inhibits the downward migration of groundwater and dissolved contamination, and because the well is constructed in the protected environment of the inside of the drill rods, the RGA wells were constructed without the necessity of first installing an isolation casing through the Upper Continental Recharge System to near the top of the RGA.

Each borehole began by advancing a four-inch drill string, followed by a six-inch drill string, in 10-ft intervals. Once the six-inch drill string was set at each 10-ft depth, the drillers retrieved the four-inch drill string and extracted the contained core for the interval. The drillers advanced an outer, eight-inch diameter, drill string over the six-inch drill string at target depths (e.g., the base of the UCD and the base of the LCD) and intermediate depths, as required by drilling.

Once the eight-inch drill string reached the target depth for the well, generally two to five ft below the intended bottom of the well screen, the drillers removed the four-inch and six-inch drill strings, leaving the inside of the eight-inch drill string open for construction of the well. The drillers added potable water to the drill string as the internal rods were removed to maintain a high water level within the drill string. The higher water level within the drill rods minimized the potential for flowing sands to "flood" the interior of the eight-inch drill string. After the driller removed the internal drill rods, the depth of the remaining open borehole was measured and sand was added, as necessary, to create a hole of the correct depth for the construction of the well.

Each of the wells consists of four-inch diameter, schedule 40, polyvinyl chloride (PVC) well casing and 0.010 slot well screen (10-ft length). Drillers attached a two-ft sump at the base of the well screen in each well and fitted a well centralizer on the sump. Ten-ft lengths of casing were added to the well assembly as it was lowered into place. Once the complete well-screen-and-casing-assembly was in place, the drillers suspended the well in the center of the eight-inch drill string. The centralizer at the base of the well and the suspension point at the top of the well string kept the well straight and centered.

Drillers placed the well sand pack at depth through a one-inch, PVC, tremie pipe by suspending the sand in a stream of potable water. Periodically, as several feet of the sand pack accreted around the well screen, the drillers settled the sand by vibrating the eight-inch drill string in place and then raised the drill string to the top of the sand. The drillers continued adding to the sand pack until the sand pack extended a minimum of two ft above the top of the well screen. Using a two-inch, PVC, tremie pipe, the drillers constructed a seal of bentonite pellets with a minimum two-ft thickness. After the bentonite pellets hydrated overnight (minimum of 15 hours), the drillers sealed the upper part of the borehole with a 30% solids bentonite grout, that was tremied into place and periodically was replenished, as the eight-inch drill string was withdrawn.

During the original attempt to construct MW414, the drillers lost a metal tape weight at the top of the well sand pack. Despite repeated attempts, the metal weight could not be retrieved. To ensure the integrity of the finished well, the drillers pulled the well string from the first MW414 borehole and grouted the borehole shut. The SI drilled a second MW414 borehole, five ft away, and "rebuilt" the MW414 well. (The drillers cleaned the well casing and screen before rebuilding MW414.)

The SI field crew developed the wells by overpumping and surging them using a Grundfos submersible pump. Effluent was contained in 1,000-gal mobile tanks. The field crew routed a side-stream of the effluent through a flow cell equipped with instrumentation to monitor the following water quality parameters: turbidity, temperature, pH, and conductivity. Development continued until the water turbidity was minimal and the water quality parameters stabilized. Appendix E includes summaries of the logs from well development.

A.12 HEALTH AND SAFETY

Sampling to protect the health and safety of the workers is an important part of any project. During drilling and sampling operations, a photoionization detector, or PID, was used to determine if VOCs were present at hazardous levels in the workers' breathing zone. Personal samplers were also used to establish baseline values early in the project. Monitoring for radioactive constituents occurred because the expected levels of ^{99}Tc at some locations were above maximum contaminant levels (MCLs), and a radiation work permit was required. Additional details and requirements for health and safety sampling were found in *Environmental, Safety, and Health Plan for the Southwest Plume Site Investigation at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, BJC/PAD-591/R1 (2004), and its addendum.

A.13 FIELDWORK DOCUMENTATION

All fieldwork and sampling at PGDP was conducted in accordance with approved medium-specific work instructions or procedures consistent with the *U.S. Environmental Protection Agency (EPA), Region IV, Standard Operating Procedures* revised last in 1996. Field documentation was maintained throughout the Southwest Plume SI in various types of documents and formats, including the field logbooks, sample labels, sample tags, chain-of-custody forms, and field data sheets. General guidelines for maintaining field documentation were contained in the *Data Management Implementation Plan for the Southwest Plume Site Investigation at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, BJC/PAD-589/R1 (2004) and its addendum. All entries were written clearly and legibly using indelible ink.

- Corrections were made by striking through the error with a single line that does not obliterate the original entry. Corrections were dated and initialed.

- Dates and times were recorded using the format "mm/dd/yy" for the date and the military (i.e., 24-hr) clock to record the time.

- Zeroes were recorded with a slash (/) to distinguish them from letter Os.

- Blank lines were prohibited. Information was recorded on each line or the line was lined out, initialed, and dated.

- No documents were allowed to be altered, destroyed, or discarded even if they were illegible or contained inaccuracies that required correction.

- All information blocks on field data forms were completed or a line was drawn through the unused section, and the area was dated and initialed.

- Unused logbook pages were marked with a diagonal line drawn from corner to corner and a signature and date was placed on the line.

- Security of all logbooks was maintained by storing them in a secured (e.g., locked) area when not in use.

- Photocopies of all logbooks, field data sheets, and chain-of-custody forms were made weekly and sent to the project file.

Field team personnel used bound field logbooks with sequentially numbered pages for the maintenance of field records and for documenting any information pertinent to field activities. Field forms were numbered sequentially or otherwise controlled. A designated field team member recorded sampling activities and information from site exploration and observation in the field logbook. Field documentation conformed to approved procedures for use of field logbooks. An integral component of Quality Assurance/Quality Control for the field activities was the maintenance of accurate and complete field records and the collection of appropriate field data forms. The primary purpose of the logbook was to document each day's field activities; the personnel on each sampling team; and any administrative occurrences, conditions, or activities that may have affected the fieldwork or data quality of any environmental samples for any given day. The level of detailed information recorded in the field logbook was such that an accurate reconstruction of the field events could be created from the logbook. The project name, logbook number, client, contract number, task number, document control number, activity or site name, and the start and completion dates were listed on each logbook’s front cover.

Chain-of-custody procedures documented sample possession from the time of collection, through all transfers of custody, to receipt at the laboratory and subsequent analysis. Chain-of-custody records accompanied each packaged lot of samples; the laboratory did not analyze samples that were not accompanied by a correctly prepared chain-of-custody record. A sample was considered under custody if it was (1) in the possession of the sampling team, (2) in view of the sampling team, or (3) transferred to a secured (i.e., locked) location.

THIS PAGE INTENTIONALLY LEFT BLANK.

APPENDIX B (CD)

ANALYTICAL DATA, QA/QC RESULTS, AND CHAIN-OF-CUSTODY RECORDS

AND

APPENDIX C (CD)

STORM SEWER SURVEY

THIS PAGE INTENTIONALLY LEFT BLANK.

APPENDIX B (CD)
ANALYTICAL DATA, QA/QC RESULTS,
AND CHAIN-OF-CUSTODY RECORDS

AND

APPENDIX C (CD)
STORM SEWER SURVEY

THIS PAGE INTENTIONALLY LEFT BLANK.

OUTFALL 008 STORM SEWER VIDEO SURVEY

Process wastes that were generated in the C-400 Cleaning Building may have contaminated the backfill material of the Outfall 008 storm sewer, that in turn could continue to serve as a source of contamination to the Southwest Plume. This SI included a video survey of the Outfall 008 storm sewer downflow (west) from the southeast corner of the C-400 block to evaluate the integrity of the storm sewer piping.

The subtask contractor for the video survey of the Outfall 008 storm sewer documented the survey as a VHS cassette video recording and as Site Data Sheets that summarize pertinent observations between survey waypoints, defined by manhole access points. This Appendix C includes a DVD recording of the video survey and the Site Data Sheets.

The first leg of the Outfall 008 storm sewer video survey entered the storm sewer from a manhole access at PGDP west coordinate 5530 and proceeded east toward the southeast corner of the C-400 block (identified by a manhole at PGDP west coordinate 4035). However, the first leg of the survey ended slightly short of its target when the remotely operated camera turned over while crossing debris within the sewer approximately at PGDP west coordinate 4064. This leg of the survey is identified on the Site Data Sheets as Site IDs 1 through 6.

A second leg of the Outfall 008 storm sewer video survey traveled west from the manhole access at PGDP west coordinate 5530 to approximately 300 ft east of the end of the Outfall 008 storm sewer (for a total video survey of 3,000 ft). Site Data Sheets with Site IDs 7 through 11 document this leg of the survey.

The Site Data Sheet for Site ID 12 details a final leg of the video survey, an east-to-west survey from the southeast corner of the C-400 block (manhole at PGDP west coordinate 4035) meant to address the east-most storm sewer not reached by the first leg of the video survey.

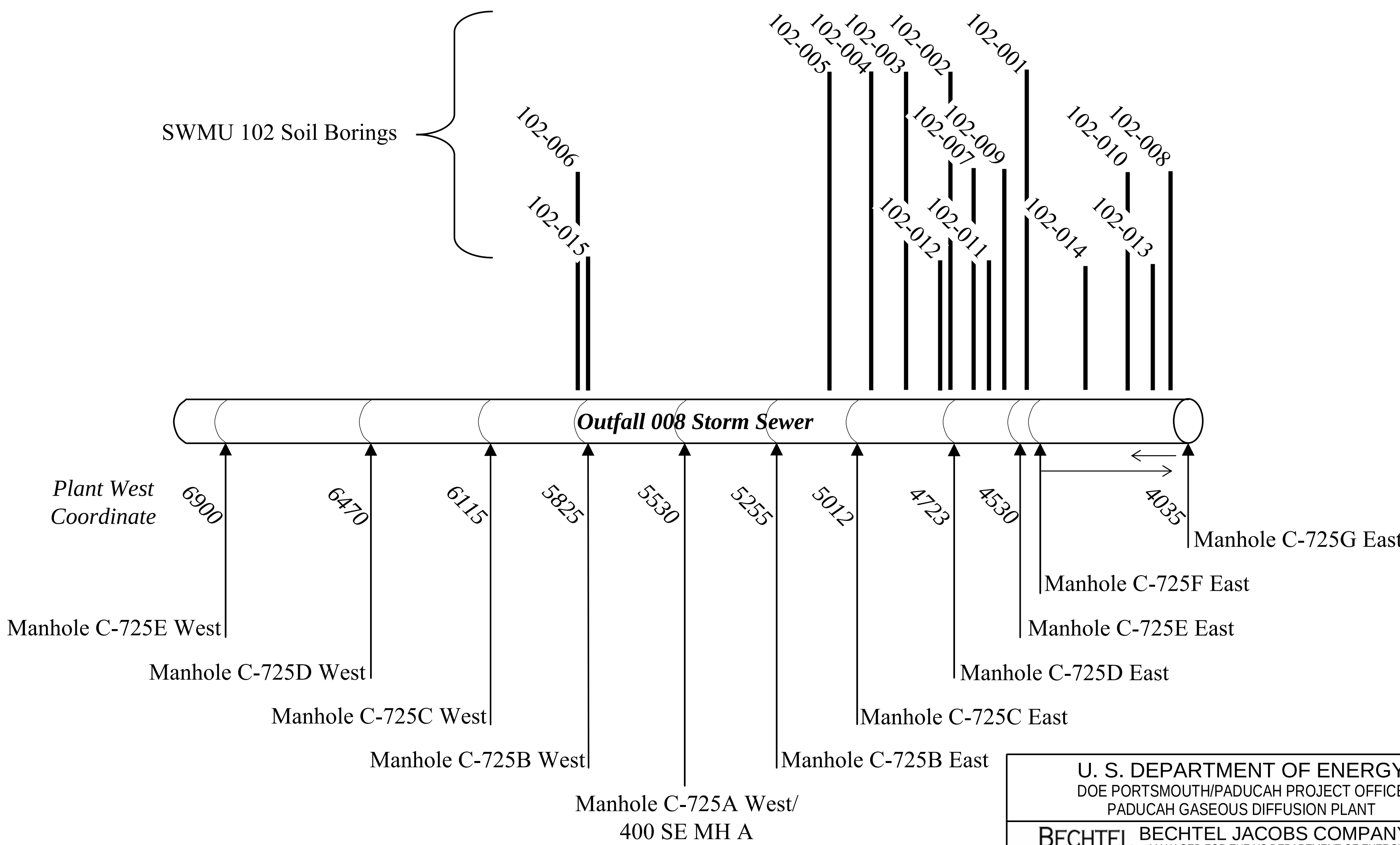
Table C.1 summarizes the Site ID references to the video survey, rearranged to proceed in an east to west survey. Figure C.1 illustrates the location of soil sample borings that were placed adjacent to the Outfall 008 storm sewer relative to the storm sewer video survey.

THIS PAGE INTENTIONALLY LEFT BLANK.

Table C.1. Summary of video survey by Site ID references

Plant West Coordinate (ft)		Manhole		Site ID	Notes
East End of Leg	West End of Leg	East	West		
4035	4181	C-725G East		12	Southeast corner of C-400 Block
4064	4470		C-725F East	6	Camera turned.
4470	4530	C-725F East	C-725E East	5	
4530	4723	C-725E	C-725D	4	
4723	5012	C-725D East	C-725C	3	
5012	5255	C-725C East	C-725B	2	
5255	5530	C-725 East	400 SE MH A	1	
5530	5825	C-725A West	C-725B West	7	
5825	6115	C-725B West	C-725C West	8	
6115	6470	C-725C West	C-725D West	9	
6470	6900	C-725D West	C-725E West	10	
6900	7021	C-725E West		11	Stop at 3,000 ft.

THIS PAGE INTENTIONALLY LEFT BLANK.



U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-03OR22980
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications
International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. C.1. SWMU 102 utility survey and soil borings.

THIS PAGE INTENTIONALLY LEFT BLANK.

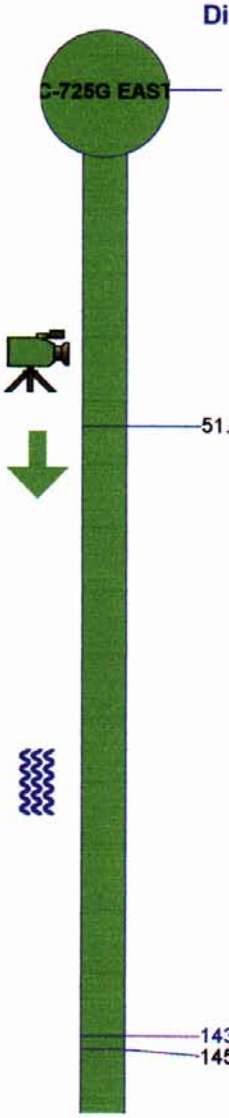
G.R.L. CONSTRUCTION
9597 WAGON WHEEL ROAD
PEVELY MO 63070
636-479-4898
636-262-5396

Site Data

Project Name	Site ID	City	Street	Starting Dist.
Usec	12	USEC	TENN STREET	7.0

Date	Time	M.H. Start	M.H. Stop	M.H. Depth	Pipe Size(in)
05/11/2004	10:20:20 AM	C-725G EAST	C-725F	0.0	36

Type of Pipe	Direction	Surface Condition	Final Dist(ft)
Concrete	Away-DS	Concrete	+3.4



Distance	Category	Category Details	Pict 1	Pict 2	Video	Comments
	Other	CAMARA UNDER W				CAMARA UNDER WATER
51.0	Pipe Problem	HEAVY DEBRI				
143.7	Service Conn.	Break in Conn.				END OF RUN FOR 3000 FEET
145.7						

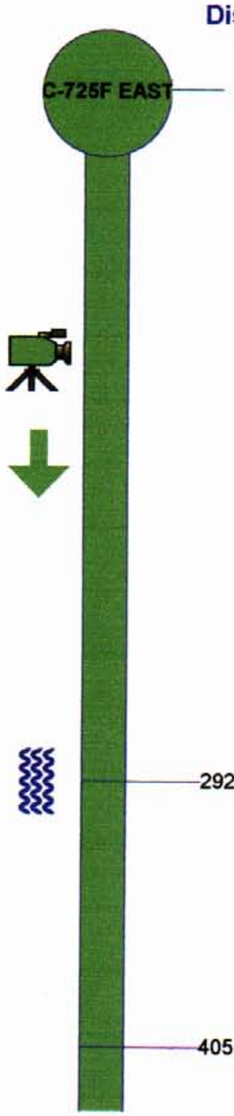
G.R.L. CONSTRUCTION
9597 WAGON WHEEL ROAD
PEVELY MO 63070
636-479-4898
636-262-5396

Site Data

Project Name	Site ID	City	Street	Starting Dist.
USEC	6	USEC	TENN STREET	0.0

Date	Time	M.H. Start	M.H. Stop	M.H. Depth	Pipe Size(in)
05/10/2004	03:54:51 PM	C-725F EAST	C-725G	0.0	36

Type of Pipe	Direction	Surface Condition	Final Dist(ft)
Concrete	Away-US	Concrete	



Distance	Category	Category Details	Pict 1	Pict 2	Video	Comments
292.5	Service Conn.	Connection				HEAVY DEBRI
405.5	Other	CAMARA TURNED				HEAVY DEBRI

G.R.L. CONSTRUCTION
9597 WAGON WHEEL ROAD
PEVELY MO 63070
636-479-4898
636-262-5396

Site Data

Project Name		Site ID	City	Street	Starting Dist.
USEC		5	USEC	TENN STREET	0.0
Date	**Time**	**M.H. Start**	**M.H. Stop**	**M.H. Depth**	**Pipe Size(in)**
05/10/2004	03:42:16 PM	C-725E EAST	C-725 F EAST	0.0	48
Type of Pipe		**Direction**	**Surface Condition**		**Final Dist(ft)**
Concrete		Away-US	Concrete		+59.8

Distance	Category	Category Details	Pict 1	Pict 2	Video	Comments
52.0	Joint Problem	Infiltration				

G.R.L. CONSTRUCTION
9597 WAGON WHEEL ROAD
PEVELY MO 63070
636-479-4898
636-262-5396

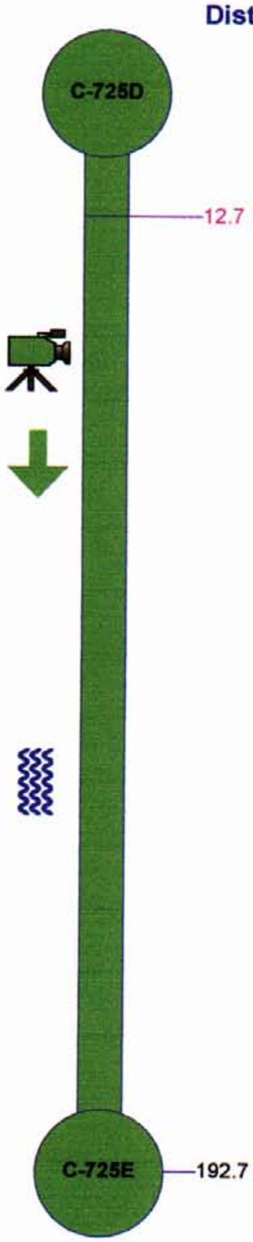
Site Data

Project Name	Site ID	City	Street	Starting Dist.
USEC	4	USEC	TENN STREET	0.0

Date	Time	M.H. Start	M.H. Stop	M.H. Depth	Pipe Size(in)
05/10/2004	03:20:23 PM	C-725D	C-725E	0.0	48

Type of Pipe	Direction	Surface Condition	Final Dist(ft)
Concrete	Away-US	Concrete	+192.7

Distance	Category	Category Details	Pict 1	Pict 2	Video	Comments
12.7	Pipe Problem	HEAVY DEBRI				



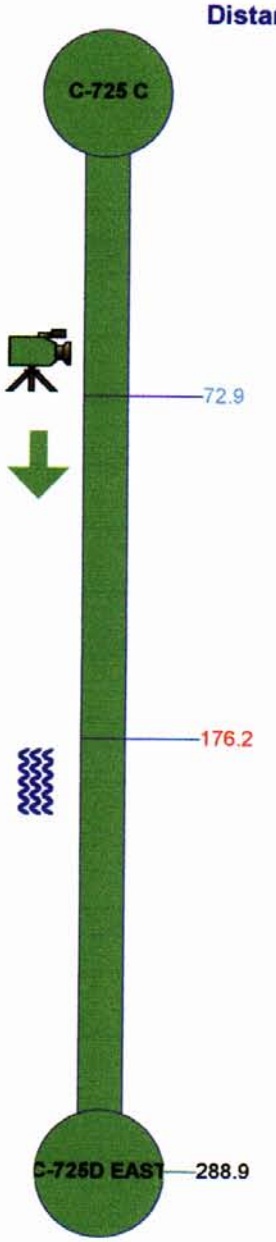
G.R.L. CONSTRUCTION
9597 WAGON WHEEL ROAD
PEVELY MO 63070
636-479-4898
636-262-5396

Site Data

Project Name	Site ID	City	Street	Starting Dist.
USEC	3	USEC	TENN STREET	0.0

Date	Time	M.H. Start	M.H. Stop	M.H. Depth	Pipe Size(in)
05/10/2004	03:08:15 PM	C-725 C	C-725D EAST	0.0	54

Type of Pipe	Direction	Surface Condition	Final Dist(ft)
Concrete	Away-US	Concrete	+288.9

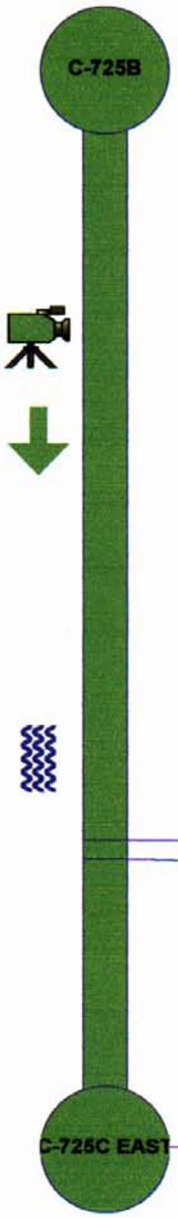


Distance	Category	Category Details	Pict 1	Pict 2	Video	Comments
72.9	Pipe Problem	Longit Crack				
176.2	Joint Problem	Infiltration				
288.9						

G.R.L. CONSTRUCTION
9597 WAGON WHEEL ROAD
PEVELY MO 63070
636-479-4898
636-262-5396

Site Data

Project Name		Site ID	City	Street	Starting Dist.
USEC		2	USEC	TENN STREET	0.0
Date	**Time**	**M.H. Start**	**M.H. Stop**	**M.H. Depth**	**Pipe Size(in)**
05/10/2004	02:59:58 PM	C-725B	C-725C EAST	0.0	72
Type of Pipe		**Direction**	**Surface Condition**		**Final Dist(ft)**
Concrete		Away-US	Concrete		+248.2



Distance	Category	Category Details	Pict 1	Pict 2	Video	Comments
183.7	Service Conn.	Break in Conn.				TOP LEFT SIDE
188.6	Joint Problem	Infiltration				
248.2						

G.R.L. CONSTRUCTION
9597 WAGON WHEEL ROAD
PEVELY MO 63070
636-479-4898
636-262-5396

Site Data

Project Name	Site ID	City	Street	Starting Dist.
USEC	1	USEC	TENN STREET	7.0

Date	Time	M.H. Start	M.H. Stop	M.H. Depth	Pipe Size(in)
05/10/2004	01:34:57 PM	C725 EAST	400 SE MH A	14.6	72

Type of Pipe	Direction	Surface Condition	Final Dist(ft)
Concrete	Away-US	Concrete	+265.8

C725 EAST

Distance	Category	Category Details	Pict 1	Pict 2	Video	Comments
9.3	Joint Problem	Infiltration				
9.3	Joint Problem	Infiltration				
16.5	Joint Problem	Mineral Deposi				
21.7	Joint Problem	Infiltration				
21.7	Joint Problem	Mineral Deposi				
25.5	Joint Problem	Infiltration				
25.5	Joint Problem	Mineral Deposi				
32.1	Pipe Problem	Hole LIFT				
41.3	Joint Problem	Infiltration				
71.4	Joint Problem	Infiltration				
123.9	Joint Problem	Infiltration				
157.0	Joint Problem	Infiltration				
187.8	Joint Problem	Infiltration				

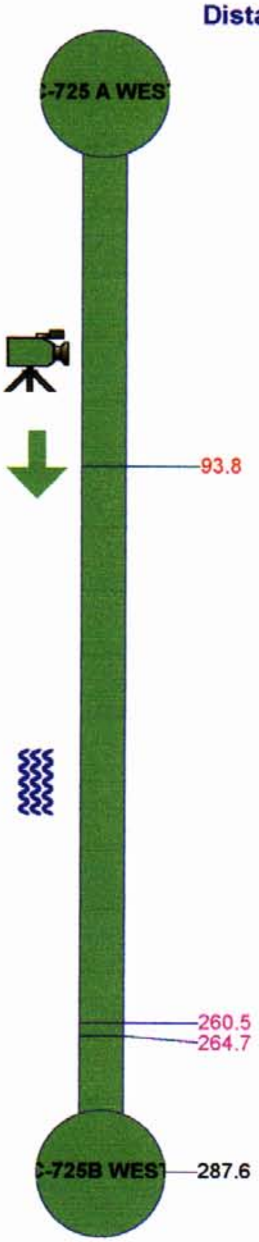
400 SE MH A — 265.8

G.R.L. CONSTRUCTION
9597 WAGON WHEEL ROAD
PEVELY MO 63070
636-479-4898
636-262-5396

Site Data

Project Name		Site ID	City	Street	Starting Dist.
Usec		7	USEC	TENN STREET	7.0
Date	**Time**	**M.H. Start**	**M.H. Stop**	**M.H. Depth**	**Pipe Size(in)**
05/11/2004	08:38:37 AM	C-725 A WEST	C-725B WEST	14.6	72
Type of Pipe		**Direction**	**Surface Condition**		**Final Dist(ft)**
Concrete		Away-US	Concrete		+287.6

Distance	Category	Category Details	Pict 1	Pict 2	Video	Comments
93.8	Pipe Problem	Hole				
260.5	Joint Problem	Infiltration				
264.7	Joint Problem	Infiltration				



G.R.L. CONSTRUCTION
9597 WAGON WHEEL ROAD
PEVELY MO 63070
636-479-4898
636-262-5396

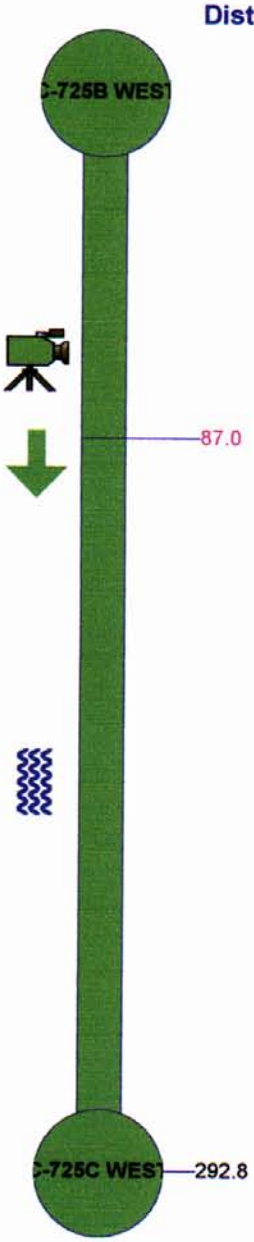
Site Data

Project Name	Site ID	City	Street	Starting Dist.
Usec	8	USEC	TENN STREET	0.0

Date	Time	M.H. Start	M.H. Stop	M.H. Depth	Pipe Size(in)
05/11/2004	09:44:04 AM	C-725B WEST	C-725C WEST	0.0	72

Type of Pipe	Direction	Surface Condition	Final Dist(ft)
Concrete	Away-US	Concrete	+292.8

Distance	Category	Category Details	Pict 1	Pict 2	Video	Comments
87.0	Service Conn.	Break in Conn.				LEFT SIDE / INSIDE ABOUT 1.5 FEET



G.R.L. CONSTRUCTION
9597 WAGON WHEEL ROAD
PEVELY MO 63070
636-479-4898
636-262-5396

Site Data

Project Name	Site ID	City	Street	Starting Dist.
Usec	9	USEC	TENN STREET	0.0

Date	Time	M.H. Start	M.H. Stop	M.H. Depth	Pipe Size(in)
05/11/2004	09:51:41 AM	C-725C WEST	C-725D WEST	0.0	72

Type of Pipe	Direction	Surface Condition	Final Dist(ft)
Concrete	Away-US	Concrete	+357.1

Distance	Category	Category Details	Pict 1	Pict 2	Video	Comments
56.6	Pipe Problem	Hole LIFT				
92.0	Pipe Problem	Hole LIFT				
357.1						

G.R.L. CONSTRUCTION
9597 WAGON WHEEL ROAD
PEVELY MO 63070
636-479-4898
636-262-5396

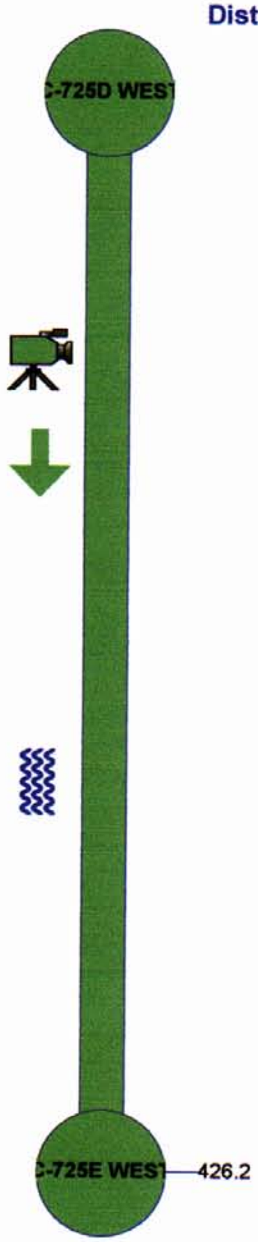
Site Data

Project Name	Site ID	City	Street	Starting Dist.
Usec	10	USEC	TENN STREET	0.0

Date	Time	M.H. Start	M.H. Stop	M.H. Depth	Pipe Size(in)
05/11/2004	10:01:12 AM	C-725D WEST	C-725E WEST	0.0	72

Type of Pipe	Direction	Surface Condition	Final Dist(ft)
Concrete	Away-US	Concrete	+426.2

Distance	Category	Category Details	Pict 1	Pict 2	Video	Comments



G.R.L. CONSTRUCTION
9597 WAGON WHEEL ROAD
PEVELY MO 63070
636-479-4898
636-262-5396

Site Data

Project Name	Site ID	City	Street	Starting Dist.
Usec	11	USEC	TENN STREET	0.0

Date	Time	M.H. Start	M.H. Stop	M.H. Depth	Pipe Size(in)
05/11/2004	10:13:14 AM	C-725E WEST	C-725F WEST	0.0	72

Type of Pipe	Direction	Surface Condition	Final Dist(ft)
Concrete	Away-US	Concrete	

Distance	Category	Category Details	Pict 1	Pict 2	Video	Comments
121.1						TVED ONLY 3000 FEET STOP HERE

APPENDIX D

MIP REPORT

THIS PAGE INTENTIONALLY LEFT BLANK.

P•E•S
Environmental Consulting & Mobile Laboratory Services

Plains Environmental Services
P.O. Box 6288 • Salina, KS 67401-0288 • (785) 827-4545
Fax (785) 827-4582 • www.plainsenv.com

Laboratory Report

Client: Miller Drilling Co., Inc
107 Helton Drive
Lawrenceburg, TN 38464
Attn: Mark Miller

Date: April 29, 2004
Project Location: Paducah, KY

Sample R. L.	Date Analyzed	Depth (feet)	VC 5 ng	1,1-DCE 2 ng	t-DCE 2 ng	c-DCE 2 ng	TCA 1 ng	TCE 2 ng	PCE 1 ng
001-201-MIP	4/29/2004	0-15	ND	ND	ND	ND	ND	ND	ND
001-201-MIP	4/29/2004	15-30	ND	ND	ND	ND	ND	ND	ND
001-201-MIP	4/29/2004	30-45	ND	ND	ND	ND	ND	ND	ND
001-201-MIP	4/29/2004	45-60	56	ND	ND	8	ND	150	ND
001-202-MIP	5/5/2004	0-15	ND	ND	ND	ND	ND	ND	ND
001-202-MIP	5/5/2004	15-30	11	11	ND	19	ND	28	ND
001-202-MIP	5/5/2004	30-45	ND	64	ND	260	ND	460	ND
001-202-MIP	5/5/2004	45-60	ND	100	ND	280	ND	670	1
001-203-MIP	5/3/2004	0-15	ND	8	45	14	ND	110	ND
001-203-MIP	5/3/2004	15-30	72	20	ND	20	ND	55	ND
001-203-MIP	5/3/2004	30-45	82	12	4	2	ND	11	ND
001-203-MIP	5/3/2004	45-60	ND	4	ND	2	ND	ND	ND
001-204-MIP	5/5/2004	0-15	ND	5	ND	3	ND	33	6
001-204-MIP	5/5/2004	15-30	ND	ND	ND	3	ND	7	ND
001-204-MIP	5/5/2004	30-45	ND	ND	ND	28	ND	75	ND
001-204-MIP	5/5/2004	45-60	ND	ND	ND	ND	ND	ND	ND
001-205-MIP	5/4/2004	0-15	ND	10	ND	24	ND	75	6
001-205-MIP	5/4/2004	15-30	130	ND	ND	100	14	97	ND
001-205-MIP	5/4/2004	30-45	35	ND	2	460	ND	530	ND
001-205-MIP	5/4/2004	45-60	ND	ND	ND	15	ND	150	1
102-001-MIP	5/17/2004	0-20	8	17	ND	11	ND	13	ND
102-002-MIP	5/17/2004	0-20	ND	13	ND	ND	ND	ND	ND
102-003-MIP	5/17/2004	0-20	ND	19	ND	ND	ND	ND	ND
102-004-MIP	5/17/2004	0-20	ND	15	ND	4	ND	12	ND
102-005-MIP	5/14/2004	0-20	ND	3	ND	2	ND	3	ND
102-006-MIP	5/20/2004	0-20	ND	ND	ND	ND	ND	ND	ND
102-007-MIP	5/18/2004	0-20	ND	9	ND	ND	ND	ND	ND
102-008-MIP	5/20/2004	0-21	ND	13	ND	32	ND	1700	28
102-009-MIP	5/20/2004	0-20	ND	ND	ND	ND	ND	ND	ND
102-010-MIP	5/19/2004	0-20	ND	ND	ND	ND	ND	2	ND
102-011-MIP	5/19/2004	0-20	ND	5	ND	ND	ND	ND	ND
102-012-MIP	5/20/2004	0-20	ND	2	ND	ND	ND	ND	ND
102-013-MIP	5/19/2004	0-20	ND	36	ND	27	ND	170	ND
102-014-MIP	5/19/2004	0-20	ND	23	ND	ND	ND	5	6
102-015-MIP	5/18/2004	0-20	ND	10	ND	ND	2	ND	3
720-101-MIP	5/12/2004	0-15	ND	5	ND	9	ND	15	3
720-101-MIP	5/12/2004	15-30	ND	40	ND	2	ND	10	ND
720-101-MIP	5/12/2004	30-45	2600	790	2	4	ND	70	4
720-101-MIP	5/12/2004	45-52	20	270	2	2	ND	52	14
720-102-MIP	5/6/2004	0-15	ND	19	ND	40	ND	96	6
720-102-MIP	5/6/2004	15-30	7	20	ND	12	ND	24	7
720-102-MIP	5/6/2004	30-45	ND	28	ND	7	ND	13	ND

Laboratory Report

720-102-MIP	5/6/2004	45-60	ND	130	19	24	ND	72	4
720-103-MIP	5/7/2004	0-15	ND	22	4	17	ND	55	ND
720-103-MIP	5/7/2004	15-30	ND	9	ND	3	ND	9	ND
720-103-MIP	5/7/2004	30-45	200	150	2	17	ND	60	ND
720-103-MIP	5/7/2004	45-60	ND	9	50	21	72	250	12
720-104-MIP	5/11/2004	0-15	8	8	ND	ND	ND	26	ND
720-104-MIP	5/11/2004	15-30	ND	22	ND	5	ND	91	2
720-104-MIP	5/11/2004	30-45	16	18	ND	4	ND	76	ND
720-104-MIP	5/11/2004	45-60	ND	ND	ND	ND	ND	32	ND
720-105-MIP	5/10/2004	0-15	ND	4	ND	ND	ND	ND	ND
720-105-MIP	5/10/2004	15-30	ND	26	ND	38	ND	2	2
720-105-MIP	5/10/2004	30-45	400	28	ND	2	ND	520	8
720-105-MIP	5/10/2004	45--60	450	230	2	42	ND	750	11
720-106-MIP	5/12/2004	0-15	ND	18	ND	ND	ND	21	ND
720-106-MIP	5/12/2004	15-30	120	150	3	3	ND	74	ND
720-106-MIP	5/12/2004	30-45	6	20	ND	3	ND	100	ND
720-106-MIP	5/12/2004	45-60	6	ND	ND	2	ND	71	ND
720-107-MIP	5/13/2004	0-15	ND	4	ND	ND	ND	4	ND
720-107-MIP	5/13/2004	15-30	32	29	ND	ND	ND	200	6
720-107-MIP	5/13/2004	30-45	7	ND	ND	ND	ND	57	3
720-107-MIP	5/13/2004	45-60	ND	3	ND	4	ND	55	ND
720-108-MIP	5/13/2004	0-15	ND	3	ND	ND	ND	9	ND
720-108-MIP	5/13/2004	15-30	8	22	ND	ND	ND	22	ND
720-108-MIP	5/13/2004	30-45	ND	4	ND	ND	ND	30	ND
720-108-MIP	5/13/2004	45-60	ND	10	ND	2	ND	18	ND

Abbreviations:

VC= vinyl chloride
c-DCE = cis-1,2-dichloroethene
TCE = trichloroethene
PCE = tetrachloroethene
REC = recovery
1,1-DCE = 1,1-dichloroethene
TCA = 1,1,1-trichloroethane
t-DCE = trans-1,2-dichloroethene
SURR = surrogate
R.L. = Reporting Limit

All samples represent air samples air samples from the MIP flow that were trapped on Vocarb 3000 traps. The traps were then desorbed on a Tekmar 2000 LSC purge and trap system and analyzed on a Shimadzu GC using *in situ* PID and ECD detectors. All results are reported in nanograms desorbed form the trap in the given interval and time.

All analyses were performed on-site by Plains Environmental Services using GC/PID/ECD.

Plains Environmental Services

Lynn R Newcomer

Lynn R Newcomer
President

Plains Environmental Services Analysis Log Sheet

Client: Miller Drilling
Date: 4/25/04
Location: PGDP Paducah, KY

Sampler: Blake Couch
Analyst: Dan DeGraw
Project Number

Sample ID	Time	Depth	PES ID	Matrix	Comments
Calibration Check (continuing)	12:55pm	-	CC1	liquid	20ng of chloro compounds
001-201-MIP	2:07pm	0-15ft	PDGP1	MIP Trip	Trap #3
method Blank (trunkline)	1:45pm	-	Blank 1	Trunkline	Trap #2
001-201-MIP	2:26pm	15-30ft	PDGP2	MIP	Trap #1
001-201-MIP	2:55pm	30-45ft	PDGP3	MIP	Trap #2 Hit start button 1.25min for secs RT Times off
001-201-MIP	3:16pm	45-60ft	PDGP4	MIP	Trap #3
Continuing cc/ check	3:46pm	—	CC2	liquid	20ng

Plains Environmental Services Analysis Log Sheet

Client: Miller Drilling
Date: 4/29/04
Location: Paducah, KY   DOE Gas exchanger

Sampler: Miller Drilling
Analyst: Darch DeGruson
Project Number

Sample ID	Time	Depth	PES ID	Matrix	Comments
Sanity Test	11:00 AM	–	Test 1	100 µg/L TCE	Baseline = 85,000 TT= delta =186,000
001-201-MIP	1:33pm	59.54	MIP1	MIP	Baseline = 80,000 =4723

Plains Environmental Services Analysis Log Sheet

Client: Miller Drilling
Date: May 3, 2004
Location: PDGP Paducah, KY

Sampler: Blake Couch (Miller Drilling)
Analyst: Darin DeGruson
Project Number

Sample ID	Time	Depth	PES ID	Matrix	Comments
MIP Sanity Test	2:30pm	–	Test1	TCE 100ng/L	Baseline ECD = 23,000 PID = 28,400 TT = 83 ECD = 175,000
Calibration pt #1	2:00pm	–	Cal1	Liquid	20ng
Calibration pt #2	2:20pm	–	Cal2	liquid	50ng
Calibration pt #3	2:35pm	–	Cal3	liquid	100ng
Mip Point 001-203-MIP	2:49pm	60.04	MIP2	MIP	Baseline = ECD = 22000 PID = 10500
Method (Transfer line) Blank	2:50pm	–	Blank	GAS	Trap #3
001-203-MIP	3:16pm	0-15	PGDP5	GAS	Trap #1 Trap had (forgot to bake) residual contamination
001-203-MIP	3:34pm	15-30	PGDP6	GAS	Trap #2
001-203-MIP	3:55pm	30-45	PGDP7	GAS	Trap #3
001-203-MIP	4:20pm	45-60	PGDP8	GAS	Trap #1

Plains Environmental Services Analysis Log Sheet

Client: Miller Drilling
Date: 5/4/04
Location: PGDP Paducah, KY

Sampler: Miller Drilling
Analyst: Derik DeGraw
Project Number

Sample ID	Time	Depth	PES ID	Matrix	Comments
MIP Sensitivity Test	9:30 Am	-	Test	100µg/L/TCE	ECD = 31000 deflection PID = 25,000 TT = 85 sec
Calibration Check	9:35 Am	-	cc 3	liquid	50ng Trap #1
Trunkline Blank	9:40 Am	-	Blank 3	Gas	Isolate line purge Trap #2
MIPPoint 001-205-MIP	12:35 pm	59.93	MIP3	MFP	Baseline = ECD = 50,000 PID = 4000
001-205-MIP	12:58 pm	0 - 15	PGDP9	GAS	Trap #1
001-205-MIP	1:21 pm ~~1:17 pm~~	15 - 30	PGDP10	GAS	Trap #3
001-205-MIP	1:42 pm	30 - 45	PGDP11	GAS	Trap #2
001-205-MIP	2:05 pm	45 - 60	PGDP12	GAS	Trap #1

Plains Environmental Services Analysis Log Sheet

Client: Miller Drilling
Date: 5/5/04
Location: PGDP Paducah, KY

Sampler: Miller Drilling
Analyst: David Debruson
Project Number

Sample ID	Time	Depth	PES ID	Matrix	Comments
Sanity Test	8:30 Am	—	Test	100ppb/L TCE	Baseline ECD: 70,000 PID = 8500 TT = 85sec def/ = 150,000
Trunk line Blank	9:05 Am	—	Blank 4	GAS	Trap #2
MIP Point 001-204-MIP	9:12 Am	60.08	MIP 4	MIP	Baseline = ECD: PID:
001-204-MIP	9:32 Am	0 - 15	PGDP13	GAS ~~MIP~~	Trap #1
001-204-MIP	9:53 Am	15 - 30	PGDP14	GAS	Trap #3
001-204-MIP	10:13 Am	30 - 45	PGDP15	GAS	Trap #2
001-204-MIP	10:34 Am	45 - 60	PGDP16	GAS	Trap #1
Sanity Test	1:53 pm	—	Test	100ppb/L TCE	PID = 38000 TT = 83 ECD = 12000 def = 39000
MIP Point 001-202-MIP	2:20 pm	60.05	MIP 5	MIP	Baseline = ECD: 80,000 PID: 70,000
001-202-MIP	2:37 pm ~~11:37~~	0 - 15	PGDP17	GAS	Trap #2
001-202-MIP	3:02 pm	15 - 30	~~PGDP~~ PGDP18	GAS	Trap #3
001-202-MIP	3:23 pm	30 - 45	PGDP19	GAS	Trap #1
001-202-MIP	3:47 pm	45 - 60	PGDP20	GAS	Trap #2

Plains Environmental Services Analysis Log Sheet

Client: Miller Drilling
Date: 5/6/011
Location: PGDP Paducah, KY

Sampler: Miller Drilling
Analyst: Derik DeGrasen
Project Number

Sample ID	Time	Depth	PES ID	Matrix	Comments
Sanity Test	10:52Am	–	Test	100 ppb/L TCE	ECD: 13400 T= 85 PID: 100ppb def/c 40,000
720-102 MIP Point ~~720-001~~ -MIP	11:45 Am	32.17	MIP 6	MIP	Baseline E: 90,000 P= 26000
720-102 MIP MIP Point redo	5:23pm	60.19	MIP 6b	MIP	ECD= 42000 P.d = 19000
Trunk line Blank	11:53 Am	–	Blank 5	GAS	15min line purge Trap # 1
720 ~~720~~ - 102 - MIP	12:16 pm	0 - 15	PGDP21	GAS	Trap #2
720 - 102 - MIP	12:35pm	15 - 30	PGDP22	GAS	Trap #3
720 - 102 - MIP	1:03pm	30 - ~~45~~ 32	PGDP 23	GAS	Trap # 1
~~720 - 102 - MIP~~		~~45 - 60~~	~~PGDP24~~	~~GAS~~	~~Trap #2~~
720 - 102 - MIP	5:54pm	30 - 45	PGDP23b	GAS	Trap #3
720 - 102 - MIP	6:22pm	45 - 60	PGDP24	GAS	Trap #2

Plains Environmental Services Analysis Log Sheet

Client: Miller Drilling
Date: 5/7/04
Location: PGDP Paducah, KY

Sampler: Miller Drilling
Analyst: Dana DeGruson
Project Number

Sample ID	Time	Depth	PES ID	Matrix	Comments
Trunkline Blank	8:44	—	Blank 6	GAS	15 minute trunkline purge. Trap #2
Sanity Test	8:46	-	Test	100 µg/L TCE	ECD: [illegible] 77:88 PID=47000 def=120,000
MIP Point 720-103-MIP	9:00		MIP6	~~GAS~~ MIP	ECD=50,000 PID=24000
720-103-MIP	9:20	0-15	PGDP25	GAS	Trap #1
720-103-MIP	0942	15-30	PGDP26	GAS	Trap #3
720-103-MIP	1014	30-45	PGDP27	GAS	Trap #2
720-103-MIP	1044	45-61	PGDP28	GAS	Trap #1

Plains Environmental Services Analysis Log Sheet

Client: Miller Drilling
Date: 5/10/04
Location: PGDP Paducah, KY

Sampler:
Analyst:
Project Number

Sample ID	Time	Depth	PES ID	Matrix	Comments	
Sanity Test	1:30pm	–	MIP Test	100 µg/L TCE	100,000 TT = 86 380000 dESI = 95,000	
Trunk line Blank	2:00pm ~~1:50pm~~	–	Blank 7	GAS	15min purge Trap #1	
MIP Probe 720-105-MIP	1:50 pm	16.26	MIP8	MIP	Baseline: ECD = 100,000 PID = 300,000	Probe leak went out
720-105-MIP	2:21	0 - 15	PGDP29	GAS	Trap #2	
720-105-MIP	–	15 - 16	PGDP30	GAS	Trap #3 (did not run this trap)	
Restart 720-105-MIP	~~1510~~ 3:10pm		MIP 85	MIP	Baseline PID = 50000 ECD = 40000	
720-105-MIP	3:40 pm	15 - 30	PGDP30	GAS	~~Trap #2~~ Trap #2	
720-105-MIP	4:21 pm	30 - 45	PGDP31	GAS	Trap #1	Strong PCE/ now 35 ft.
720-105-MIP	4:52	45 -	PGDP32	GAS	Trap #3	

Plains Environmental Services Analysis Log Sheet

Client: Miller Drilling
Date: 5/11/04
Location: PGDP Paducah, KY

Sampler: Miller Drilling
Analyst: Darin Dobinson
Project Number

Sample ID	Time	Depth	PES ID	Matrix	Comments
Sanity Test	8:29 Am	–	Test	100µg/L TCE	P=35000 TT=?? E=80000 daf=110.00
Trunk line Blank	8:50 Am	–	Blank 8	GAS	15 min purge Trap #1
MIP Point 720-104-MIP	8:44 Am	60.00	MIP9	MIP	P=24000 E=15000
720-104-MIP	9:06 Am	0 - 15 ft	PGDP33	GAS	Trap #3
720-104-MIP	9:26 Am	15 - 30	PGDP34	GAS	Trap #2
720-104-MIP	9:50 AM	30 - 45	PGDP35	GAS	Trap #1
720-104-MIP	10:18 Am	45 - 60	PGDP36	GAS	Trap #3
MIP Point 720-101-MIP	2:05 pm	32.67	MIP10	MIP	P=25500 E=80000
720-101-MIP	2:28 pm	0 - 15	PGDP37	GAS	Trap #2
720-101-MIP	2:47 pm	15 - 30	PGDP38	GAS	Trap #1
720-101-MIP	—	30 - 33	PGDP39	GAS	Trap #4 didn't run 1st interv.
~~720-101-MIP~~	~~—~~	~~—~~	~~PGDP40~~	~~GAS~~	
			Hit refusal @	32.7 ft	so there is no 4th Sample @ 720-101-MIP

Plains Environmental Services Analysis Log Sheet

Client: Miller Drilling
Date: 5/12/04
Location: PGDP Paducah, KY

Sampler: Miller Drilling
Analyst: Darin DeGrasse
Project Number

Sample ID	Time	Depth	PES ID	Matrix	Comments
Transfer Line Blank	8:15 Am	–	Blank 9	GAS	15 min Purge Trap #2
MIP Point 720-101-MIP Rerun	0805 Am	52.75	MIP105	MIP	Baseline P=8000 E=5000
720-101-MIP	8:31 Am	0 - 15	PGDP 37b	GAS	Trap #4
720-101-MIP	8:46 Am	15 - 30	PGDP 38b	GAS	Trap #1
720-101-MIP	9:15 Am	30 - 45	PGDP39	GAS	Trap #2
720-101-MIP	9:33 Am	45 - 62.75	PGDP40	GAS	Trap #4
Transfer Line Blank	12:57 pm	–	Blank 10	GAS	15 min Purge Trap #2
720-106-MIP	1:38 pm	0 - 15	PGDP41	GAS	Trap #1
720-106-MIP	2:08 pm	13 - 30	PGDP42	GAS	Trap #2
720-106-MIP	2:32 pm	30 - 45	PGDP43	GAS	Trap #4
720-106-MIP	2:57 pm	45 - 60	PGDP44	GAS	Trap #1
MIP Point 720-106-MIP	13:10	59.86	MIP 11	MIP	Baseline: P=15000 E=10000

Plains Environmental Services Analysis Log Sheet

Client: Miller Drilling
Date: 5/13/04
Location: PGDP Paducah, KY

Sampler: Miller Drilling
Analyst: Darik DeGrasen
Project Number

Sample ID	Time	Depth	PES ID	Matrix	Comments
Trunk line Blank	0822 Am	—	Blank 11	GAS	15 min Purge on to Trap #1
Sanity Test	8:38 Am	—	Test	100 µg/L TCE	Base: P= 24000 TT= 86 E= 3500 def = 20 k
Calibration/RT check	08:35 Am	—	CC3	liquid (Aqueous)	(Trap # 1) 100 ng on Column
MIP Point 720-107-MIP	9:08 Am	60.01	MIP 12	MIP	Baseline: P= E=
720-107-MIP	~~9:08 Am~~ 9:23 Am	0 - 15	PGDP45	GAS	Trap # 2
720-107-MIP	9:54 Am	15 - 30	PGDP46	GAS	Trap # 1
720-107-MIP	10:39 Am	30 - 45	PGDP47	GAS	Trap # 4
720-107-MIP	11:05 Am	45 - 60	PGDP48	GAS	Trap # 2
Sanity Test	2:22 pm	—	Test	100 µg/L TCE	
					B: P= 20000 TT = 88 E= 3700 def = 90, and Another New Probe
MIP Point 720-108-MIP		60.21	MIP 13	MIP	P= 17000 E= 4000
720-108-MIP	2:47 pm	0 - 15	PGDP49	~~MIP~~ GAS	Trap # 1
720-108-MIP	3:06 pm	15 - 30	PGDP50	GAS	Trap # 4
720-108-MIP	3:24 pm	30 - 45	PGDP51	GAS	Trap # 2
720-108-MIP	3:40 pm	45 - 60	PGDP52	GAS	Trap # 1

Plains Environmental Services Analysis Log Sheet

Client: Miller drilling
Date: 5/14/04
Location: PGDP Paducah, KY

Sampler: Miller Drilling
Analyst: [signature]
Project Number

Sample ID	Time	Depth	PES ID	Matrix	Comments
Sanity Test	10:52 Am	—	Test	100 ug/L TCE	Base: D 20,700 T= 90 sec E= 115000 def = 75000
MIP Point 102-105-MIP	11:00 Am	20.18	MIP 14	MIP	Base: P= 15000 E= 40000
102-005-MIP	11:33 Am	0-20	PGDP53	GAS	Trap # 1
MIP Point 102-004-MIP	1:42 pm	~~0~~	MIP 15	MIP	Baseline: P= 15000 E= [illegible]
102-004-MIP		0 - X	PGDP54	GAS	Trap #1

did not finish due to Rain

Plains Environmental Services Analysis Log Sheet

Client: Miller Drilling
Date: 5/17/04
Location: PGDP Paducah, KY

Sampler: Miller Drilling
Analyst: Darin DeGruson
Project Number

Sample ID	Time	Depth	PES ID	Matrix	Comments
MIP Point 102-004-MIP	7:56 Am	20.21 ft	MIP15	MIP	Base = E=60000 P=19000
102-004-MIP	8:44Am	0-20ft	PGDP54	GAS	Trap #1
MIP Point 102-003-MIP	11:45pm	20.32	MIP16	MIP	Base: P=18000 E=37000
102-003-MIP	12:11pm	0-20	PGDP55	GAS	Trap #1
MIP Point 102-002-MIP	3:17pm	20.42	MIP17	MIP	Baseline P=16000 E=30000
102-002-MIP	3:43 pm	0-20 ft	PGDP56	GAS ~~MIP~~	Trap #1
MIP Point 102-001-MIP	5:10pm	20.21	MIP18	MIP	Base = P=16000 E=40000
102-001-MIP	5:38pm	0-20	PGDP57	GAS	Trap #1

Plains Environmental Services Analysis Log Sheet

Client: Miller Drilling
Date: 5/18/04
Location: PGDP Paducah, KY

Sampler: Miller Drilling
Analyst: Derek DeGrazm
Project Number

Sample ID	Time	Depth	PES ID	Matrix	Comments
Sanity Test	1:00 pm	-	Test	100ng TCE	Base: P=19000 TT=88 E=3000 dofl=80000
MIP point 102-015	1:08pm	20.19 ft	MIP19	MIP	Baseline: P=18000 E=30000
102-015-MIP	3:10 pm	0-20ft	PGDP58	GAS	Trap #1
MIP point 102-007	3:53pm	20.30	MIP20	~~GAS~~ MIP	Base P=79000 E=40000
102-007-MIP	4:20pm	0-20	PGDP59	GAS	Trap #4

Plains Environmental Services Analysis Log Sheet

Client: Miller Drilling
Date: 5/19/04
Location: PGDP Paducah, KY

Sampler: Miller Drilling
Analyst: Derik De Grason
Project Number

Sample ID	Time	Depth	PES ID	Matrix	Comments
Sanity Test	7:54 Am	—	Test	50 ng TCE	Base: P=18700 E=60000 TT=88 do f1 =
MIP Point 102-011	8:02Am	20.51	MIP21	MIP	Base: P= E=
102-011-MIP	1:27pm	0-20	PGDP60	GAS	Trap #1
MIP Point 102-14	11:01 Am	20.48	MIP22	MIP	Base: P=19000 E=60000
102-14-MIP	1:48pm	0-20	PGDP61	GAS	Trap #4
MIP Point 102-012	1:43 pm	20.23	MIP23	MIP	Base: P=20000 E=40000
102-012-MIP	3:20pm	0-20	PGDP62	GAS	Trap #1
MIP Point 102-013	3:31	20.36	MIP24	MIP	Base P=30000 E=50000
102-013-MIP	4:04pm	0-20ft	PGDP63	GAS	Trap #4

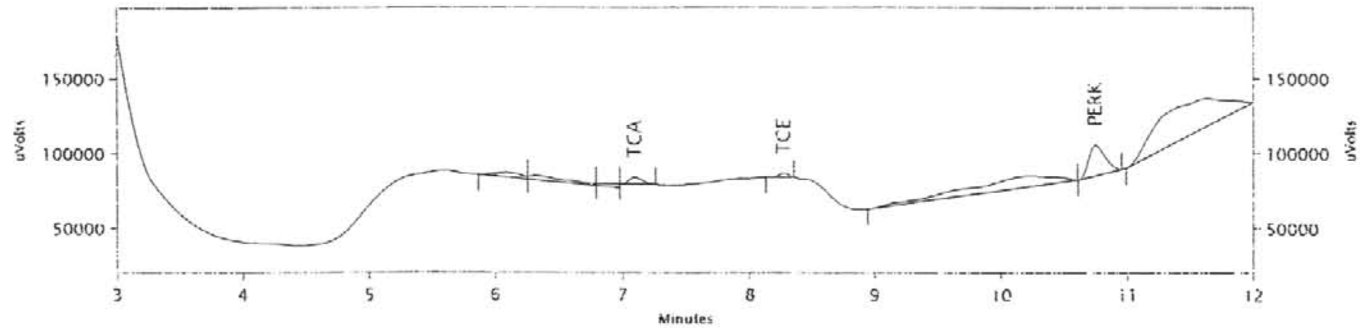
Plains Environmental Services Analysis Log Sheet

Client: Miller Drilling
Date: 5/20/04
Location: PGDP Paducah, KY

Sampler: Miller Drilling
Analyst: [illegible] DeGruson
Project Number

Sample ID	Time	Depth	PES ID	Matrix	Comments
Sanity Test	0830	—	Test	100 µg/L TCE	Base: P=16000 E=59000 TT=44 dell=90000
MIP Point 102-008	0852	21.25	MIP25	MIP	Base: P=12000 E=50000
102-008-MIP	~~15:08~~ 1:08pm	0-21	PGDP64	GAS	Trap #1
MIP Point 102-009-MIP	10:49Am	20.09	MIP26	MIP	Base: P=18000 E=150000
102-009-MIP	1:34pm	0-20	PGDP65	GAS ~~MIP~~	Trap #4
MIP Point 102-012-MIP	1:23pm	20.33	MIP 27	MIP	Base: P=17000 E=50000
102-012-MIP	3.02pm	0-20ft	PGDP 66	GAS	Trap #1
MIP Point 102-006-MIP	3:07pm	20.15	MIP28	MIP	Base: P=15000 E=40000
102-006-MIP	3:30pm	0-20 ft	PGDP67	GAS	Trap #4

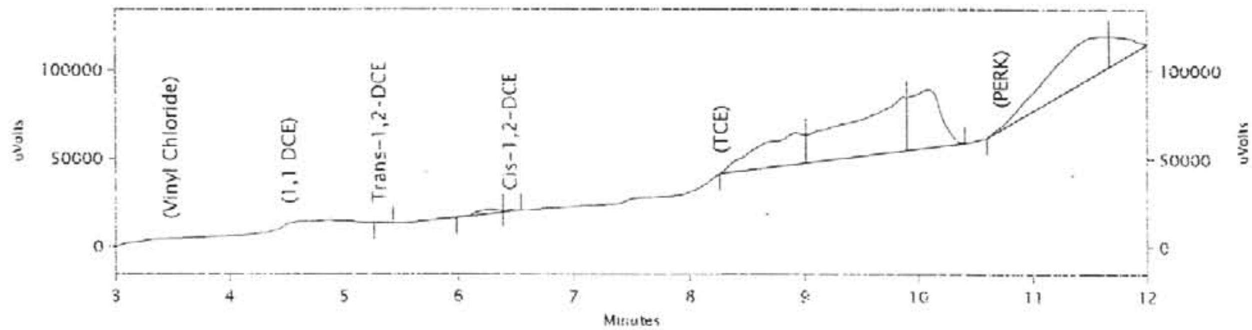
Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: 001-201-MIP 0 - 15 ft
Multiplier: 1



ECD Results

Pk #	Name	Retention Time	Area	ESTD concentration (nano
4	TCA	7.100	33442	0.000
5	TCE	8.268	13151	0.078
7	PERK	10.750	183710	0.000

Totals				
			230303	0.078

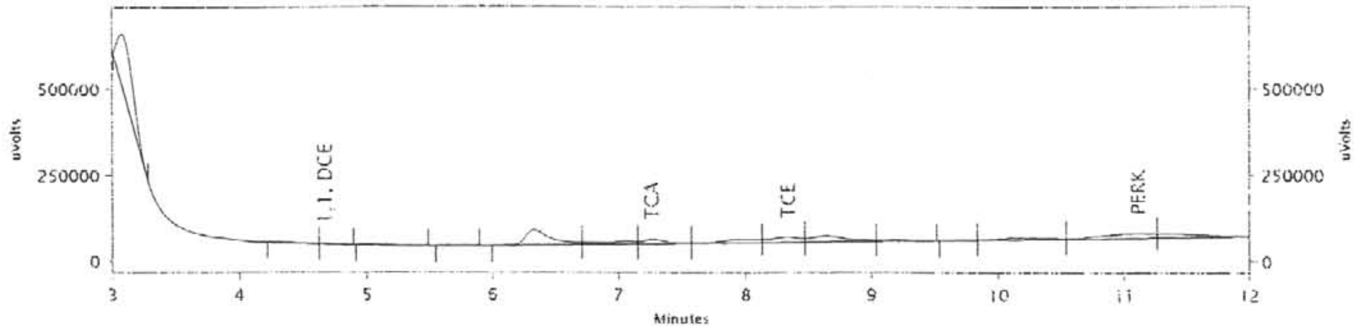


PID Results

Name	Retention Time	Area	ESTD concentration
Trans-1,2-DCE	5.312	3168	0.239
Cis-1,2-DCE	6.456	7283	0.628

Totals			
		10451	0.867

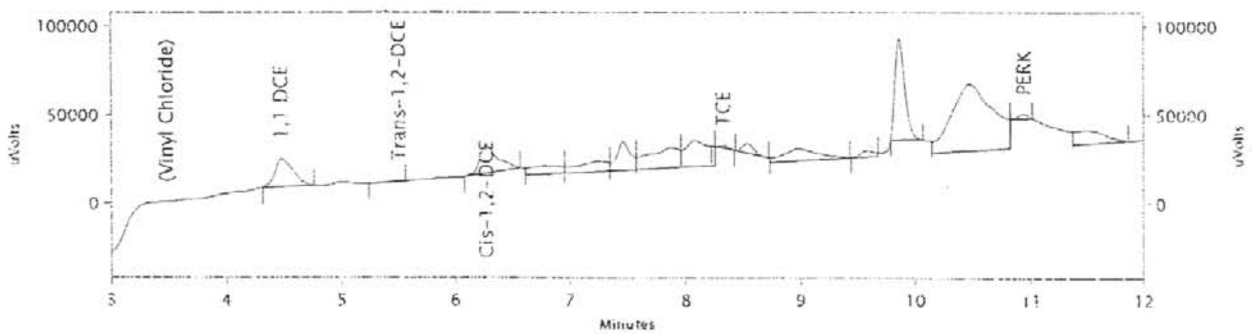
Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: 001-201-MIP 15 - 30 ft
Multiplier: 1



ECD Results

Pk #	Name	Retention Time	Area	ESTD concentration
3	1,1, DCE	4.677	20359	1.250
8	TCA	7.270	174019	0.000
10	TCE	8.336	252619	1.494
15	PERK	11.118	410709	0.000

Totals				
			857706	2.744

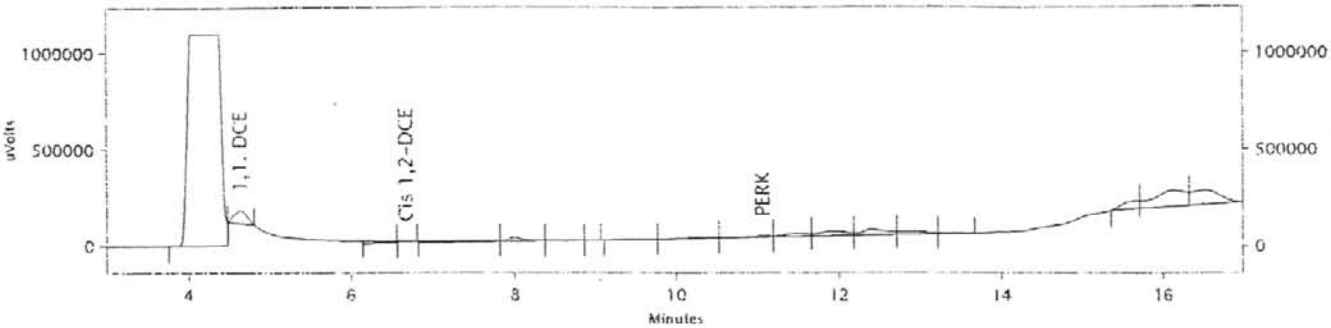


PID Results

Name	Retention Time	Area	ESTD concentration
1,1 DCE	4.475	174844	41.612
Trans-1,2-DCE	5.507	6662	0.502
Cis-1,2-DCE	6.273	170001	14.651
TCE	8.335	7175	0.296
PERK	10.948	14700	0.441

Totals			
		373382	57.703

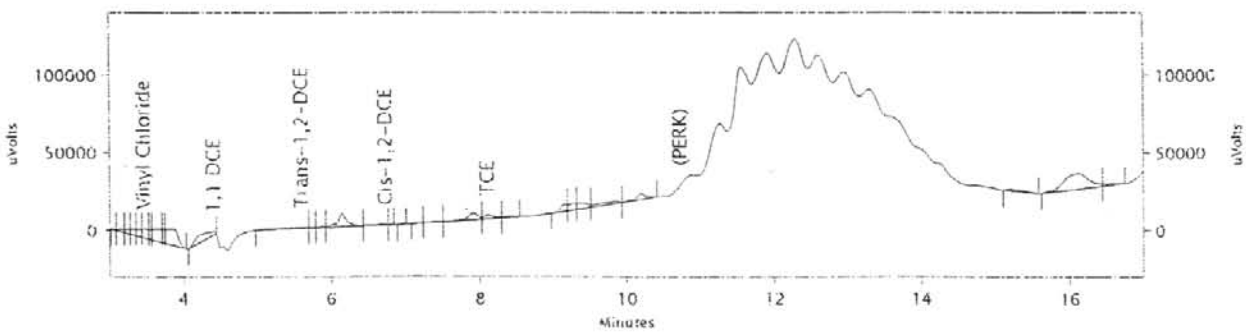
Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: 001-201-MIP 30 - 45 ft
Multiplier: 1



ECD Results

Pk #	Name	Retention Time	Area	ESTD concentration
2	1,1, DCE	4.642	737194	45.266
4	Cis 1,2-DCE	6.686	1721	0.259
11	PERK	11.068	144174	0.000

Totals				
			883089	45.524

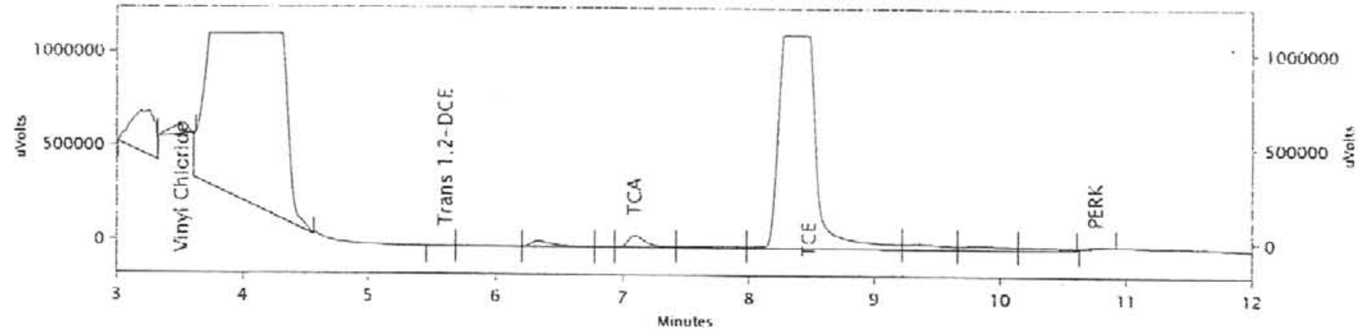


PID Results

Name	Retention Time	Area	ESTD concentration
Vinyl Chloride	3.467	31639	0.000
1,1 DCE	4.408	71194	17.025
Trans-1,2-DCE	5.605	31371	2.366
Cis-1,2-DCE	6.738	6904	0.595
TCE	9.106	23787	0.983

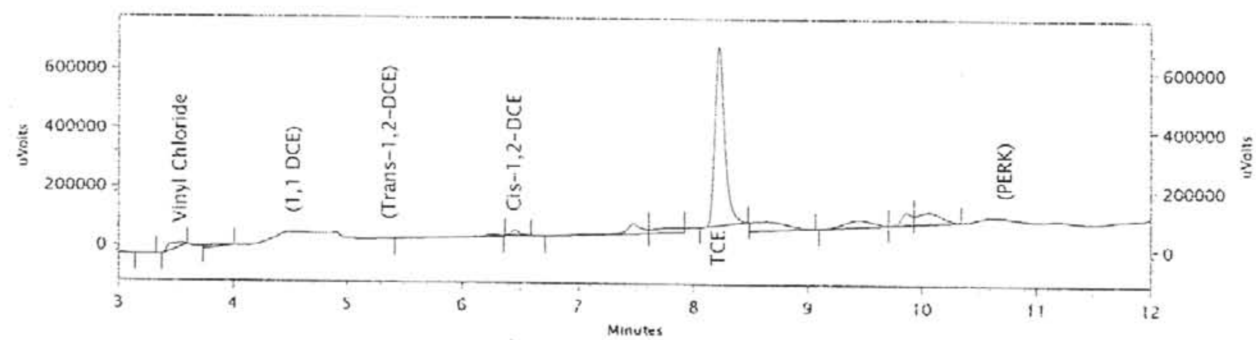
Totals			
		164895	20.969

Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: 001-201-MIP 45 - 60 ft
C:\EZStart\Data\PGDP\PGDP4
Multiplier: 1



ECD Results

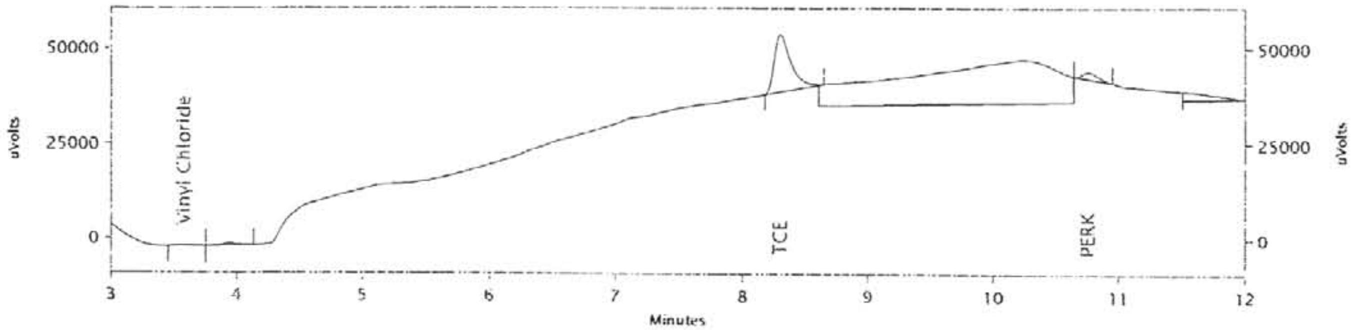
Pk #	Name	Retention Time	Area	ESTD concentration
2	Vinyl Chloride	3.517	484029	56.633
4	Trans 1,2-DCE	5.611	6994	1.445
8	TCA	7.093	658332	0.000
10	TCE	8.480	23228983	137.344
14	PERK	10.761	70488	0.000
Totals			24448826	195.421



PID Results

Name	Retention Time	Area	ESTD concentration
Vinyl Chloride	3.532	170115	0.000
Cis-1,2-DCE	6.446	94275	8.125
TCE	8.218	3644220	150.564
Totals		3908610	158.689

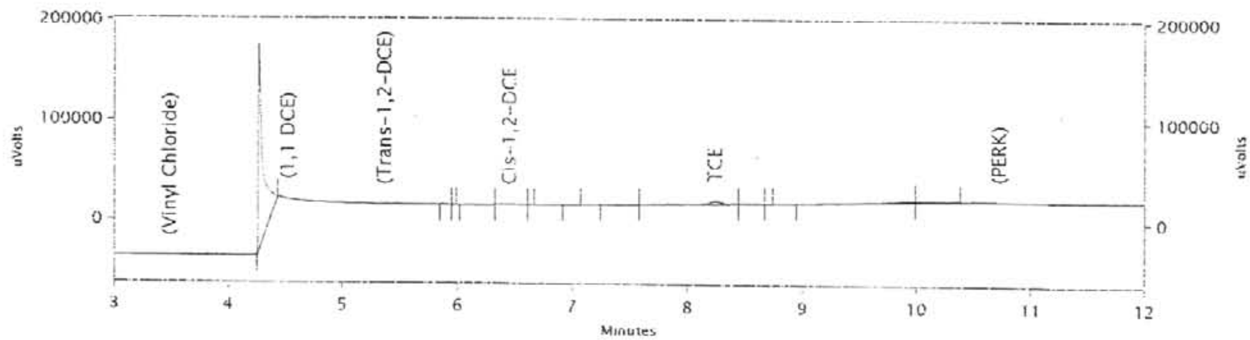
Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: 001-202-MIP 0-15 ft
C:\EZStart\Data\PGDP\PGDP17
Multiplier: 1



ECD Results

Pk #	Name	Retention Time	Area	ESTD concentration
1	Vinyl Chloride	3.577	3199	0.374
3	TCE	8.301	138152	0.817
5	PERK	10.760	16359	0.000

Totals				
			157710	1.191

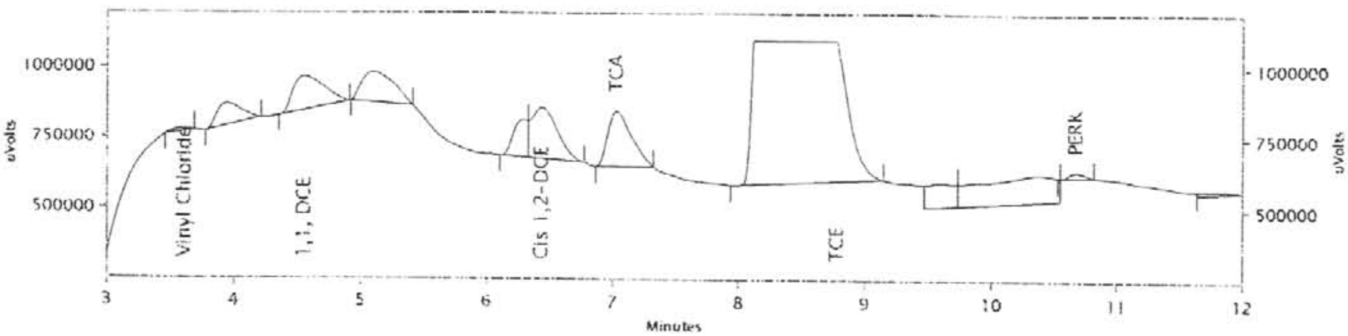


PID Results

Name	Retention Time	Area	ESTD concentration
Cis-1,2-DCE	6.456	4940	0.426
TCE	8.243	49691	2.053

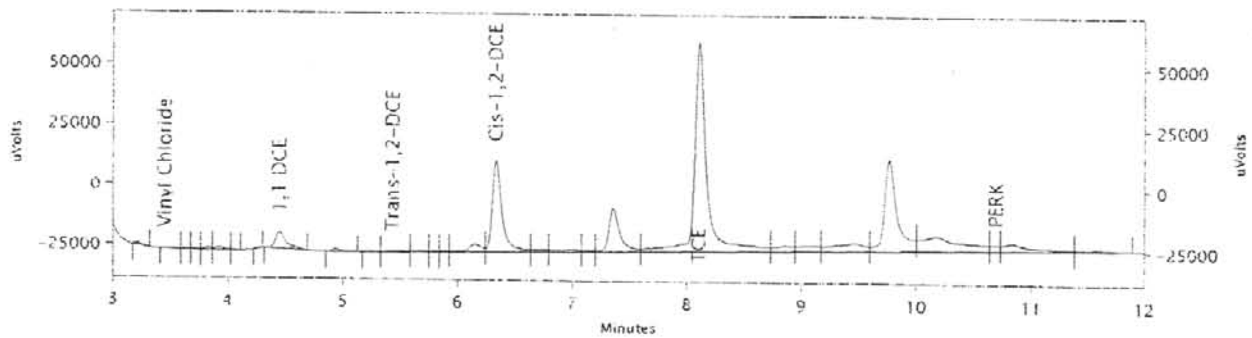
Totals			
		54631	2.479

Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: 001-202-MIP 15-30 ft
C:\EZStart\Data\PGDP\PGDP18
Multiplier: 1



ECD Results

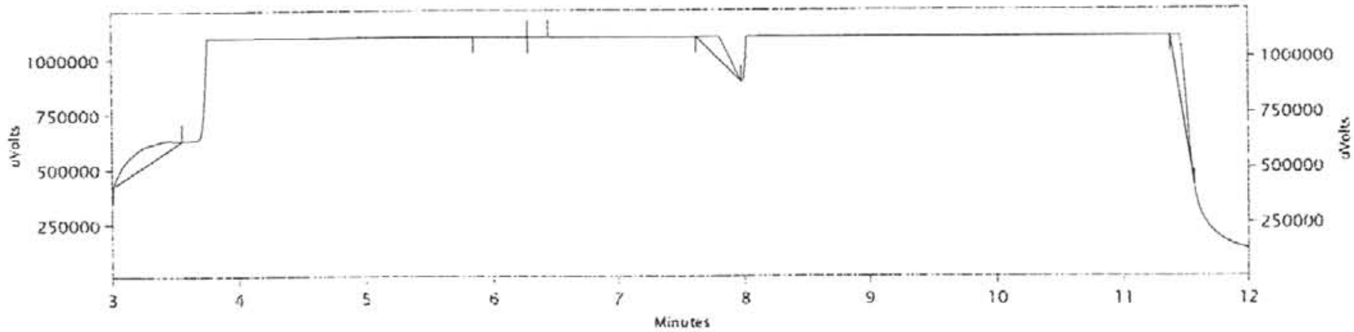
Pk #	Name	Retention Time	Area	ESTD concentration
1	Vinyl Chloride	3.605	92151	10.782
3	1,1, DCE	4.553	2025879	124.395
6	Cis 1,2-DCE	6.435	2552140	383.413
7	TCA	7.031	2553160	0.000
8	TCE	8.778	24017757	142.007
11	PERK	10.671	150965	0.000
Totals			31392052	660.597



PID Results

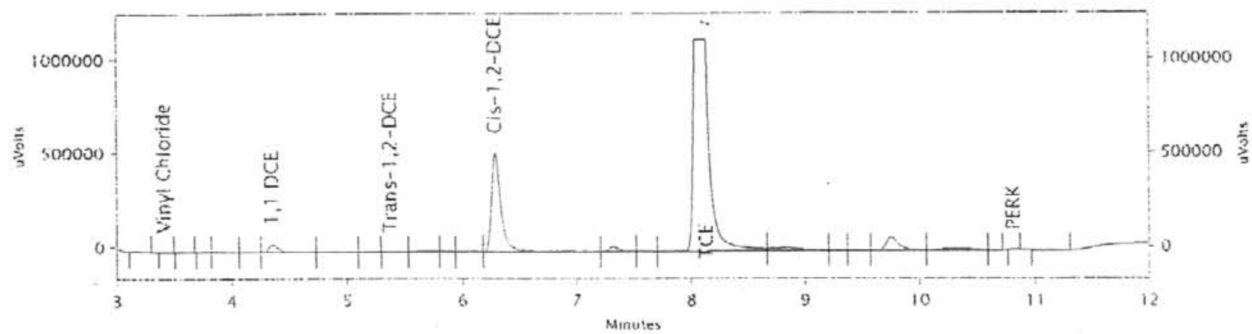
Name	Retention Time	Area	ESTD concentration
Vinyl Chloride	3.452	1103	0.000
1,1 DCE	4.447	44244	10.581
Trans-1,2-DCE	5.435	6140	0.463
Cis-1,2-DCE	6.333	224476	19.345
TCE	8.111	670924	27.720
PERK	10.698	14318	0.429
Totals		961205	58.538

Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: 001-202-MIP 30-45 ft
C:\EZStart\Data\PGDP\PGDP19
Multiplier: 1



ECD Results

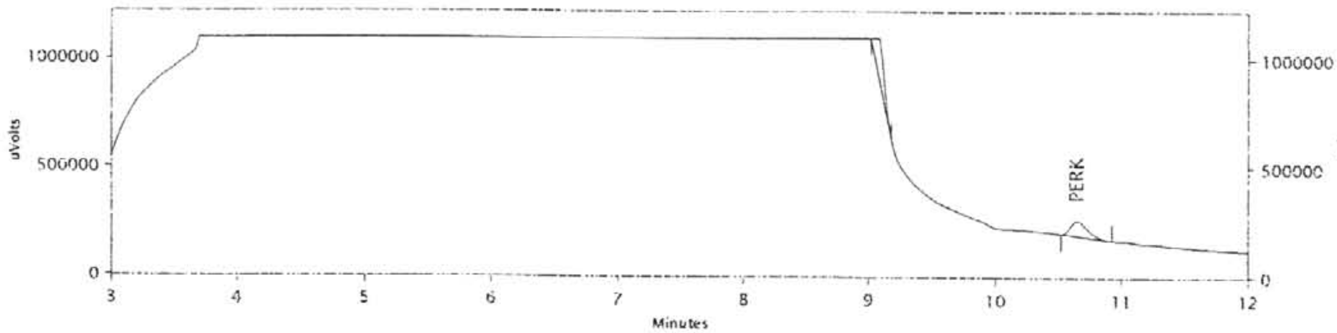
Pk #	Name	Retention Time	Area	ESTD concentration



PID Results

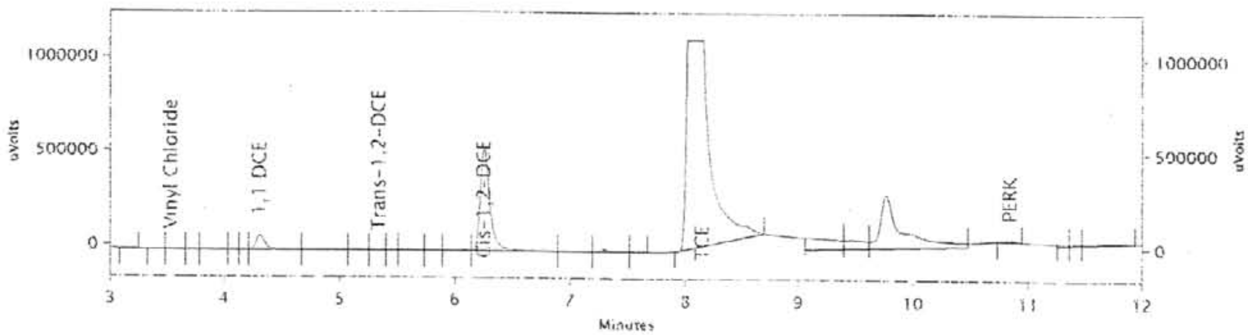
Name	Retention Time	Area	ESTD concentration
Vinyl Chloride	3.412	3850	0.000
1,1 DCE	4.350	269184	64.373
Trans-1,2-DCE	5.380	9663	0.729
Cis-1,2-DCE	6.286	3044477	262.373
TCE	8.138	11150301	460.685
PERK	10.814	4454	0.133
Totals		14481929	788.294

Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: 001-202-MIP 45-60 ft
C:\EZStart\Data\PGDP\PGDP20
Multiplier: 1



ECD Results

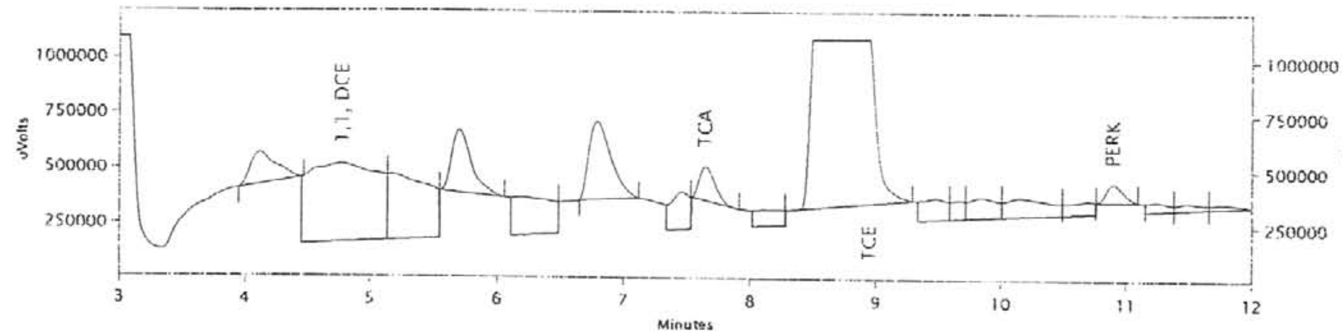
Pk #	Name	Retention Time	Area	ESTD concentration
2	PERK	10.646	683136	0.000
Totals			683136	0.000



PID Results

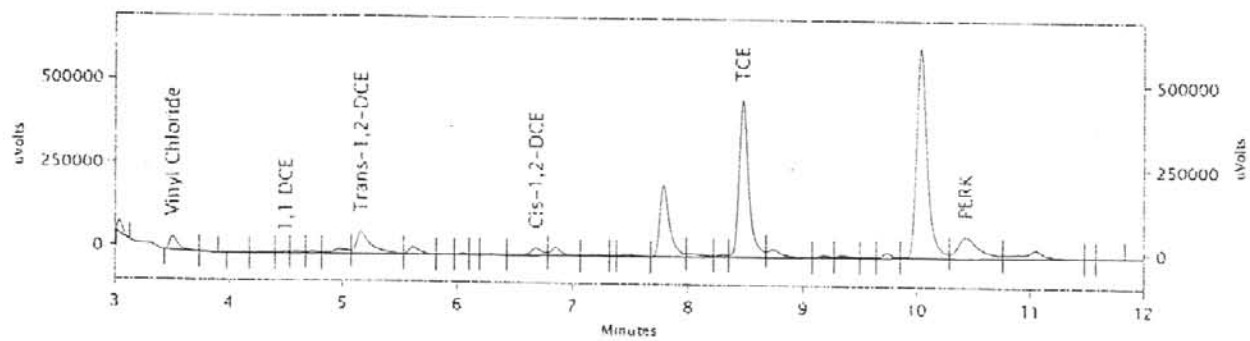
Name	Retention Time	Area	ESTD concentration
Vinyl Chloride	3.528	3086	0.000
1,1 DCE	4.310	422661	101.076
Trans-1,2-DCE	5.338	5209	0.393
Cis-1,2-DCE	6.255	3217593	277.293
TCE	8.150	16160411	667.683
PERK	10.844	48170	1.444
Totals		19857130	1047.888

Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: 001-203-MIP 0-15 ft
C:\EZStart\Data\PGDP\pgdp5
Multiplier: 1



ECD Results

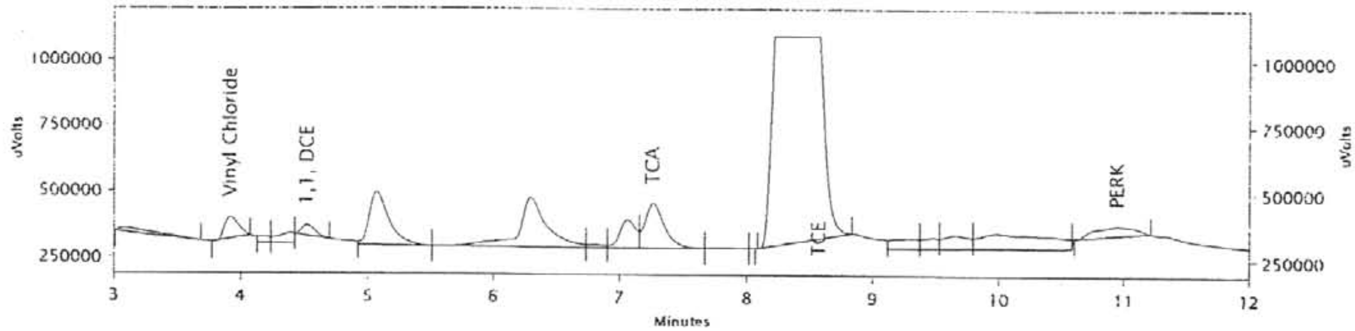
Pk #	Name	Retention Time	Area	ESTD concentration
2	1,1, DCE	4.780	13444940	825.560
8	TCA	7.648	1294100	0.000
10	TCE	8.950	25103202	148.425
16	PERK	10.899	741974	0.000
Totals			40584216	973.985



PID Results

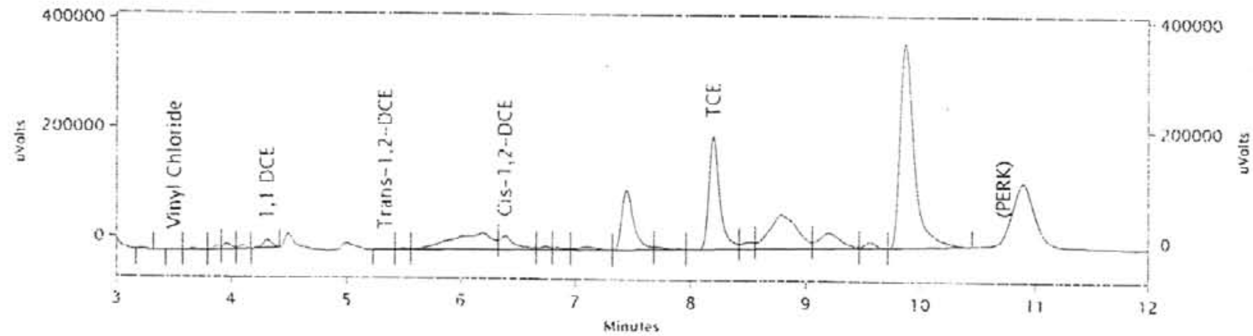
Name	Retention Time	Area	ESTD concentration
Vinyl Chloride	3.500	220634	0.000
1,1 DCE	4.498	32925	7.374
Trans-1,2-DCE	5.163	601419	45.357
Cis-1,2-DCE	6.681	172177	14.838
TCE	8.475	2725403	112.603
PERK	10.435	873136	26.166
Totals		4625694	206.837

Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: 001-203-MIP 15-30 ft
C:\EZStart\Data\PGDP\pgdp6
Multiplier: 1



ECD Results

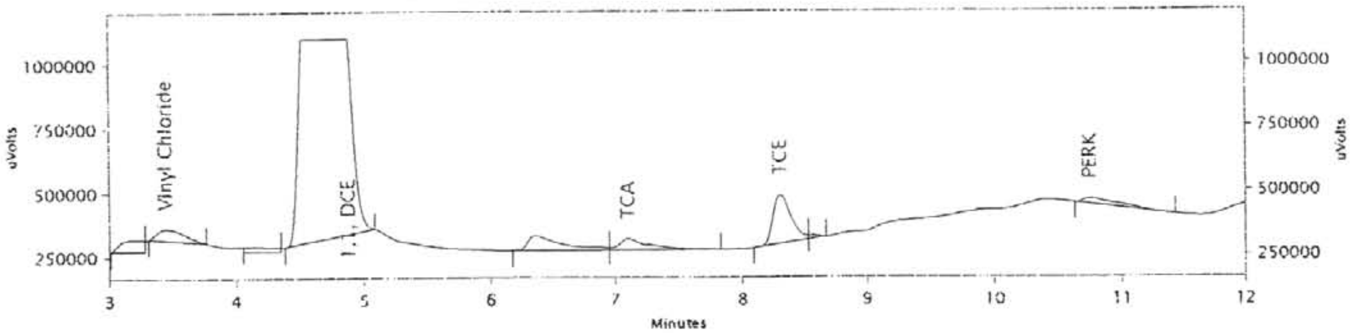
Pk #	Name	Retention Time	Area	ESTD concentration
2	Vinyl Chloride	3.920	618014	72.309
5	1,1, DCE	4.518	277939	17.066
10	TCA	7.266	1784344	0.000
13	TCE	8.573	20985220	124.077
18	PERK	10.948	850289	0.000
Totals			24515806	213.453



PID Results

Name	Retention Time	Area	ESTD concentration
Vinyl Chloride	3.498	5763	0.000
1,1 DCE	4.310	82871	19.818
Trans-1,2-DCE	5.337	11049	0.833
Cis-1,2-DCE	6.391	232868	20.069
TCE	8.196	1341741	55.435
Totals		1674292	96.155

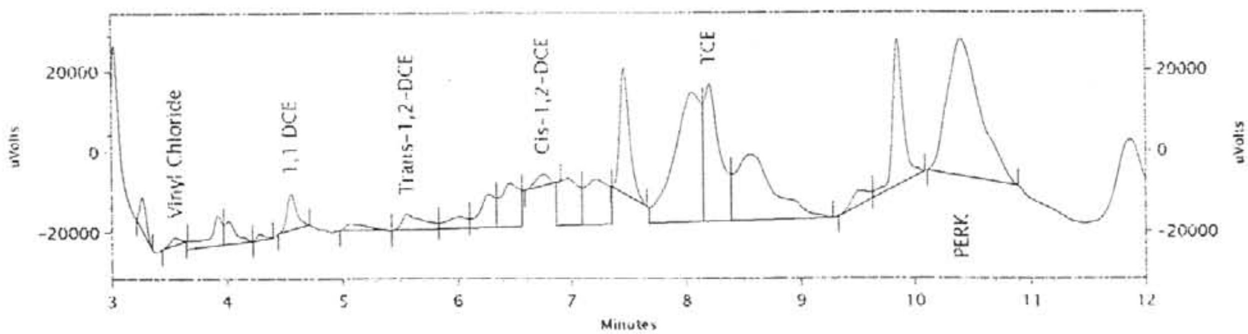
lethod name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
)ata: 001-203-MIP 30-45 ft
C:\EZStart\Data\PGDP\pgdp7
fultiplier: 1



ECD Results

Pk #	Name	Retention Time	Area	ESTD concentration
2	Vinyl Chloride	3.445	701317	82.056
4	1,1, DCE	4.882	21200538	1301.776
6	TCA	7.106	745583	0.000
7	TCE	8.300	1894358	11.201
9	PERK	10.750	435902	0.000

Totals				
			24977698	1395.033

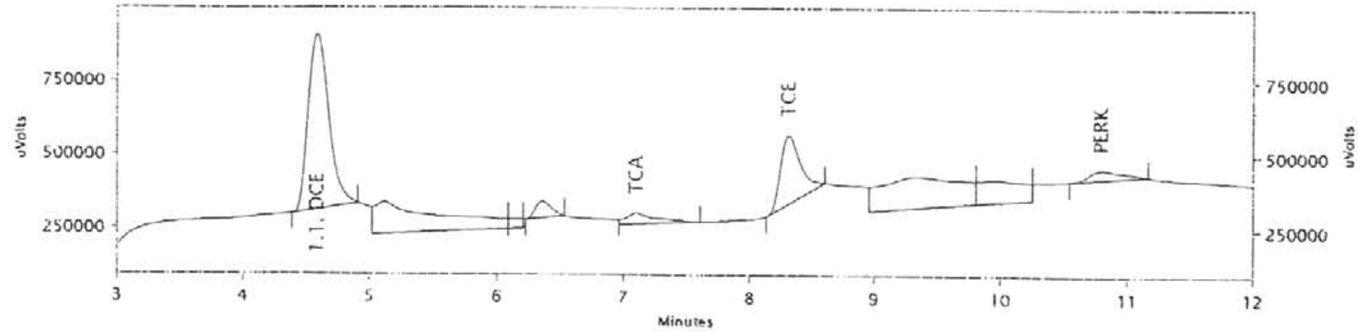


PID Results

Name	Retention Time	Area	ESTD concentration
Vinyl Chloride	3.548	11020	0.000
1,1 DCE	4.552	52071	12.452
Trans-1,2-DCE	5.562	51229	3.864
Cis-1,2-DCE	6.751	22277	1.920
TCE	8.210	321130	13.268
PERK	10.403	662886	19.865

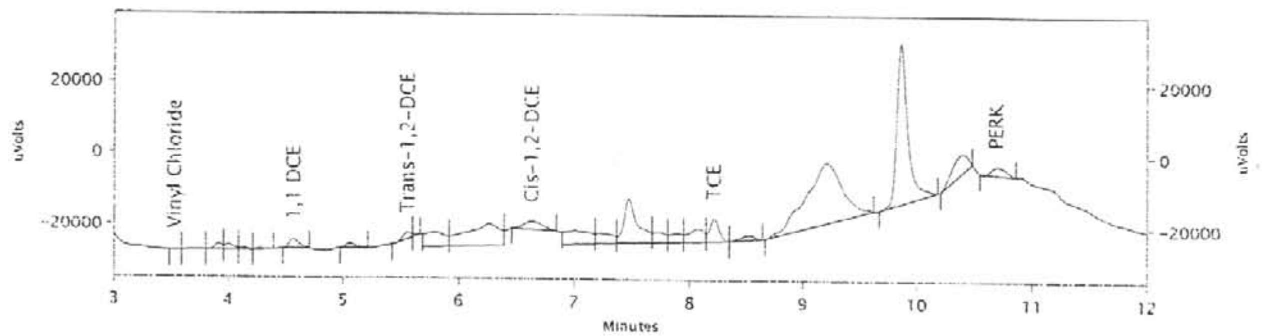
Totals			
		1120613	51.369

Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: 001-203-MIP 45-60 ft
C:\EZStart\Data\PGDP\pgdp8
Multiplier: 1



ECD Results

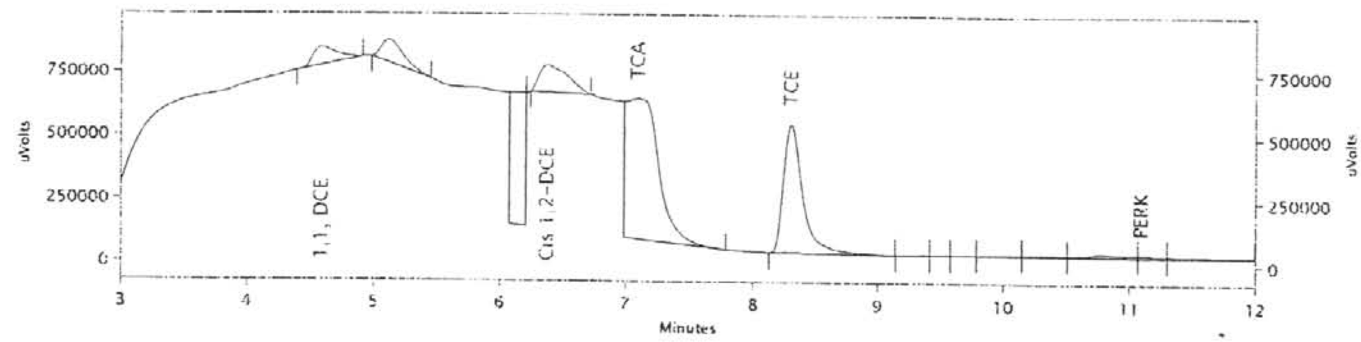
Pk #	Name	Retention Time	Area	ESTD concentration
1	1,1, DCE	4.583	6806218	417.922
5	TCA	7.103	615938	0.000
6	TCE	8.315	2548154	15.066
9	PERK	10.793	601938	0.000
Totals			10572248	432.988



PID Results

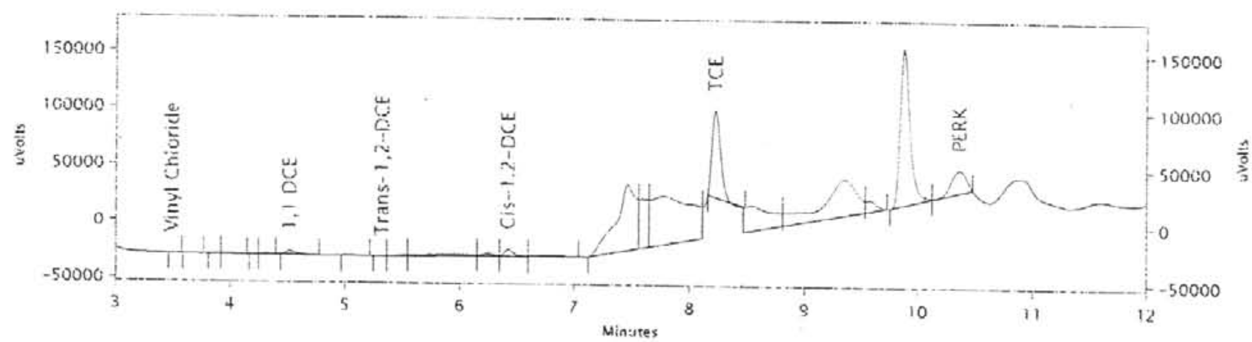
Name	Retention Time	Area	ESTD concentration
Vinyl Chloride	3.523	535	0.000
1,1 DCE	4.565	14758	3.529
Trans-1,2-DCE	5.562	7805	0.589
Cis-1,2-DCE	6.631	26178	2.256
TCE	8.218	35683	1.474
PERK	10.695	19740	0.592
Totals		104699	8.440

Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: 001-204-MIP 0 - 15 ft
C:\EZStart\Data\PGDP\PGDP13
Multiplier: 1



ECD Results

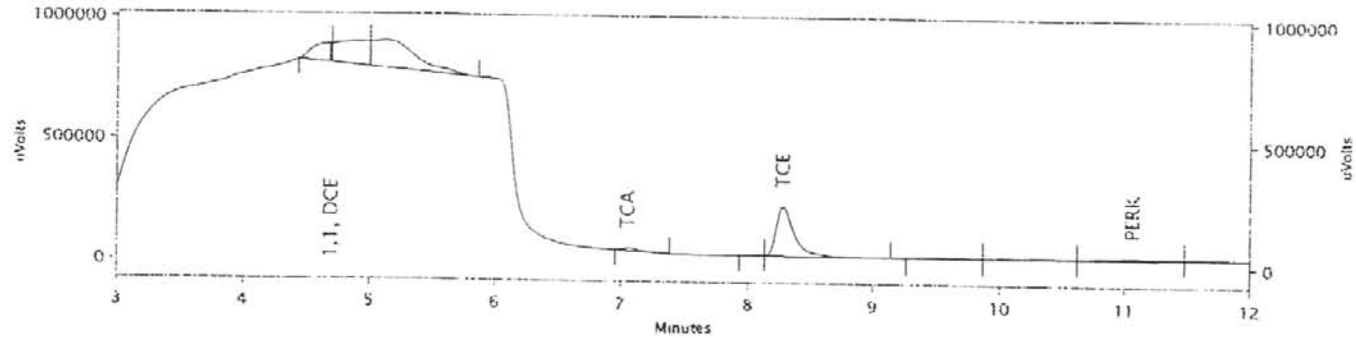
Pk #	Name	Retention Time	Area	ESTD concentration
1	1,1, DCE	4.587	899508	55.232
4	Cis 1,2-DCE	6.378	1698579	255.181
5	TCA	7.096	9971597	0.000
6	TCE	8.301	5525864	32.672
13	PERK	11.094	95991	0.000
Totals			18191537	343.085



PID Results

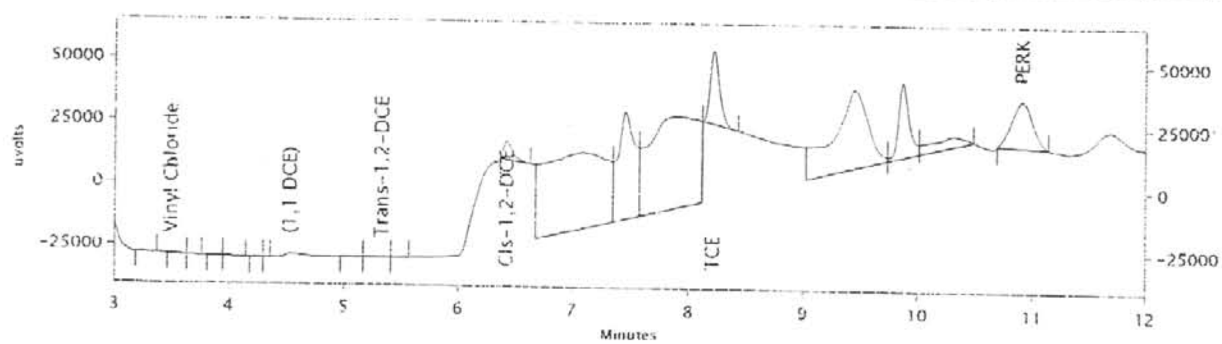
Name	Retention Time	Area	ESTD concentration
Vinyl Chloride	3.487	667	0.000
1,1 DCE	4.518	21943	5.247
Trans-1,2-DCE	5.323	1150	0.087
Cis-1,2-DCE	6.425	34295	2.956
TCE	8.221	376059	15.537
PERK	10.368	183797	5.508
Totals		617911	29.335

Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: 001-204-MIP 15-30 ft
C:\EZStart\Data\PGDP\PGDP14
Multiplier: 1



ECD Results

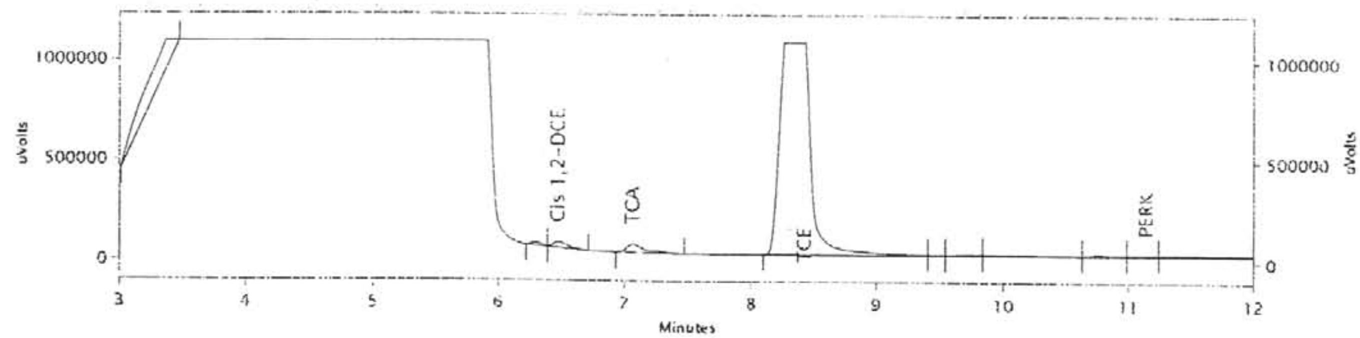
Pk #	Name	Retention Time	Area	ESTD concentration
1	1,1, DCE	4.698	779332	47.853
4	TCA	7.060	112313	0.000
6	TCE	8.278	2097550	12.402
9	PERK	11.069	272996	0.000
Totals			3262191	60.255



PID Results

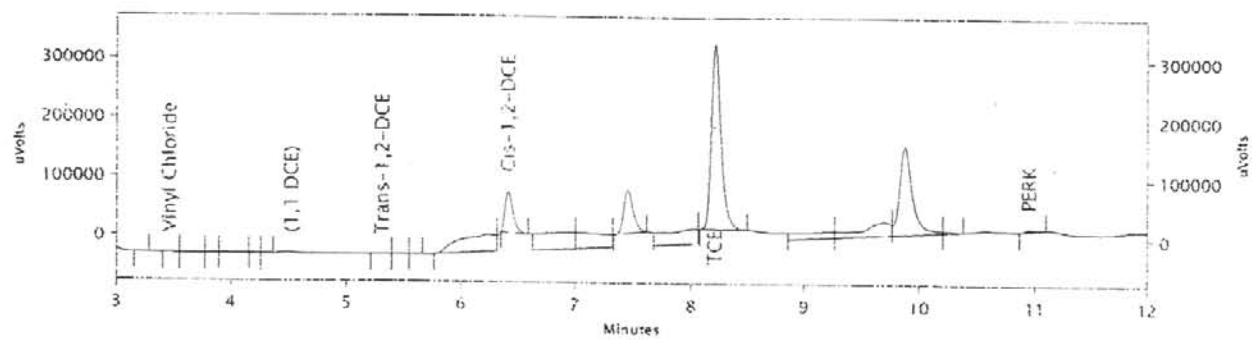
Name	Retention Time	Area	ESTD concentration
Vinyl Chloride	3.492	727	0.000
Trans-1,2-DCE	5.327	1852	0.140
Cis-1,2-DCE	6.423	38938	3.356
TCE	8.213	164969	6.816
PERK	10.909	235026	7.043
Totals		441512	17.354

Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: 001-204-MIP 30-45 ft
C:\EZStart\Data\PGDP\PGDP15
Multiplier: 1



ECD Results

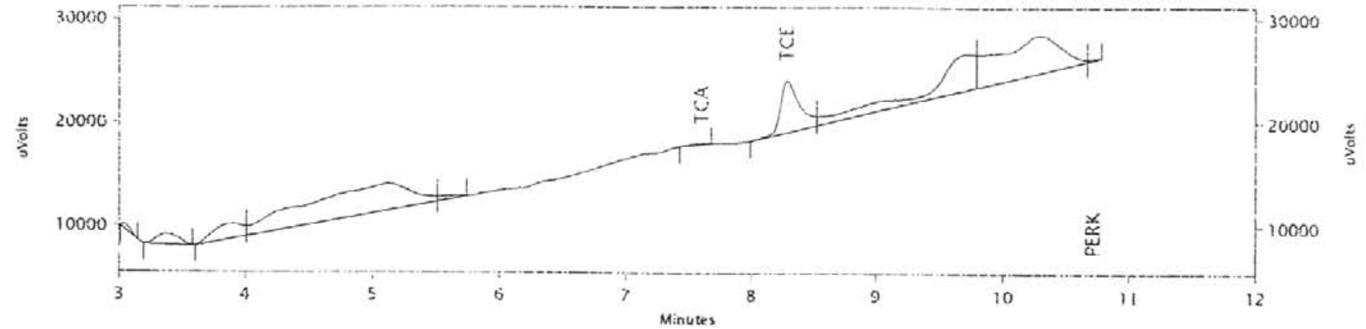
Pk #	Name	Retention Time	Area	ESTD concentration
3	Cis 1,2-DCE	6.476	225595	33.892
4	TCA	7.066	426733	0.000
5	TCE	8.436	18285616	108.115
10	PERK	11.148	85093	0.000
Totals			19023037	142.007



PID Results

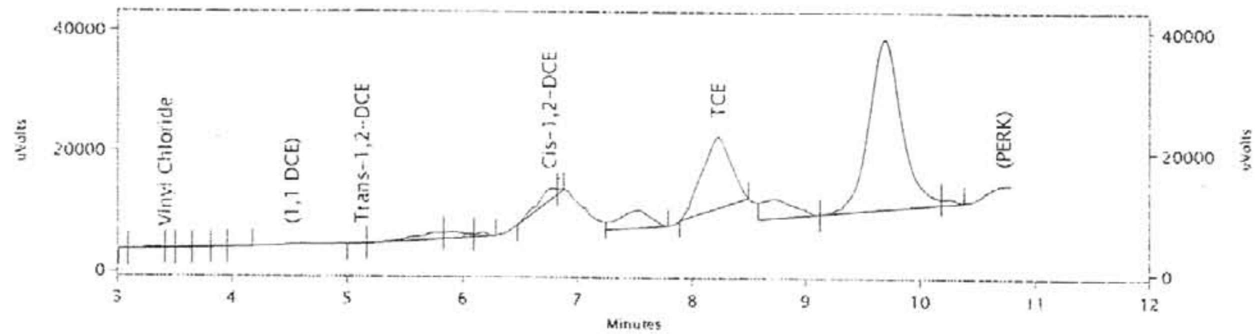
Name	Retention Time	Area	ESTD concentration
Vinyl Chloride	3.463	1741	0.000
Trans-1,2-DCE	5.312	2136	0.161
Cis-1,2-DCE	6.418	330696	28.499
TCE	8.213	1822903	75.315
PERK	10.953	15986	0.479
Totals		2173462	104.455

Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: 001-204-MIP 45 - 60 ft
C:\EZStart\Data\PGDP\PGDP16
Multiplier: 1



ECD Results

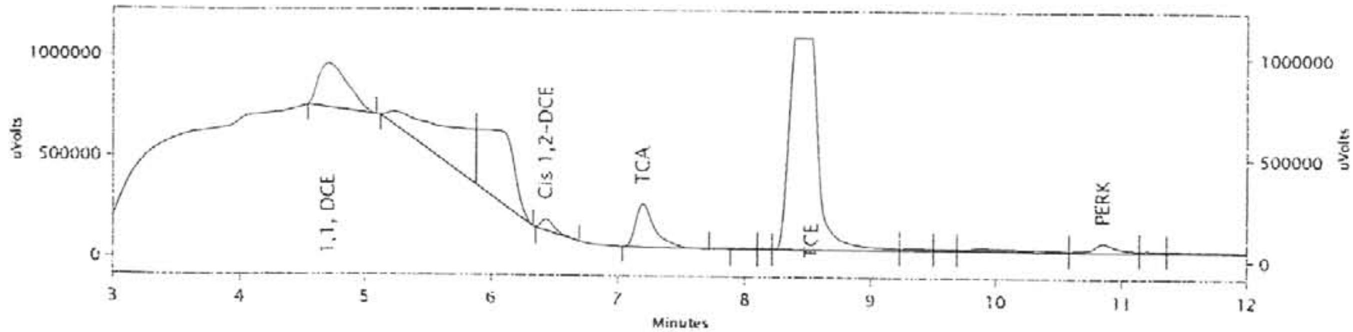
Pk #	Name	Retention Time	Area	ESTD concentration
6	TCA	7.606	1602	0.000
7	TCE	8.288	53359	0.315
10	PERK	10.716	1041	0.000
Totals			56002	0.315



PID Results

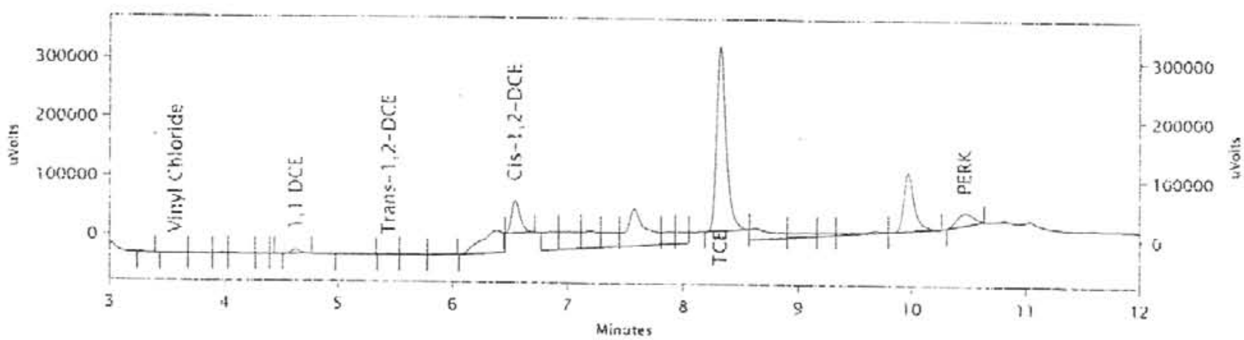
Name	Retention Time	Area	ESTD concentration
Vinyl Chloride	3.418	809	0.000
Trans-1,2-DCE	5.130	930	0.070
Cis-1,2-DCE	6.760	21057	1.815
TCE	8.231	209977	8.675
Totals		232773	10.560

Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: 001-205-MIP 0 - 15 ft
C:\EZStart\Data\PGDP\PGDP9
Multiplier: 1



ECD Results

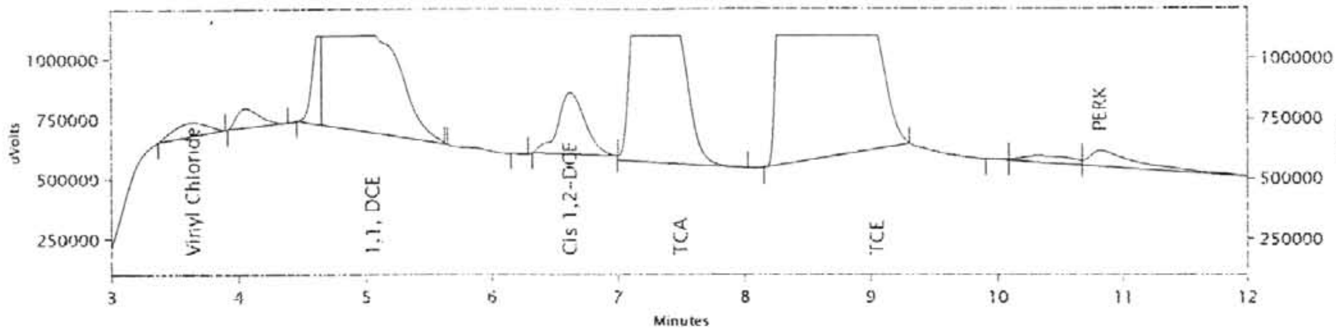
Pk #	Name	Retention Time	Area	ESTD concentration
1	1,1, DCE	4.708	3532619	216.913
4	Cis 1,2-DCE	6.431	425605	63.939
5	TCA	7.198	2163956	0.000
8	TCE	8.526	16705026	98.770
12	PERK	10.848	622834	0.000
Totals			23450040	379.623



PID Results

Name	Retention Time	Area	ESTD concentration
Vinyl Chloride	3.572	4796	0.000
1,1 DCE	4.625	43205	10.332
Trans-1,2-DCE	5.443	4152	0.313
Cis-1,2-DCE	6.541	282062	24.308
TCE	8.323	1809623	74.766
PERK	10.471	208541	6.249
Totals		2352379	115.969

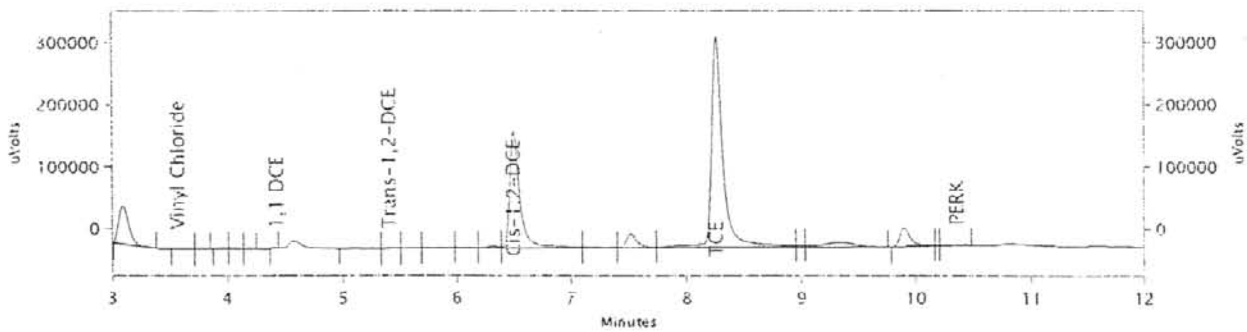
Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: 001-205-MIP 15-30 ft
C:\EZStart\Data\PGDP\PGDP10
Multiplier: 1



ECD Results

Pk #	Name	Retention Time	Area	ESTD concentration
1	Vinyl Chloride	3.643	1068057	124.965
4	1,1, DCE	5.057	16245247	997.507
6	Cis 1,2-DCE	6.626	3866654	580.894
7	TCA	7.498	16312987	14.171
8	TCE	9.056	27883314	164.863
11	PERK	10.816	1800113	0.000

Totals				
			67176372	1882.400

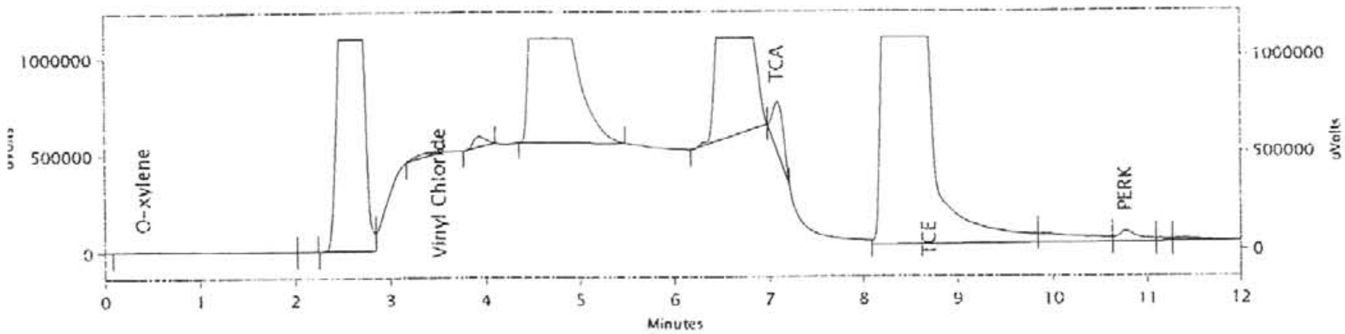


PID Results

Name	Retention Time	Area	ESTD concentration
Vinyl Chloride	3.573	2879	0.000
1,1 DCE	4.427	819	0.196
Trans-1,2-DCE	5.408	6597	0.498
Cis-1,2-DCE	6.500	1173667	101.147
TCE	8.263	2350236	97.102
PERK	10.361	21333	0.639

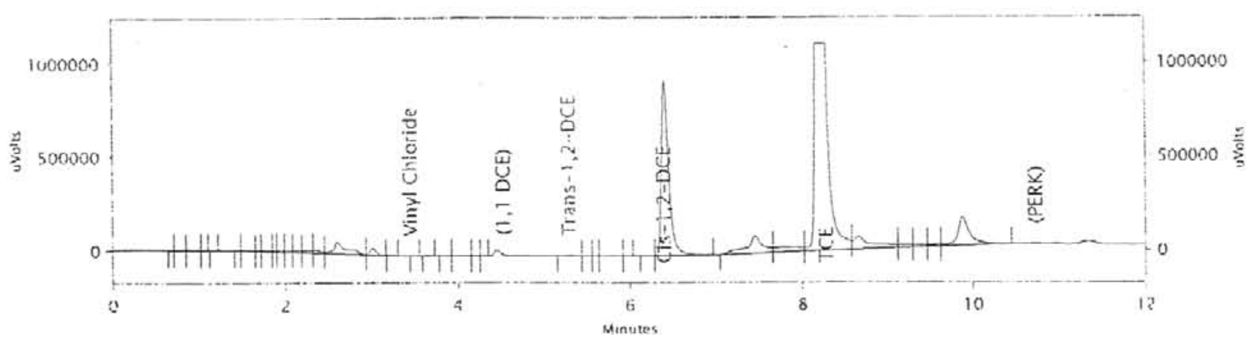
Totals			
		3555531	199.582

ethod name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
ata: 001-205-MIP 30-45 ft
C:\EZStart\Data\PGDP\PGDP11
ultiplier: 1



ECD Results

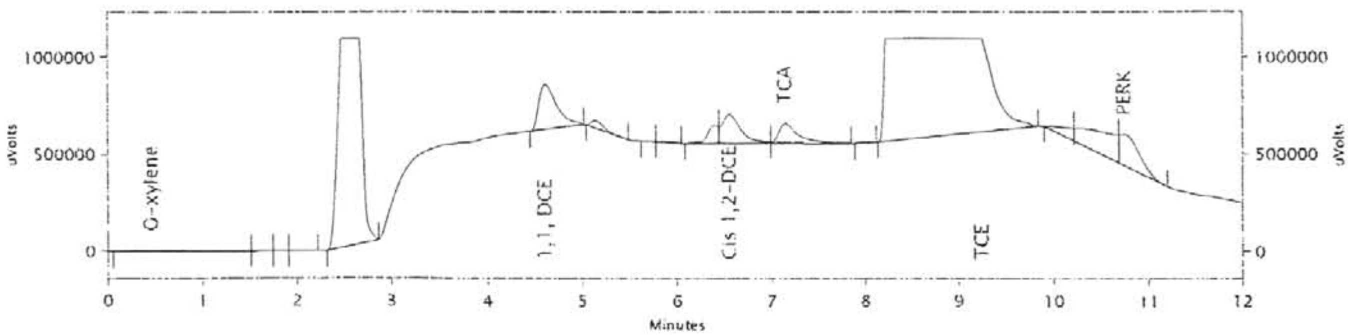
Pk #	Name	Retention Time	Area	ESTD concentration
1	O-xylene	0.410	294517	0.000
4	Vinyl Chloride	3.513	294906	34.505
8	TCA	7.086	2043496	0.000
9	TCE	8.703	43293305	255.976
11	PERK	10.764	846418	0.000
Totals			46772642	290.480



PID Results

Name	Retention Time	Area	ESTD concentration
Vinyl Chloride	3.458	717	0.000
Trans-1,2-DCE	5.296	24309	1.833
Cis-1,2-DCE	6.408	5350870	461.139
TCE	8.288	12896864	532.846
Totals		18272760	995.818

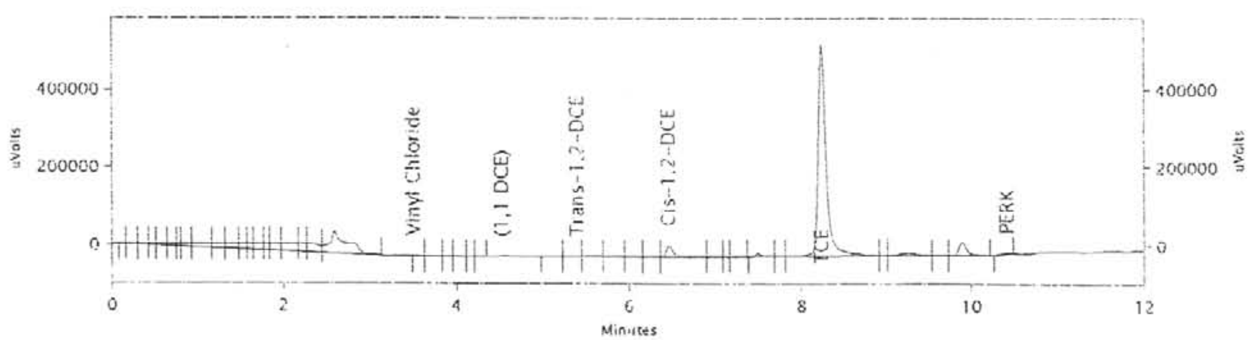
Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: 001-205-MIP 45-60 ft
C:\EZStart\Data\PGDP\PGDP12
Multiplier: 1



ECD Results

Pk #	Name	Retention Time	Area	ESTD concentration
1	O-xylene	0.462	316630	0.000
6	1,1, DCE	4.610	3067470	188.352
11	Cis 1,2-DCE	6.555	2050977	308.122
12	TCA	7.145	1465393	0.000
14	TCE	9.246	36466057	215.609
17	PERK	10.739	2360865	0.000

Totals				
			45727392	712.083

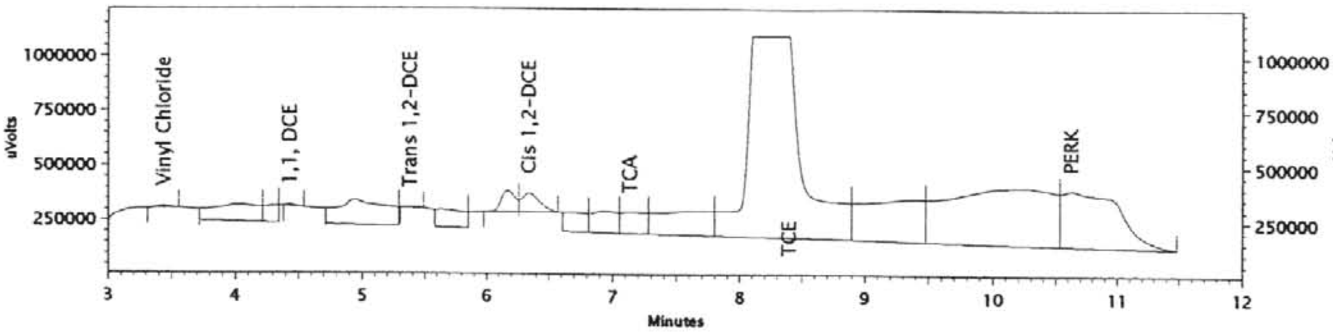


PID Results

Name	Retention Time	Area	ESTD concentration
Vinyl Chloride	3.510	530	0.000
Trans-1,2-DCE	5.400	4283	0.323
Cis-1,2-DCE	6.458	170972	14.734
TCE	8.241	3523020	145.557
PERK	10.418	20739	0.621

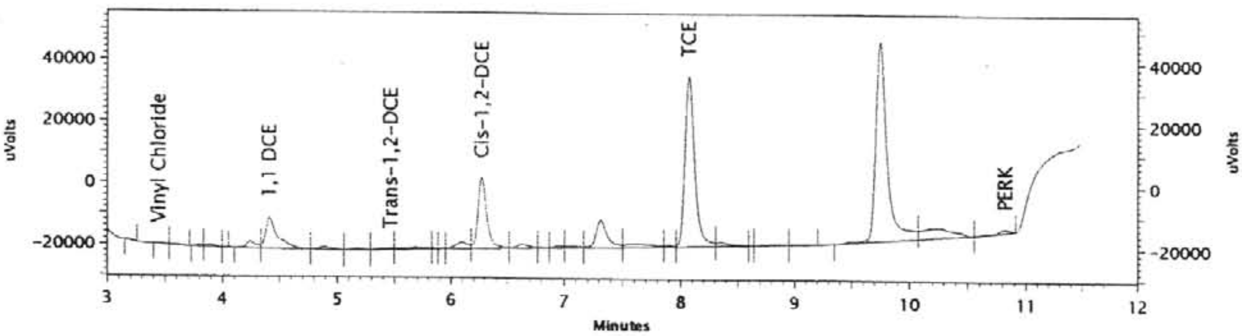
Totals			
		3719544	161.236

Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: 102-001-MIP 0-20 ft
C:\EZStart\Data\PGDP\PGDP57
Multiplier: 1



ECD Results

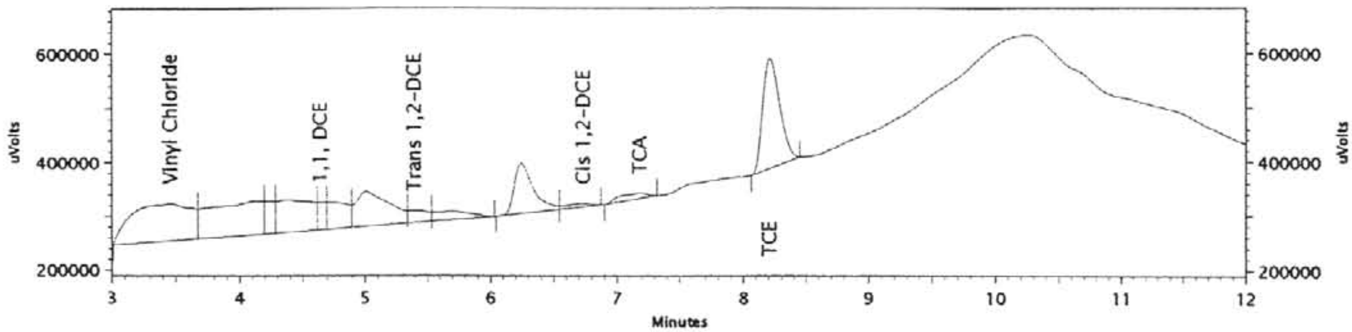
Pk #	Name	Retention Time	Area	ESTD concentration
1	Vinyl Chloride	3.437	69669	8.151
4	1,1, DCE	4.432	32816	2.015
6	Trans 1,2-DCE	5.378	21128	4.365
9	Cis 1,2-DCE	6.343	847304	127.292
12	TCA	7.135	1290570	0.000
14	TCE	8.398	27837891	164.594
17	PERK	10.626	8315467	0.000
Totals			38414845	306.418



PID Results

Name	Retention Time	Area	ESTD concentration
Vinyl Chloride	3.447	1546	0.000
1,1 DCE	4.408	72482	17.333
Trans-1,2-DCE	5.465	4313	0.325
Cis-1,2-DCE	6.271	126015	10.860
TCE	8.073	322017	13.304
PERK	10.823	8460	0.254
Totals		534833	42.077

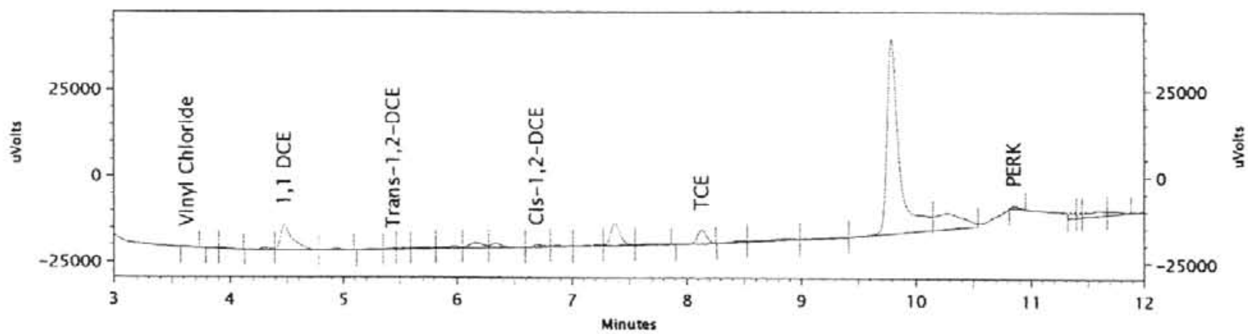
Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: 102-002-MIP 0-20 ft
C:\EZStart\Data\PGDP\PGDP56
Multiplier: 1



ECD Results

Pk #	Name	Retention Time	Area	ESTD concentration
1	Vinyl Chloride	3.460	2263075	264.786
5	1,1, DCE	4.642	226634	13.916
8	Trans 1,2-DCE	5.398	235030	48.561
11	Cis 1,2-DCE	6.736	100321	15.071
12	TCA	7.188	173724	0.000
13	TCE	8.211	1894216	11.200

Totals				
			4893000	353.534

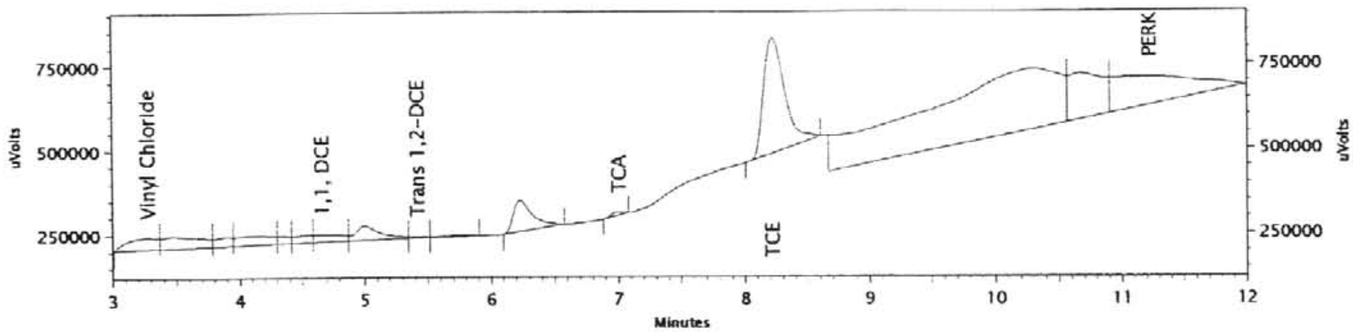


PID Results

Name	Retention Time	Area	ESTD concentration
Vinyl Chloride	3.627	1040	0.000
1,1 DCE	4.473	53169	12.715
Trans-1,2-DCE	5.438	1924	0.145
Cis-1,2-DCE	6.695	5356	0.462
TCE	8.131	22777	0.941
PERK	10.856	4077	0.122

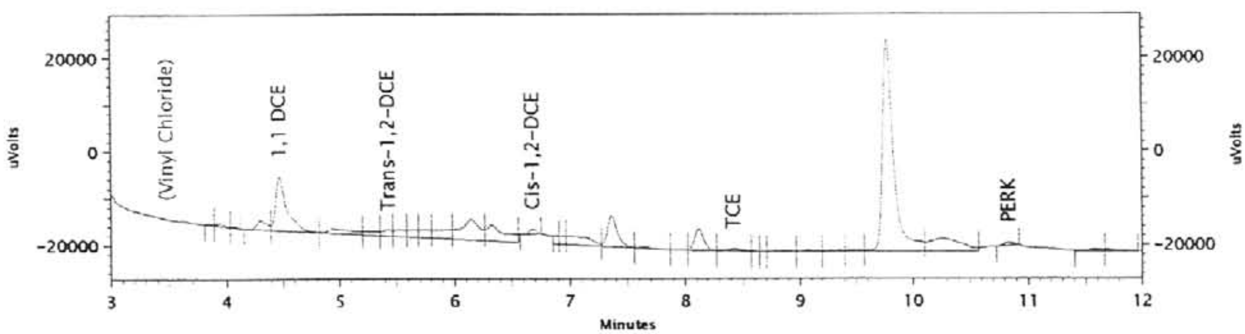
Totals			
		88343	14.385

Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: 102-003-MIP 0-20 ft
C:\EZStart\Data\PGDP\PGDP55
Multiplier: 1



ECD Results

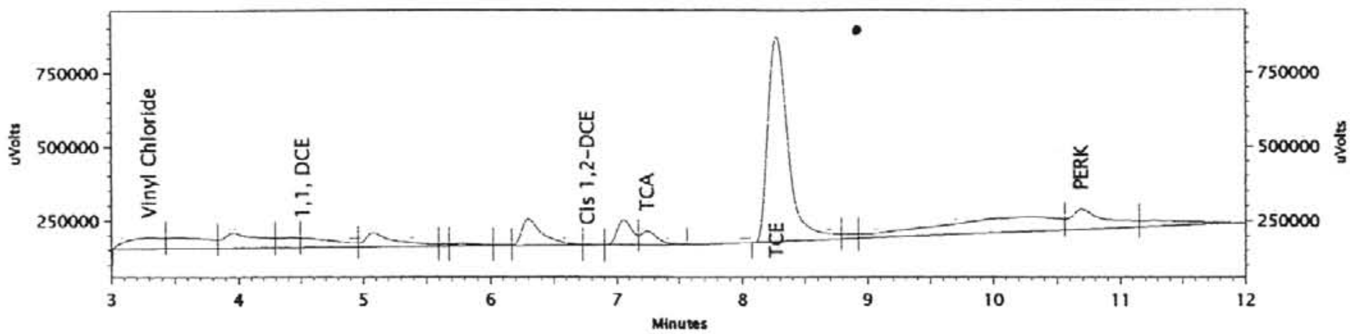
Pk #	Name	Retention Time	Area	ESTD concentration
1	Vinyl Chloride	3.278	589327	68.953
7	1,1, DCE	4.667	333053	20.450
9	Trans 1,2-DCE	5.422	51753	10.693
12	TCA	7.011	64579	0.000
13	TCE	8.220	3967391	23.458
16	PERK	11.229	3825001	0.000
Totals			8831104	123.554



PID Results

Name	Retention Time	Area	ESTD concentration
1,1 DCE	4.468	78878	18.863
Trans-1,2-DCE	5.430	7606	0.574
Cis-1,2-DCE	6.680	4528	0.390
TCE	8.418	5355	0.221
PERK	10.836	4183	0.125
Totals		100550	20.173

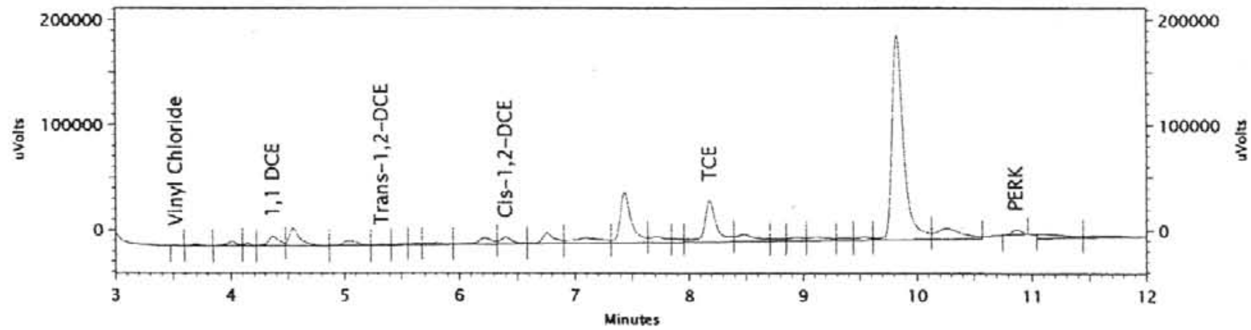
Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: 102-004-MIP 0-20 ft
C:\EZStart\Data\PGDP\PGDP54
Multiplier: 1



ECD Results

Pk #	Name	Retention Time	Area	ESTD concentration
1	Vinyl Chloride	3.300	750754	87.840
5	1,1, DCE	4.517	668586	41.053
11	Cis 1,2-DCE	6.770	15858	2.382
13	TCA	7.245	428395	0.000
14	TCE	8.275	7824448	46.263
17	PERK	10.693	1358133	0.000

Totals				
			11046174	177.539

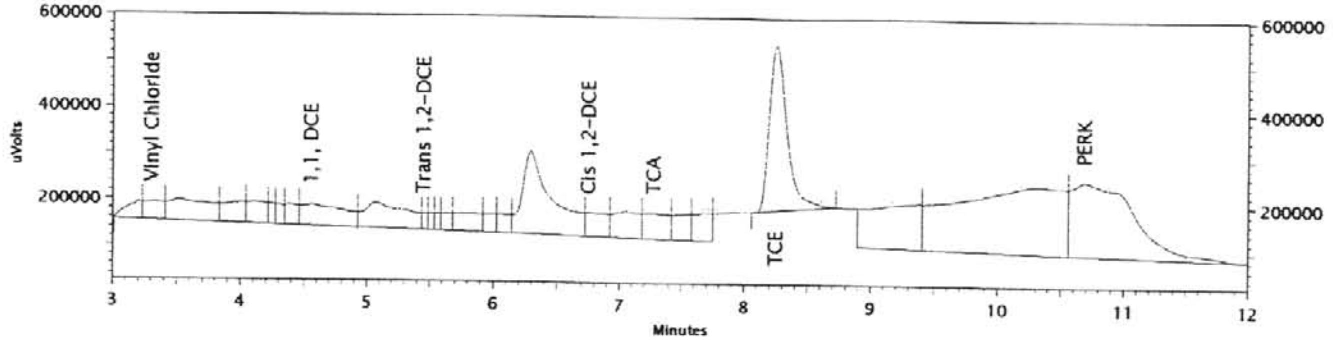


PID Results

Name	Retention Time	Area	ESTD concentration
Vinyl Chloride	3.520	836	0.000
1,1 DCE	4.363	63100	15.090
Trans-1,2-DCE	5.328	5002	0.377
Cis-1,2-DCE	6.398	46706	4.025
TCE	8.181	295116	12.193
PERK	10.866	25741	0.771

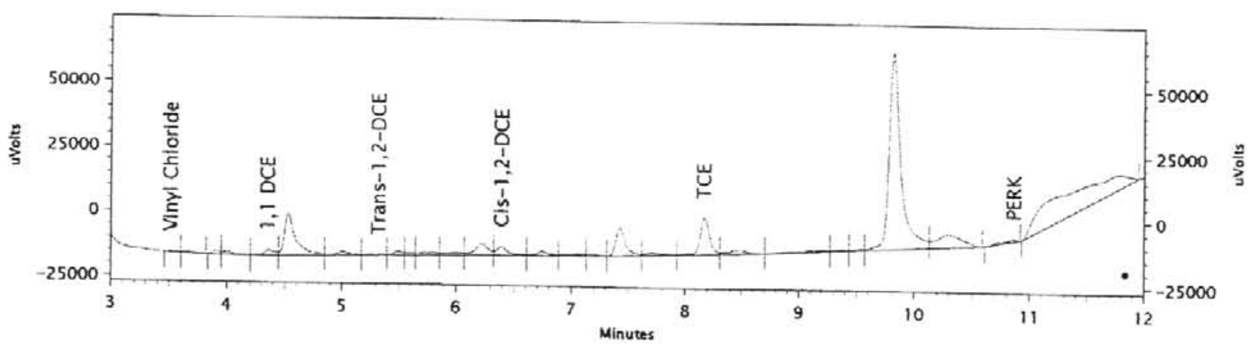
Totals			
		436501	32.457

Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: 102-005-MIP 0-20 ft
C:\EZStart\Data\PGDP\PGDP53
Multiplier: 1



ECD Results

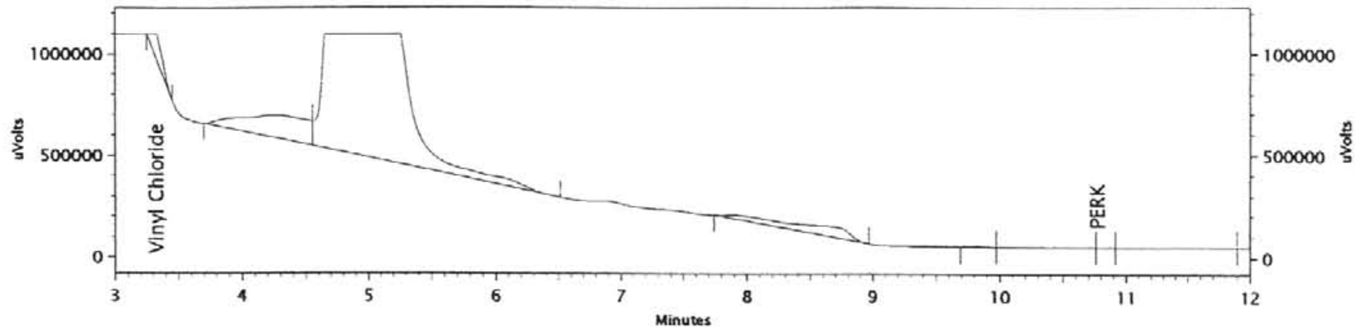
Pk #	Name	Retention Time	Area	ESTD concentration
2	Vinyl Chloride	3.303	401519	46.979
9	1,1, DCE	4.558	1103611	67.765
11	Trans 1,2-DCE	5.452	105997	21.901
19	Cis 1,2-DCE	6.753	595737	89.499
21	TCA	7.278	790134	0.000
24	TCE	8.251	3522403	20.827
27	PERK	10.690	5748191	0.000
Totals			12267592	246.970



PID Results

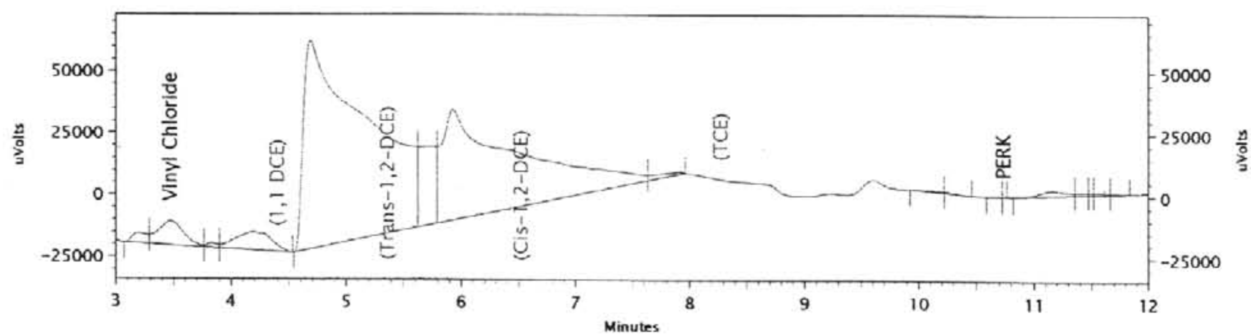
Name	Retention Time	Area	ESTD concentration
Vinyl Chloride	3.517	1445	0.000
1,1 DCE	4.355	13886	3.321
Trans-1,2-DCE	5.323	5074	0.383
Cis-1,2-DCE	6.393	24288	2.093
TCE	8.175	82499	3.409
PERK	10.869	11345	0.340
Totals		138537	9.545

Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: 102-006-MIP 0 - 20 ft
C:\EZStart\Data\PGDP\PGDP67
Multiplier: 1



ECD Results

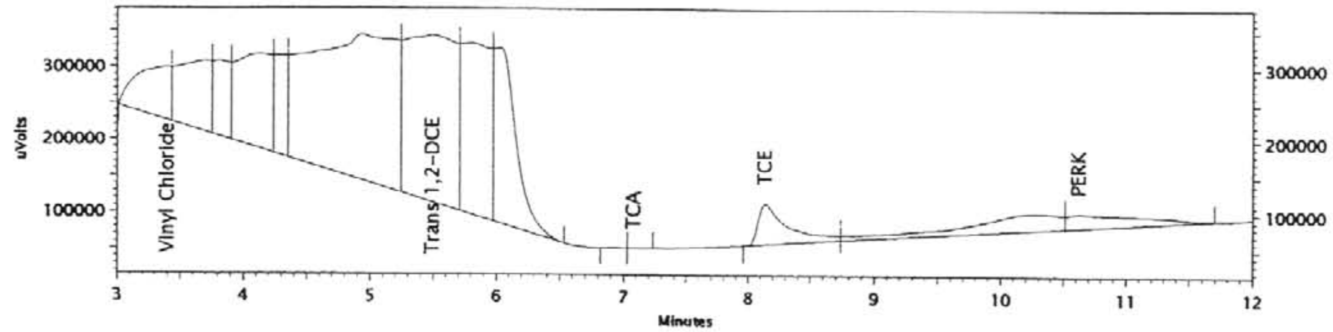
Pk #	Name	Retention Time	Area	ESTD concentration
1	Vinyl Chloride	3.328	708847	82.937
7	PERK	10.776	730	0.000
Totals			709577	82.937



PID Results

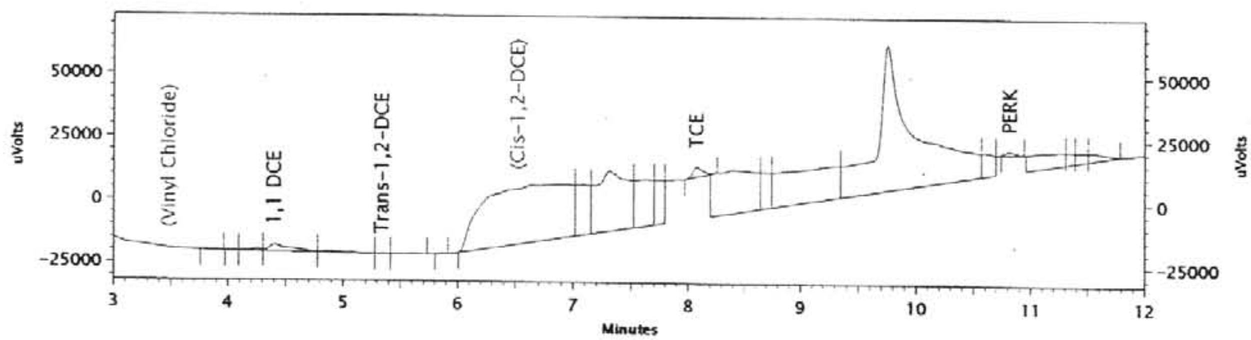
Name	Retention Time	Area	ESTD concentration
Vinyl Chloride	3.472	149755	0.000
PERK	10.736	160	0.005
Totals		149915	0.005

Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: 102-007-MIP 0 - 20 ft
C:\EZStart\Data\PGDP\PGDP59
Multiplier: 1



ECD Results

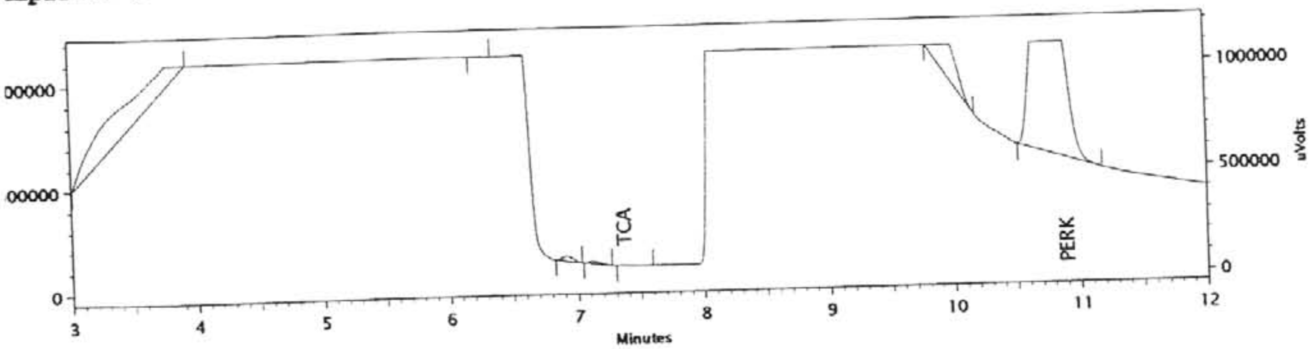
Pk #	Name	Retention Time	Area	ESTD concentration
1	Vinyl Chloride	3.395	1303986	152.570
7	Trans 1,2-DCE	5.492	6192351	1279.432
11	TCA	7.081	2779	0.000
12	TCE	8.138	938987	5.552
14	PERK	10.625	789619	0.000
Totals			9227722	1437.553



PID Results

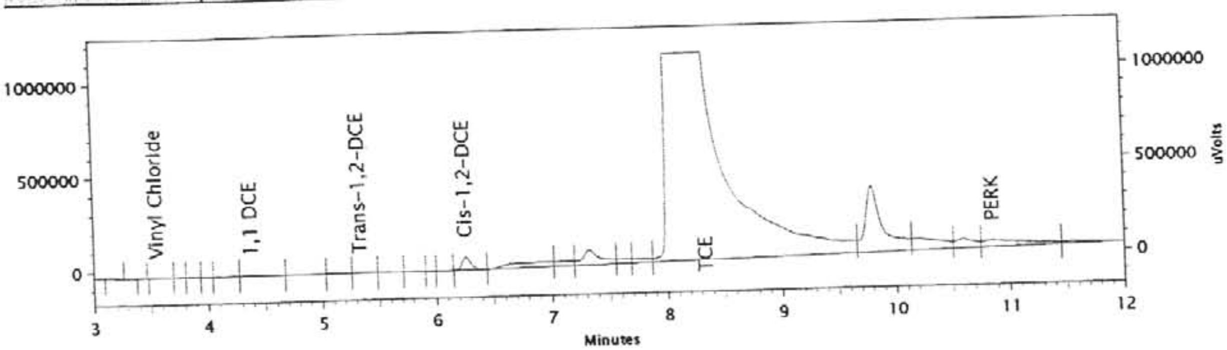
Name	Retention Time	Area	ESTD concentration
1,1 DCE	4.400	36376	8.699
Trans-1,2-DCE	5.337	829	0.063
TCE	8.075	24705	1.021
PERK	10.819	6792	0.204
Totals		68702	9.986

ıod name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
ı: 102-008-MIP 0 - 21 ft
\EZStart\Data\PGDP\PGDP64
tiplier: 1



ːD Results

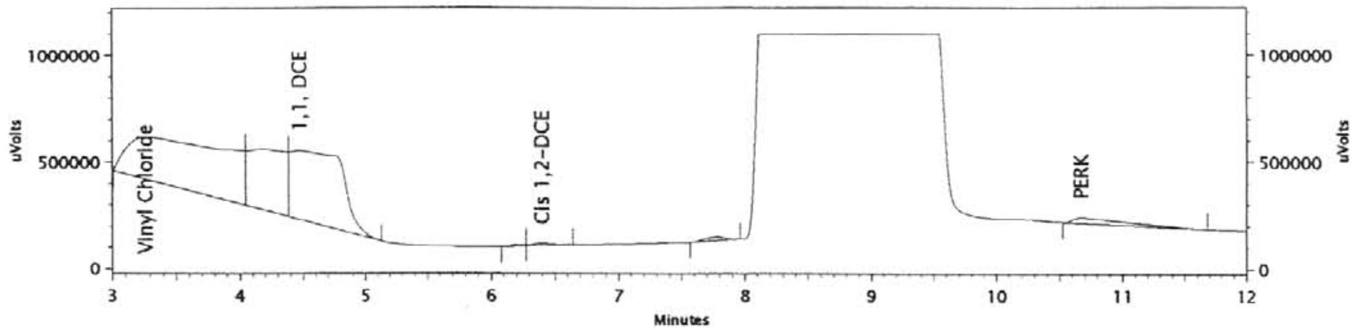
Pk #	Name	Retention Time	Area	ESTD concentration
5	TCA	7.370	14347	0.000
7	PERK	10.888	11266694	0.000
Totals			11281041	0.000



PID Results

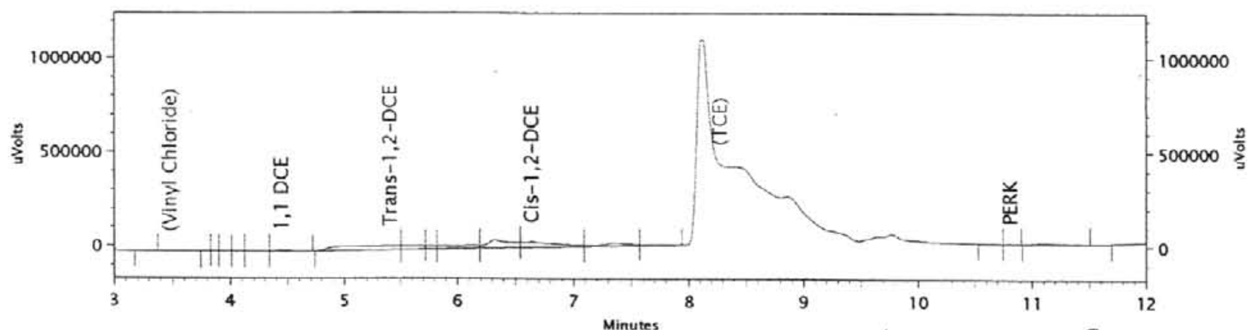
Name	Retention Time	Area	ESTD concentration
Vinyl Chloride	3.555	3296	0.000
1,1 DCE	4.378	52809	12.629
Trans-1,2-DCE	5.335	7160	0.540
Cis-1,2-DCE	6.258	372194	32.076
TCE	8.335	41379463	1709.633
PERK	10.853	926789	27.774
Totals		42741711	1782.651

Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: 102-009-MIP 0 - 20 ft
C:\EZStart\Data\PGDP\PGDP65
Multiplier: 1



ECD Results

Pk #	Name	Retention Time	Area	ESTD concentration
1	Vinyl Chloride	3.262	12343662	1444.241
3	1,1, DCE	4.475	9759197	599.244
5	Cis 1,2-DCE	6.400	125728	18.888
7	PERK	10.675	794963	0.000
Totals			23023550	2062.373

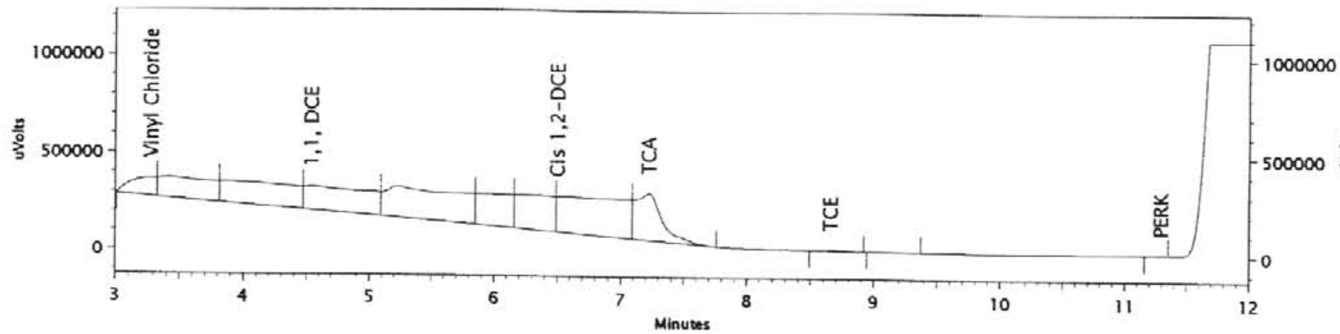


This is all carry over from 102-008-MIP

PID Results

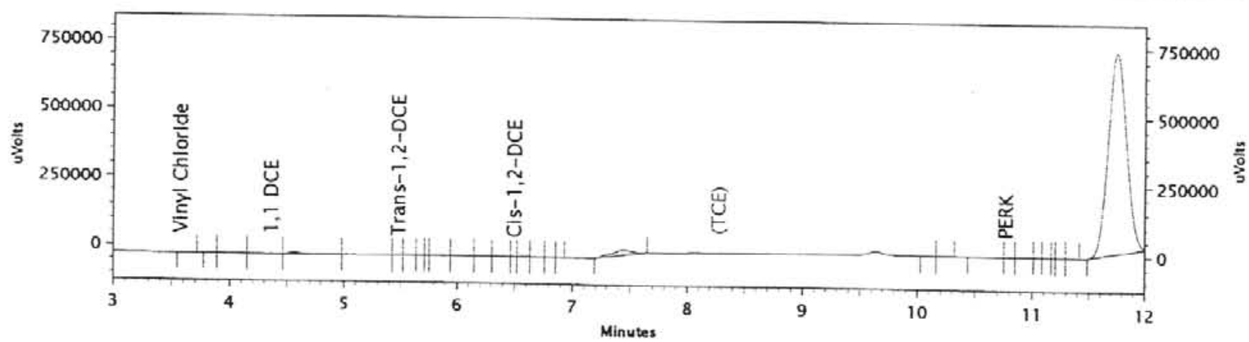
Name	Retention Time	Area	ESTD concentration
1,1 DCE	4.447	43310	10.357
Trans-1,2-DCE	5.410	873754	65.896
Cis-1,2-DCE	6.641	609050	52.488
PERK	10.816	3774	0.113
Totals		1529888	128.854

Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: 102-010-MIP 0 - 20 ft
C:\EZStart\Data\PGDP\PGDP66
Multiplier: 1



ECD Results

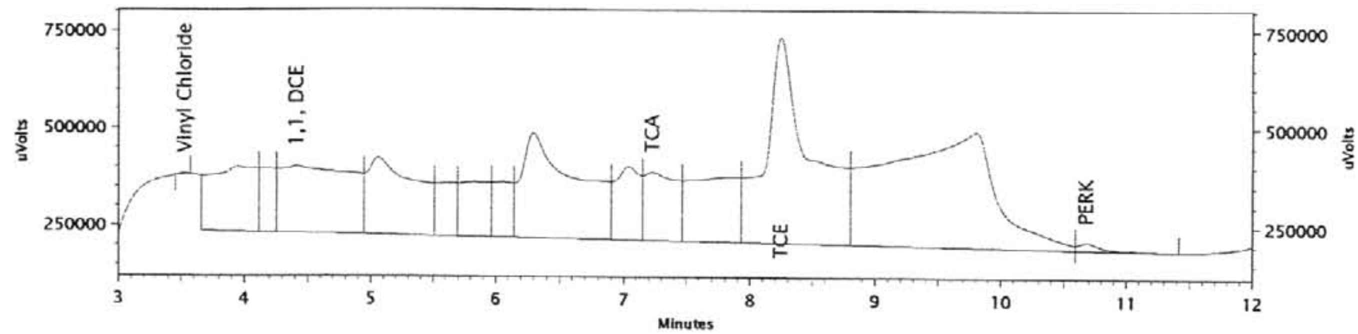
Pk #	Name	Retention Time	Area	ESTD concentration
1	Vinyl Chloride	3.278	1285632	150.422
4	1,1, DCE	4.542	4421690	271.505
8	Cis 1,2-DCE	6.501	6972575	1047.502
9	TCA	7.226	3578934	0.000
10	TCE	8.660	46048	0.272
12	PERK	11.298	840	0.000
Totals			16305719	1469.702



PID Results

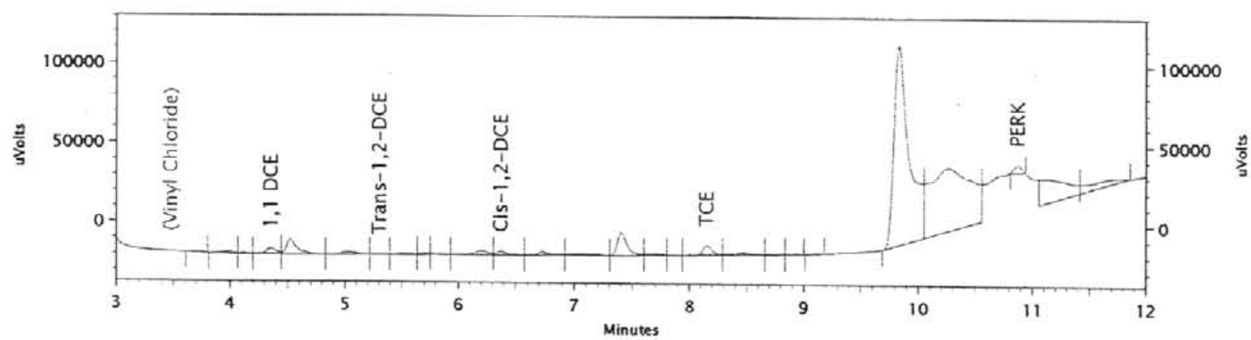
Name	Retention Time	Area	ESTD concentration
Vinyl Chloride	3.578	969	0.000
1,1 DCE	4.358	9993	2.390
Trans-1,2-DCE	5.480	458	0.035
Cis-1,2-DCE	6.501	148	0.013
PERK	10.771	550	0.016
Totals		12118	2.454

Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: 102-011-mip
C:\EZStart\Data\PGDP\PGDP60
Multiplier: 1



ECD Results

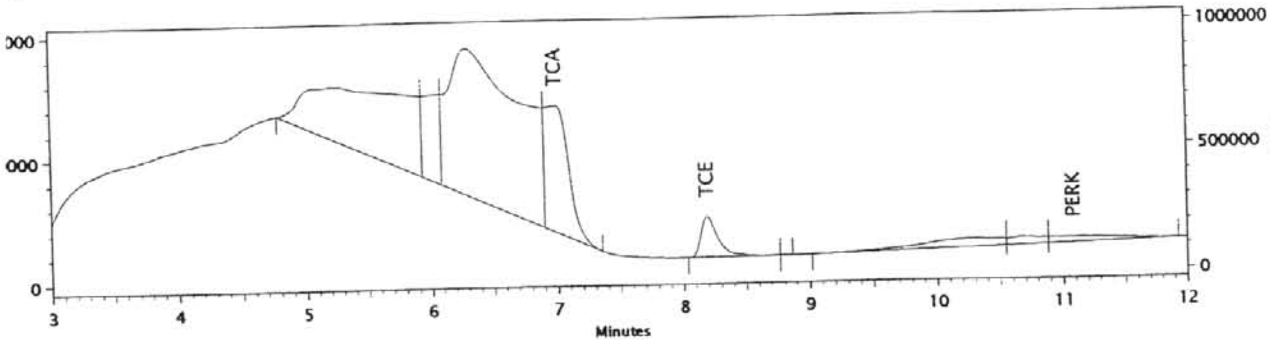
Pk #	Name	Retention Time	Area	ESTD concentration
1	Vinyl Chloride	3.528	15867	1.856
4	1,1, DCE	4.412	6683028	410.358
11	TCA	7.228	3145955	0.000
13	TCE	8.245	13464034	79.607
15	PERK	10.678	284693	0.000
Totals			23593577	491.822



PID Results

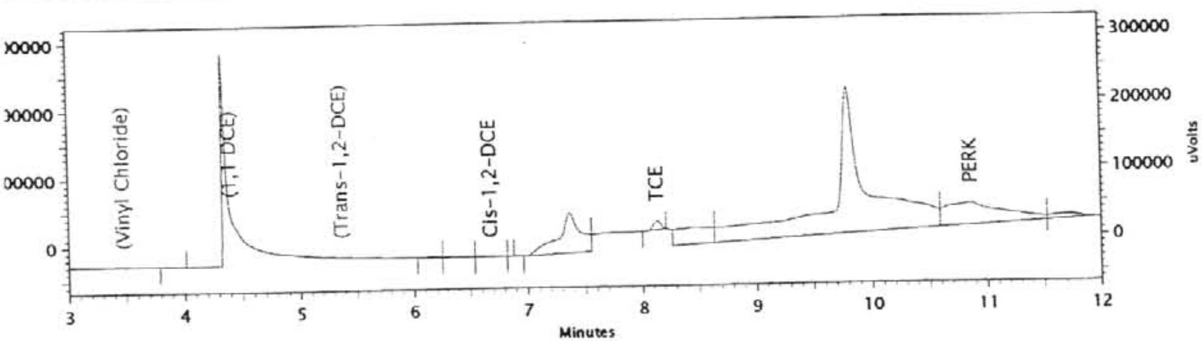
Name	Retention Time	Area	ESTD concentration
1,1 DCE	4.352	20762	4.965
Trans-1,2-DCE	5.302	2346	0.177
Cis-1,2-DCE	6.376	12406	1.069
TCE	8.155	32689	1.351
PERK	10.873	19865	0.595
Totals		88068	8.157

d name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
102-012-mip 0- 20 ft
:ZStart\Data\PGDP\PGDP62
plier: 1



Results

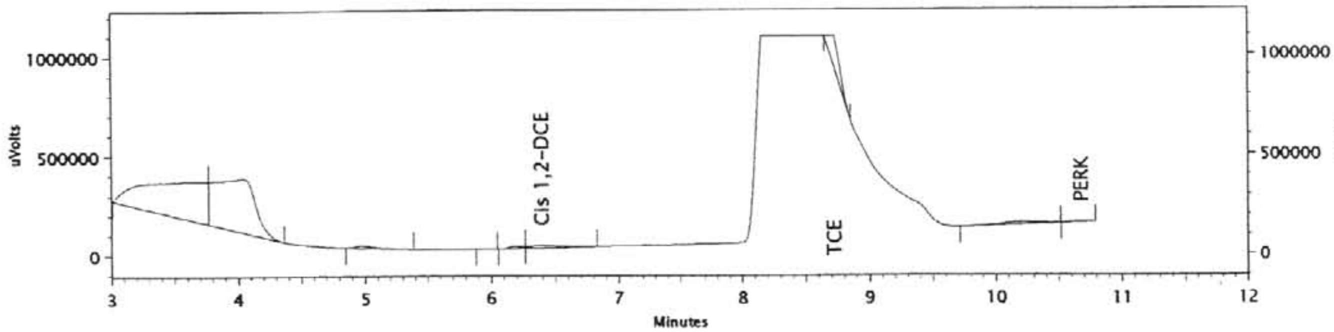
Pk #	Name	Retention Time	Area	ESTD concentration
4	TCA	6.996	6502886	0.000
5	TCE	8.190	1534483	9.073
9	PERK	11.083	850456	0.000
Totals			8887825	9.073



D Results

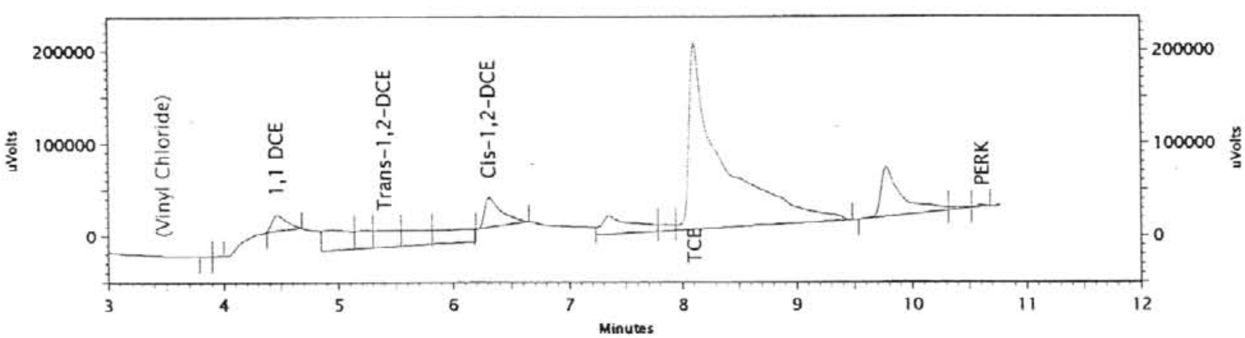
me	Retention Time	Area	ESTD concentration
s-1,2-DCE	6.683	3431	0.296
:E	8.130	57715	2.385
:RK	10.858	1128548	33.820
)tals		1189694	36.500

lethod name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
)ata: 102-013-mip 0- 20 ft
C:\EZStart\Data\PGDP\PGDP63
fultiplier: 1



ECD Results

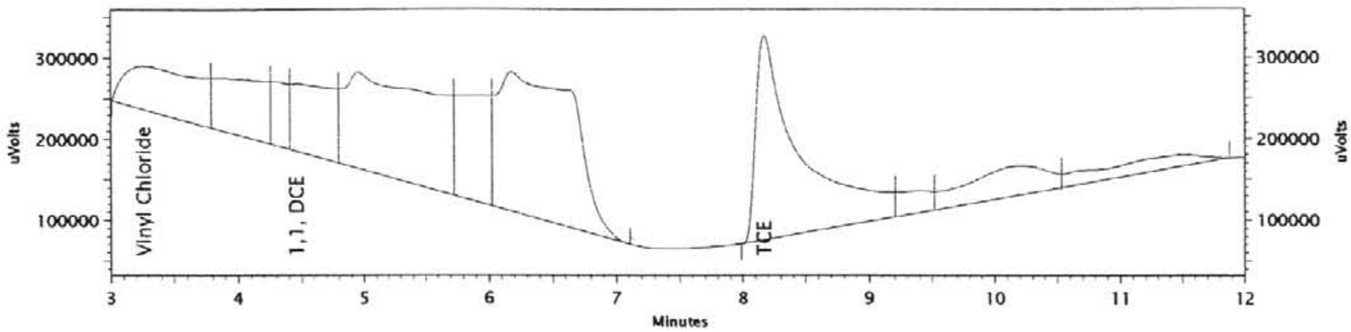
Pk #	Name	Retention Time	Area	ESTD concentration
6	Cis 1,2-DCE	6.395	249647	37.505
7	TCE	8.725	900196	5.322
9	PERK	10.678	53220	0.000
Totals			1203063	42.827



PID Results

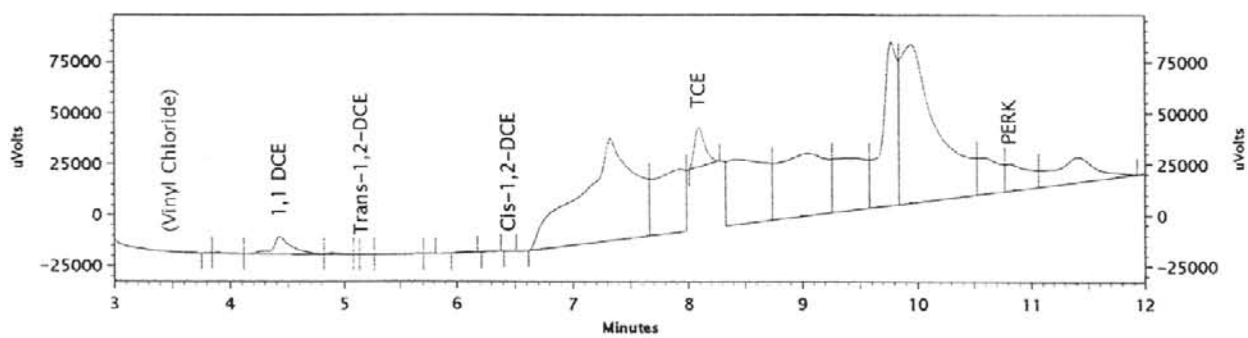
Name	Retention Time	Area	ESTD concentration
1,1 DCE	4.465	151753	36.290
Trans-1,2-DCE	5.403	265605	~~20.031~~ 10
Cis-1,2-DCE	6.315	317545	27.366
TCE	8.110	4088797	168.933
PERK	10.615	12797	0.383
Totals		4836497	253.004

Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: 102-014-mip 0- 20 ft
C:\EZStart\Data\PGDP\PGDP61
Multiplier: 1



ECD Results

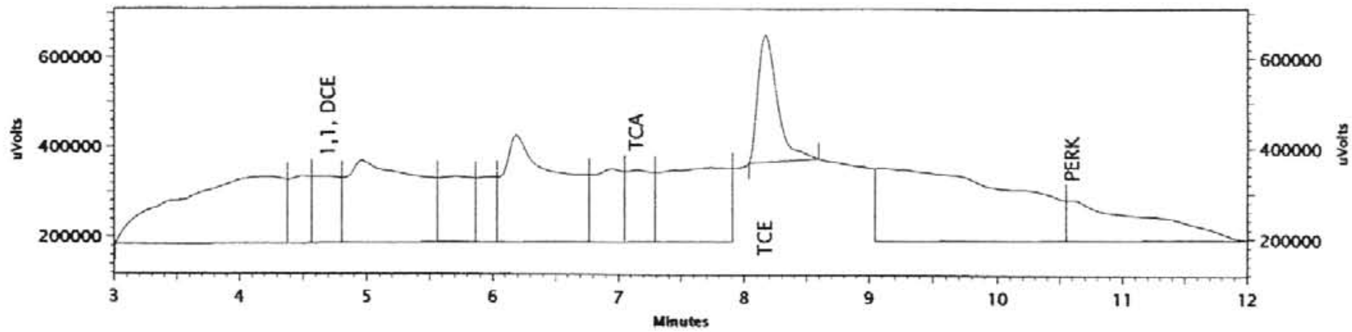
Pk #	Name	Retention Time	Area	ESTD concentration
1	Vinyl Chloride	3.260	2332668	272.928
4	1,1, DCE	4.460	2021250	124.111
8	TCE	8.173	6172194	36.494
Totals			10526112	433.533



PID Results

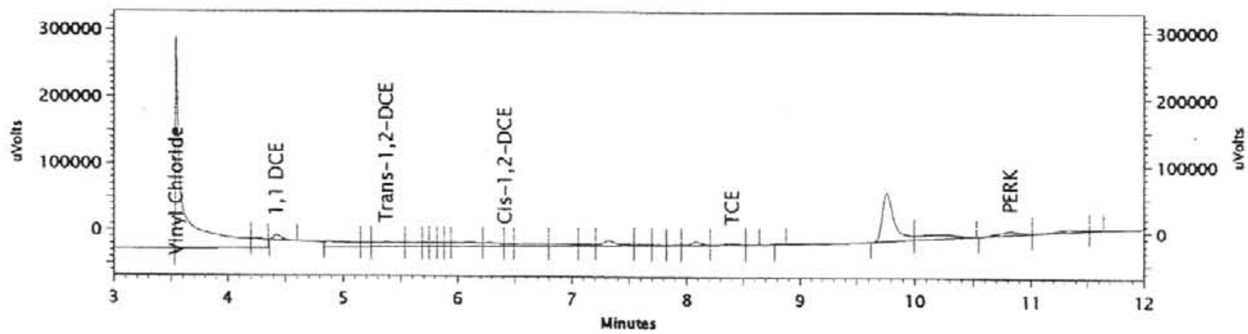
Name	Retention Time	Area	ESTD concentration
1,1 DCE	4.427	95973	22.951
Trans-1,2-DCE	5.153	606	0.046
Cis-1,2-DCE	6.445	372	0.032
TCE	8.091	122085	5.044
PERK	10.810	193274	5.792
Totals		412310	33.865

Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: 102-015-MIP 0 - 20 ft
C:\EZStart\Data\PGDP\PGDP58
Multiplier: 1



ECD Results

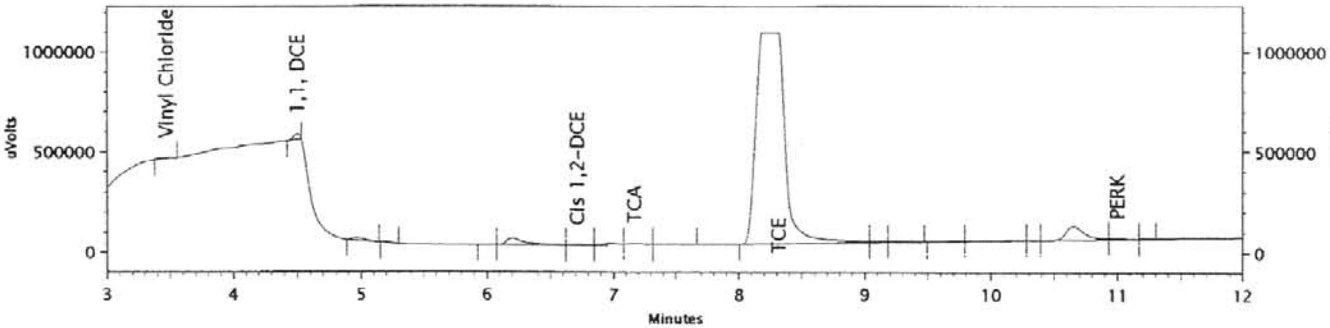
Pk #	Name	Retention Time	Area	ESTD concentration
3	1,1, DCE	4.697	2120283	130.192
9	TCA	7.145	2280255	0.000
11	TCE	8.170	3026205	17.893
13	PERK	10.603	4080362	0.000
Totals			11507105	148.084



PID Results

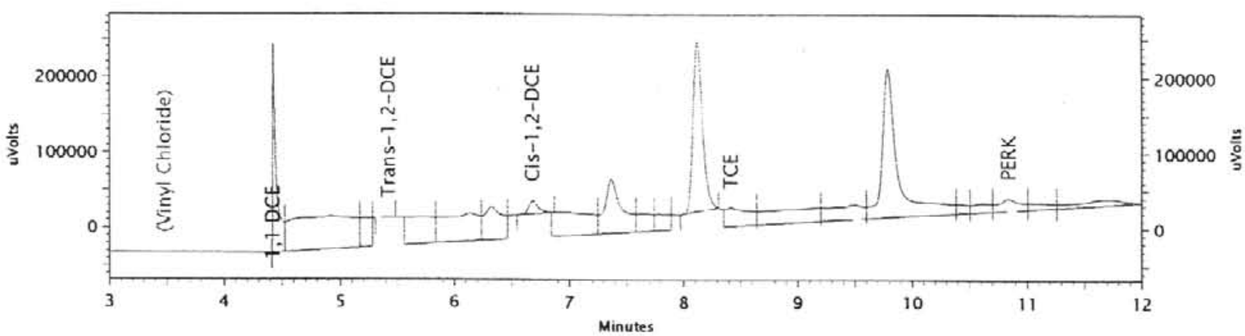
Name	Retention Time	Area	ESTD concentration
Vinyl Chloride	3.543	1450654	0.000
1,1 DCE	4.423	40335	9.646
Trans-1,2-DCE	5.377	106724	8.049
Cis-1,2-DCE	6.415	17771	1.532
TCE	8.405	13597	0.562
PERK	10.824	83734	2.509
Totals		1712815	22.297

Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: 720-101-MIP 0-15 ft
C:\EZStart\Data\PGDP\PGDP37
Multiplier: 1



ECD Results

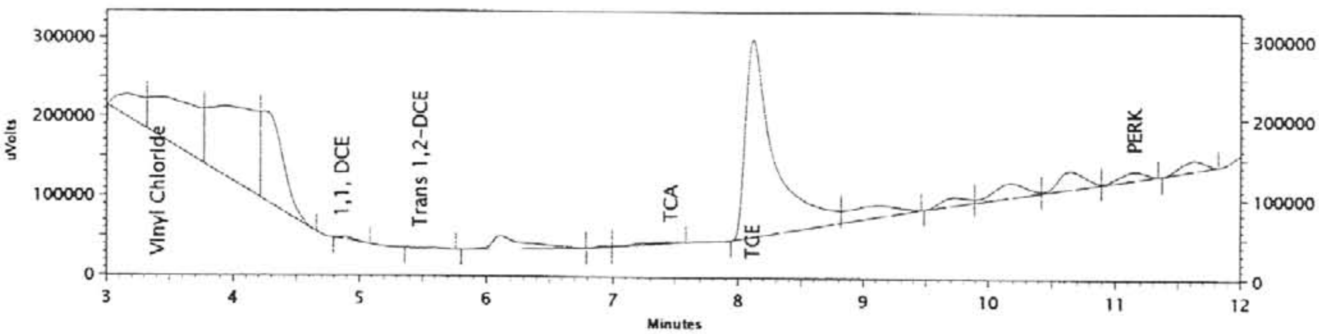
Pk #	Name	Retention Time	Area	ESTD concentration
1	Vinyl Chloride	3.473	36299	4.247
2	1,1, DCE	4.505	89959	5.524
7	Cis 1,2-DCE	6.716	9338	1.403
9	TCA	7.173	78053	0.000
11	TCE	8.321	16325765	96.528
18	PERK	11.004	47578	0.000
Totals			16586992	107.701



PID Results

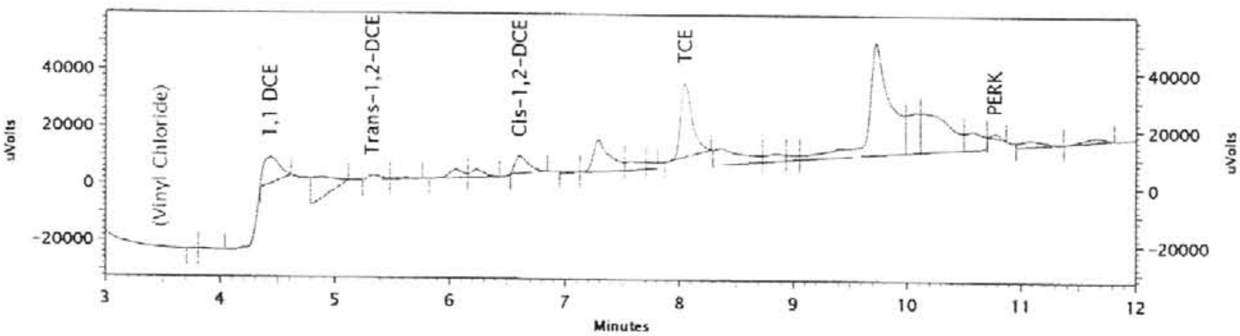
Name	Retention Time	Area	ESTD concentration
1,1 DCE	4.427	611192	146.161
Trans-1,2-DCE	5.425	4579	0.345
Cis-1,2-DCE	6.683	99145	8.544
TCE	8.421	371650	15.355
PERK	10.843	211487	6.338
Totals		1298053	176.744

Method name: C:\EZStart\Projects\Default\Methods\PID_ECD.met
Data: **720-101-MIP 0-15 ft**
C:\EZStart\Data\PGDP\PGDP37b
Multiplier: 1



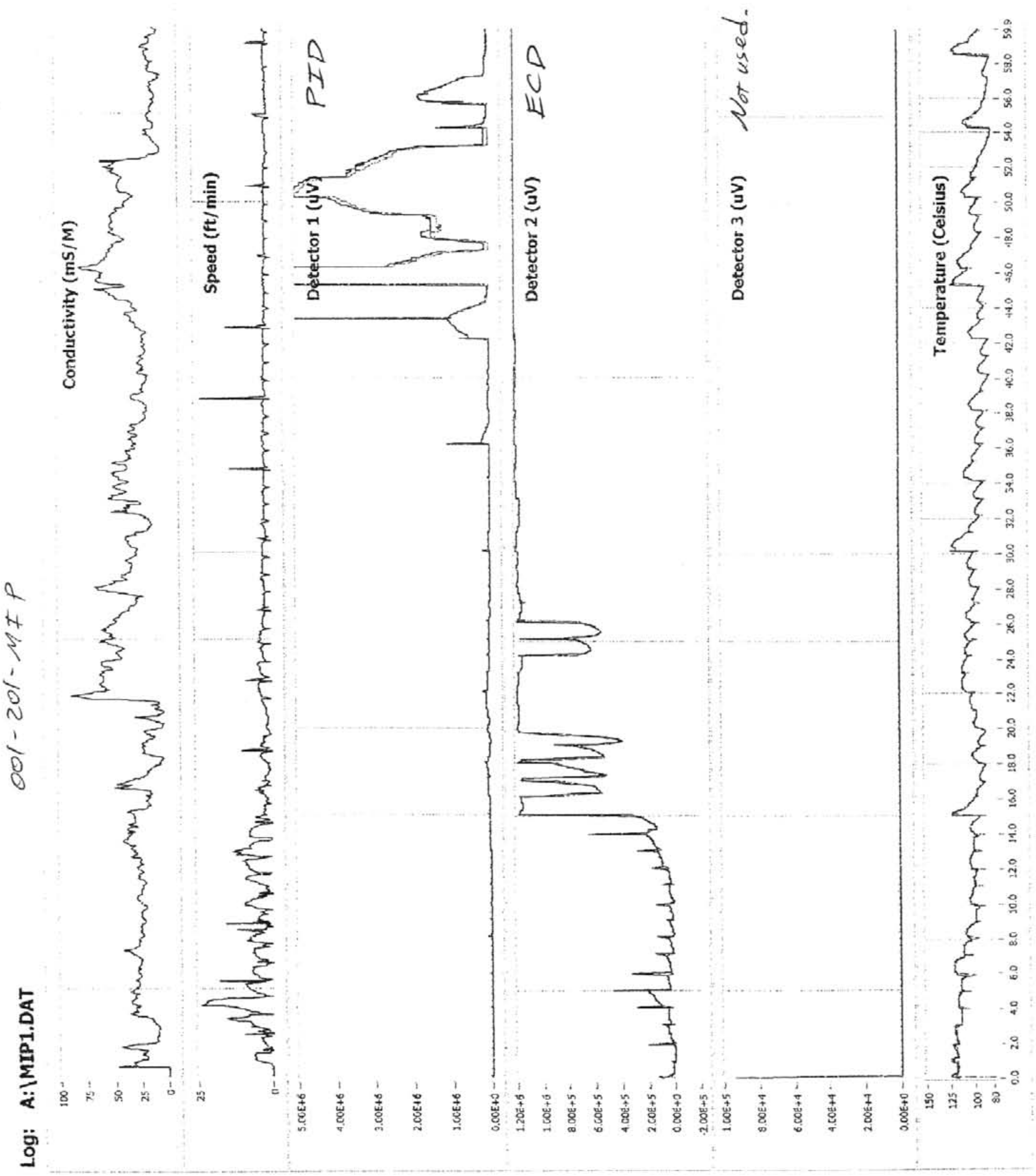
ECD Results

Pk #	Name	Retention Time	Area	ESTD concentration
2	Vinyl Chloride	3.407	1504207	175.996
5	1,1, DCE	4.863	26983	1.657
6	Trans 1,2-DCE	5.483	18987	3.923
9	TCA	7.466	55676	0.000
10	TCE	8.118	3927567	23.222
15	PERK	11.154	159644	0.000
Totals			5693064	204.798

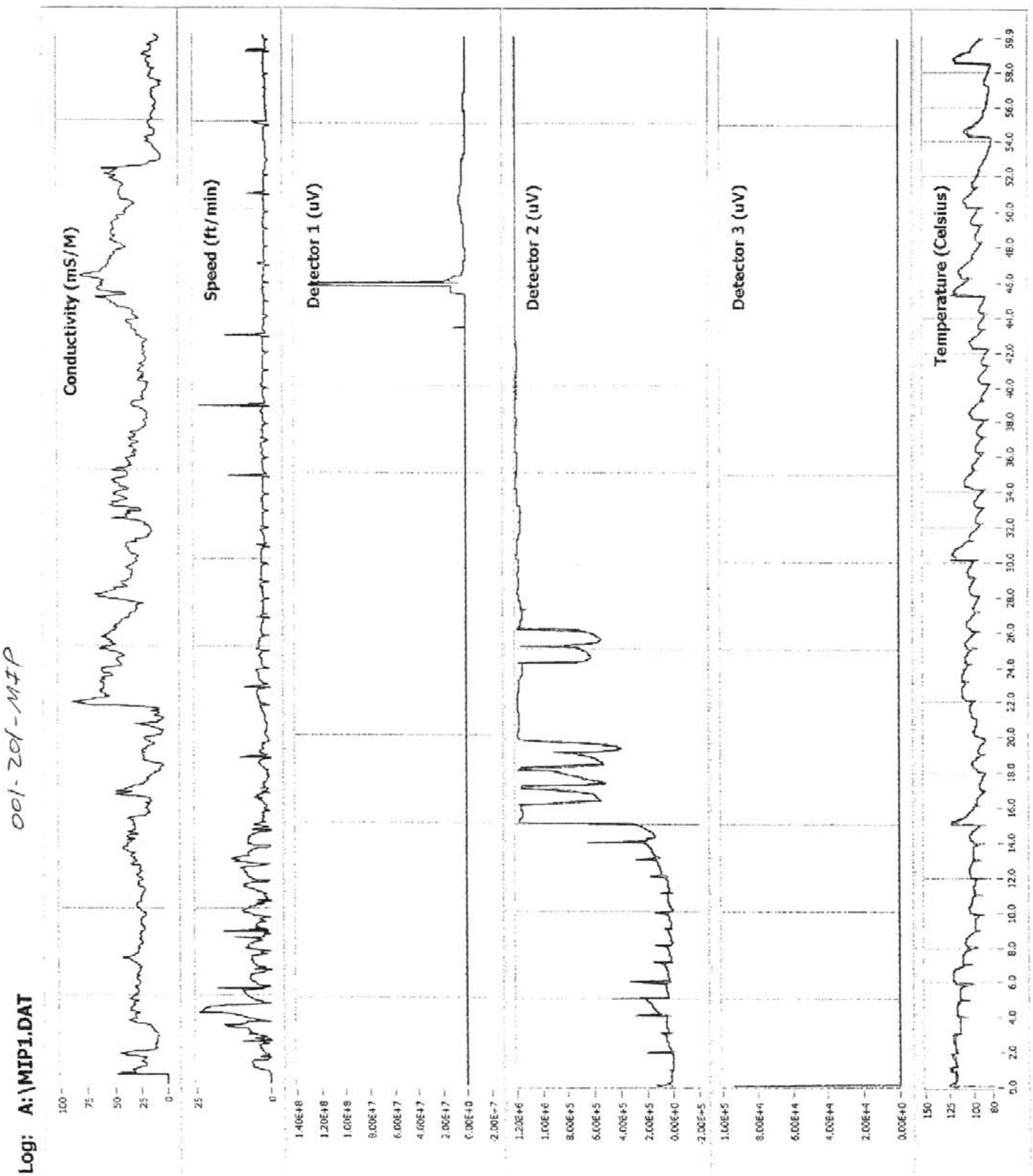


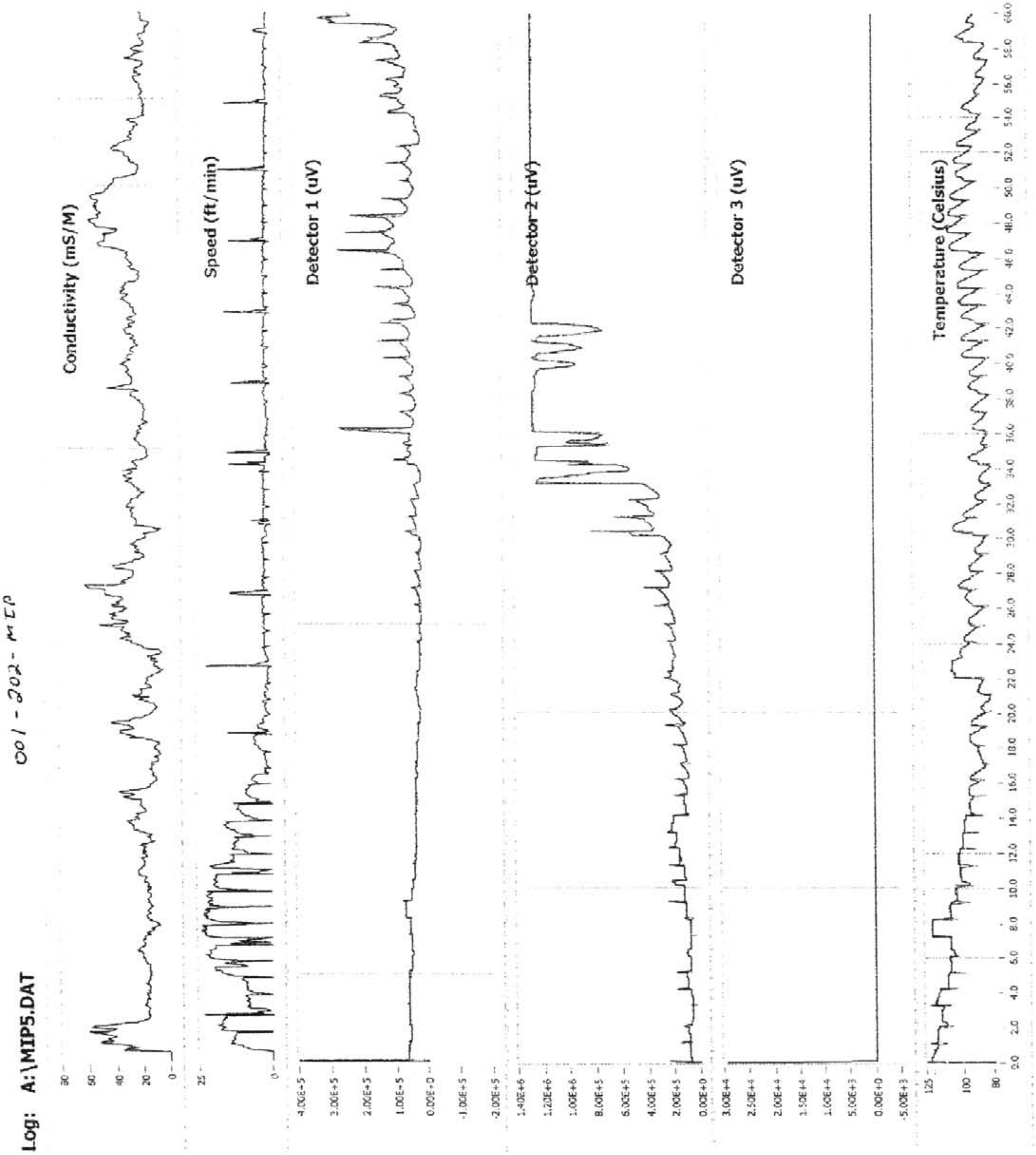
PID Results

Name	Retention Time	Area	ESTD concentration
1,1 DCE	4.430	85545	20.457
Trans-1,2-DCE	5.327	13581	1.024
Cis-1,2-DCE	6.608	47888	4.127
TCE	8.050	182727	7.550
PERK	10.775	8123	0.243
Totals		337864	33.402

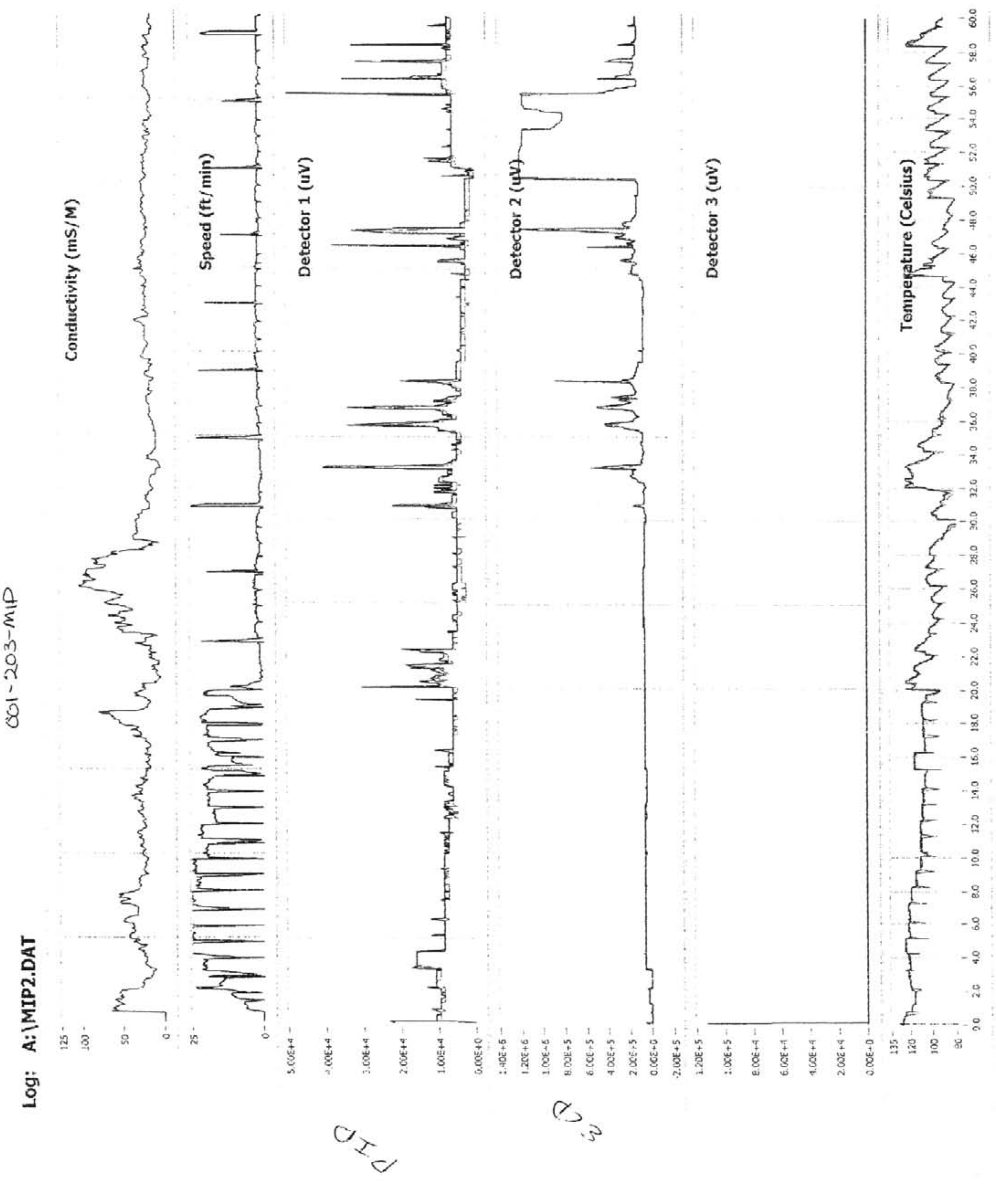


Log: A:\MIP1.DAT
001-201-MIP
Conductivity (mS/M)
Speed (ft/min)
Detector 1 (uV)
PID
Detector 2 (uV)
ECD
Detector 3 (uV)
Not used.
Temperature (Celsius)

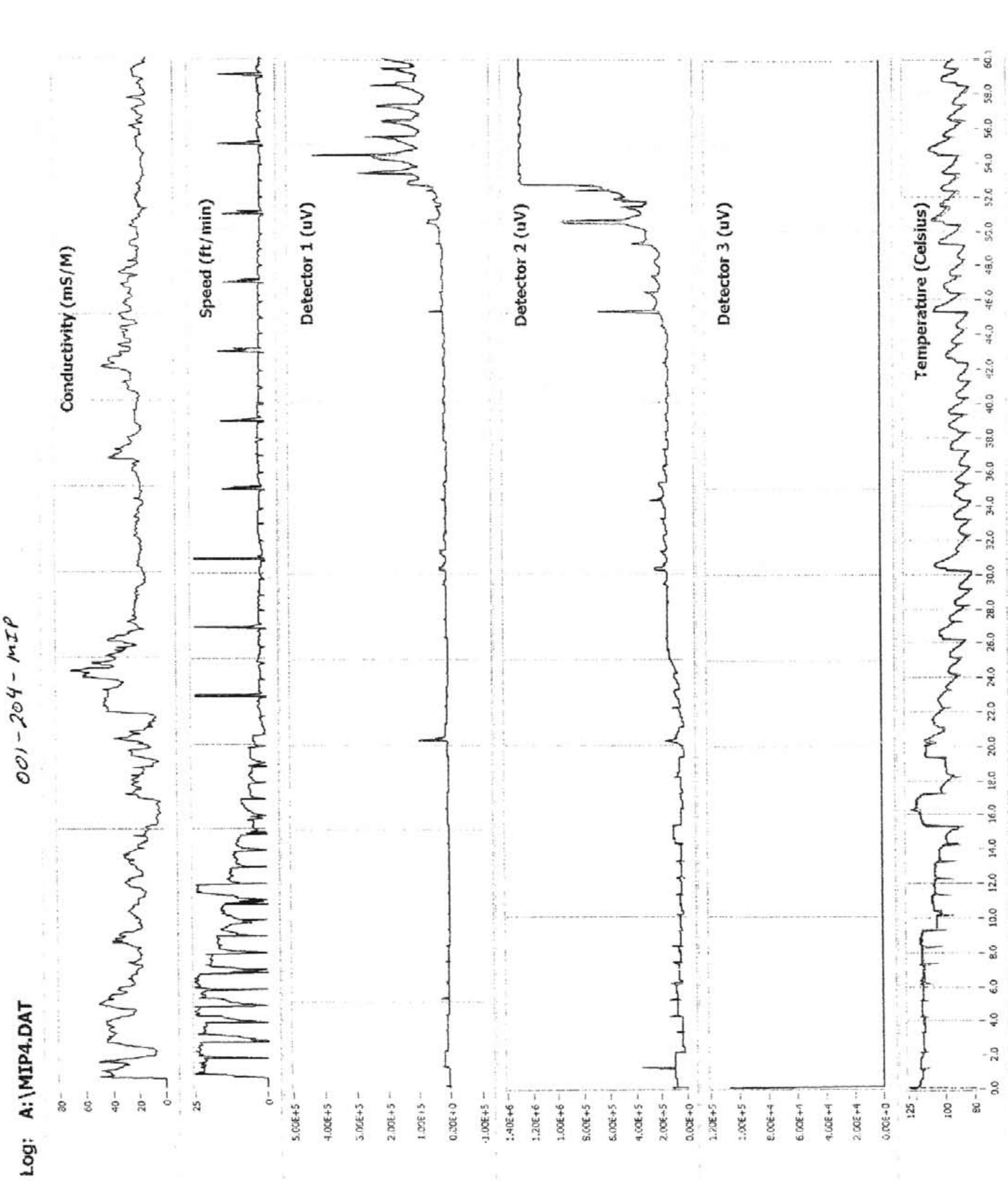

Log: A:\MIP1.DAT
001-201-MIP
Conductivity (mS/M)
Speed (ft/min)
Detector 1 (uV)
Detector 2 (uV)
Detector 3 (uV)
Temperature (Celsius)

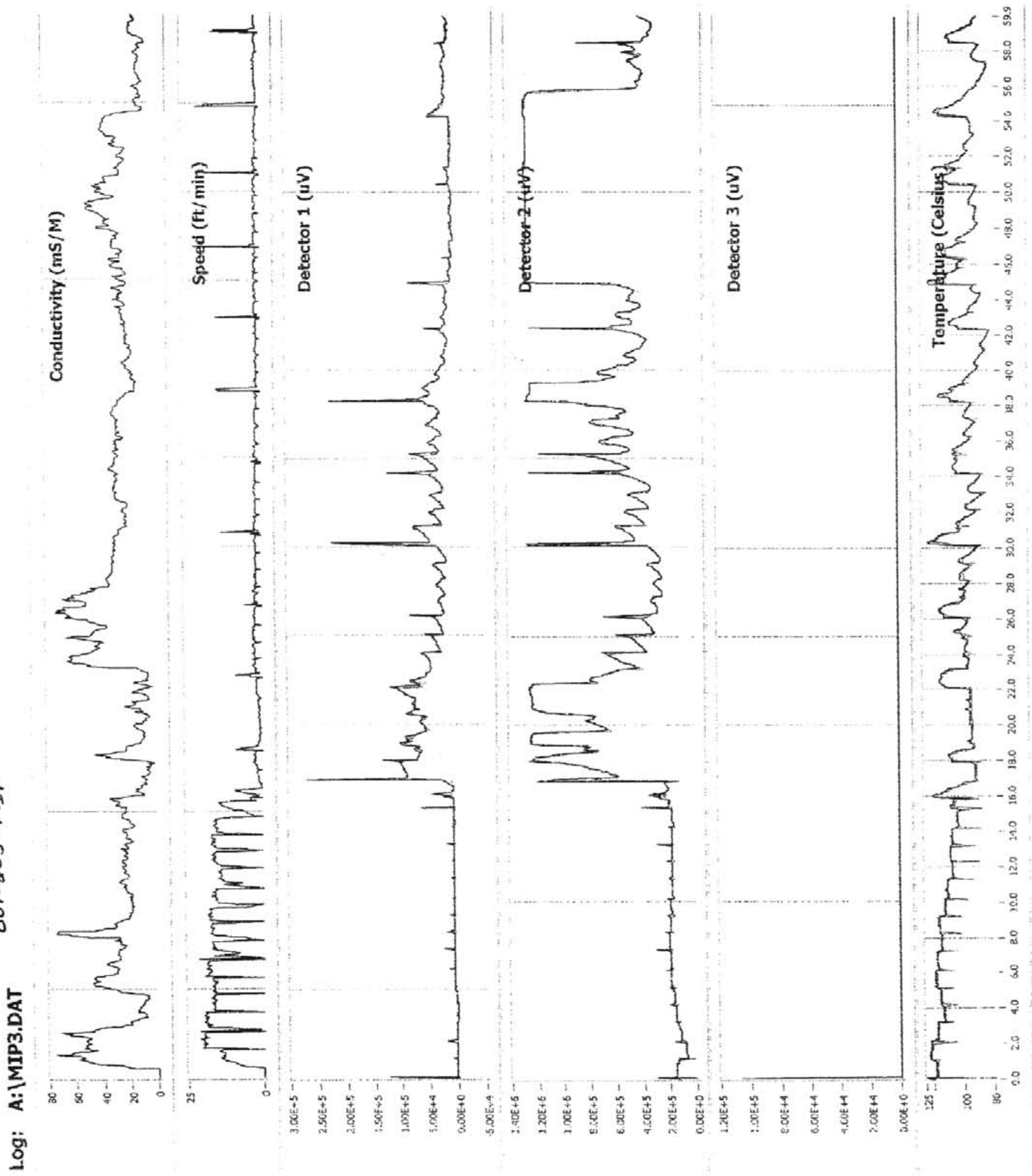


Log: A:\MIP5.DAT
001 - 202 - MIP
Conductivity (mS/M)
Speed (ft/min)
Detector 1 (uV)
Detector 2 (uV)
Detector 3 (uV)
Temperature (Celsius)

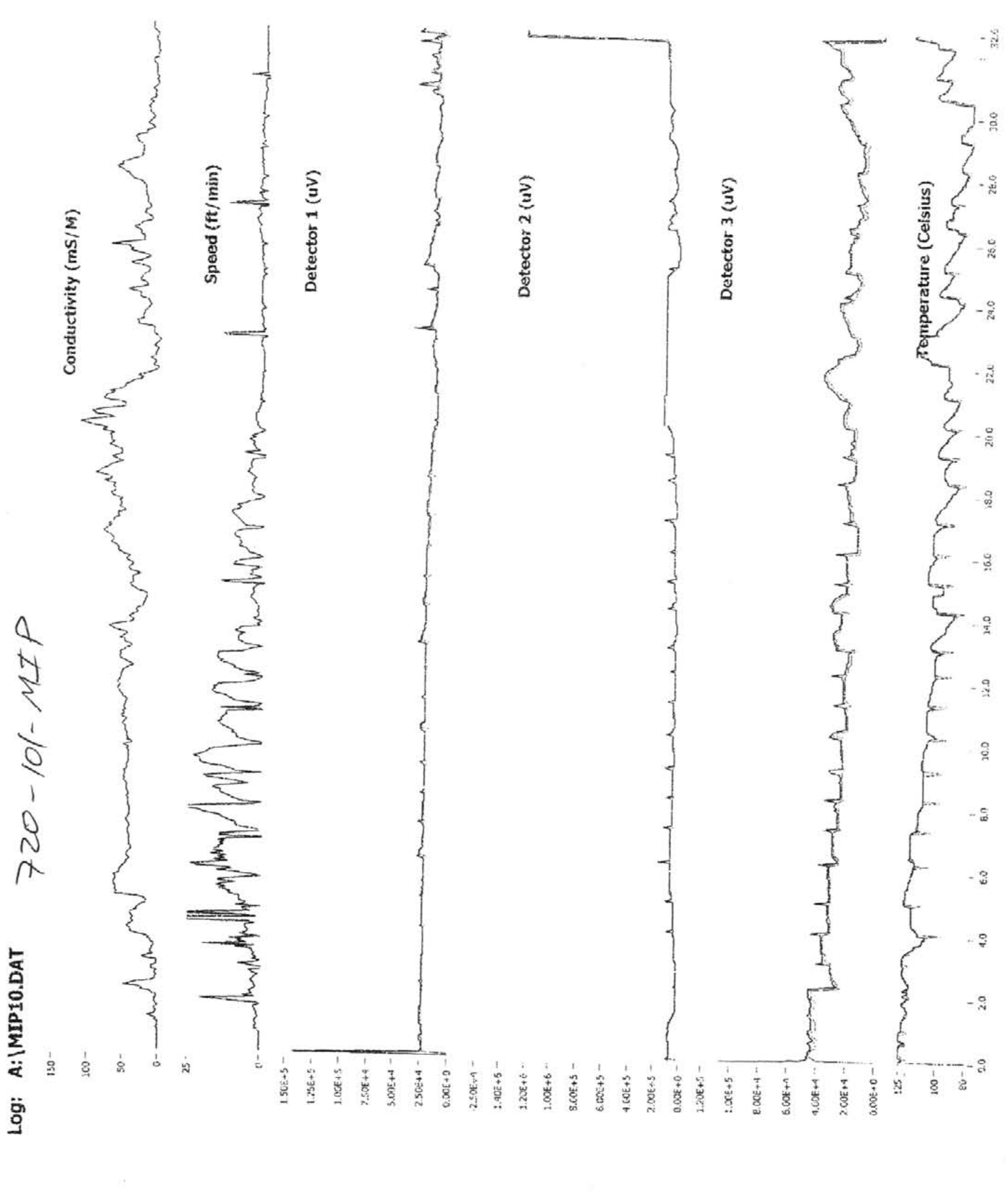


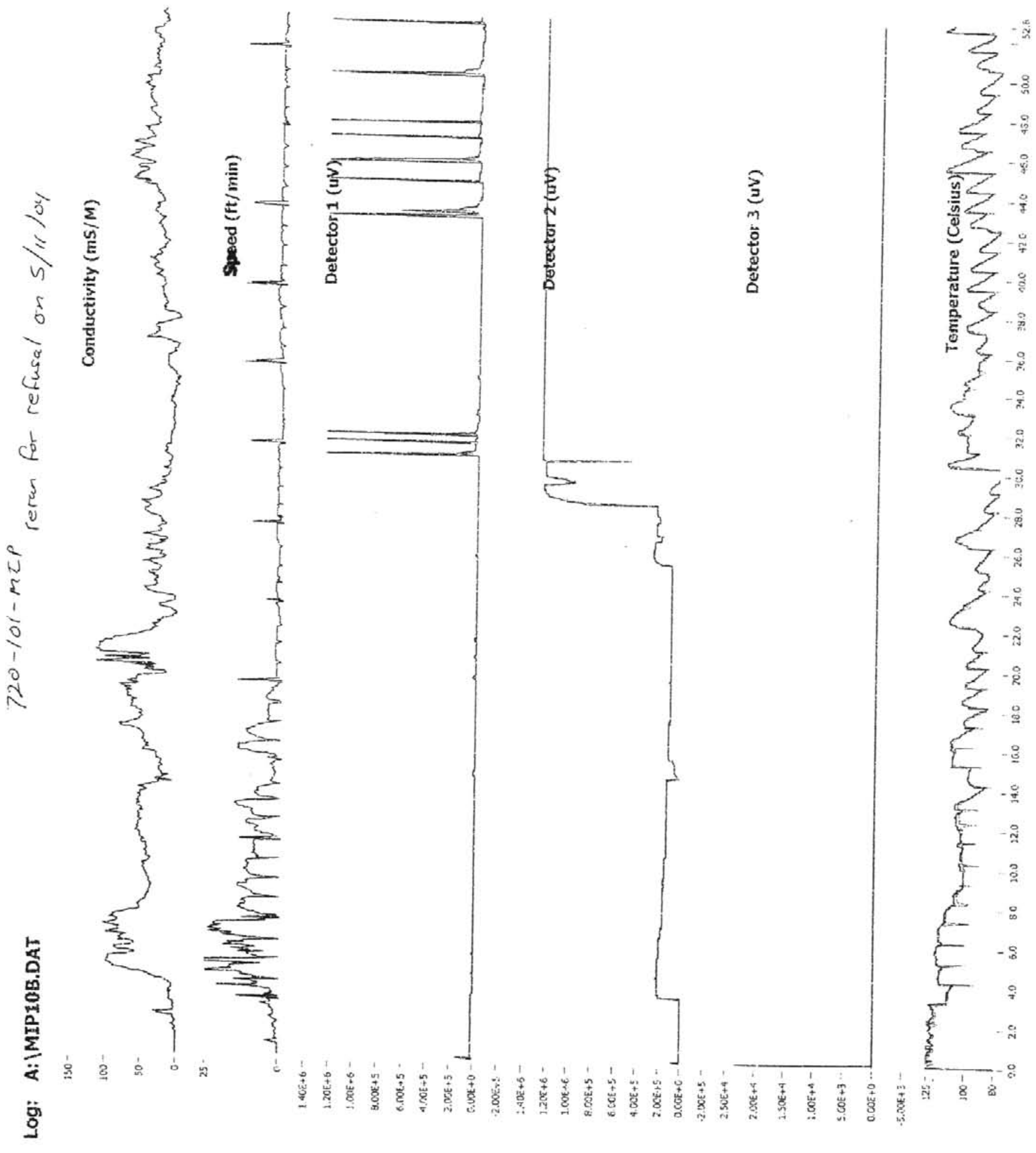
Log: A:\MIP2.DAT
601-203-MIP
Conductivity (mS/M)
Speed (ft/min)
Detector 1 (uV)
Detector 2 (uV)
Detector 3 (uV)
Temperature (Celsius)

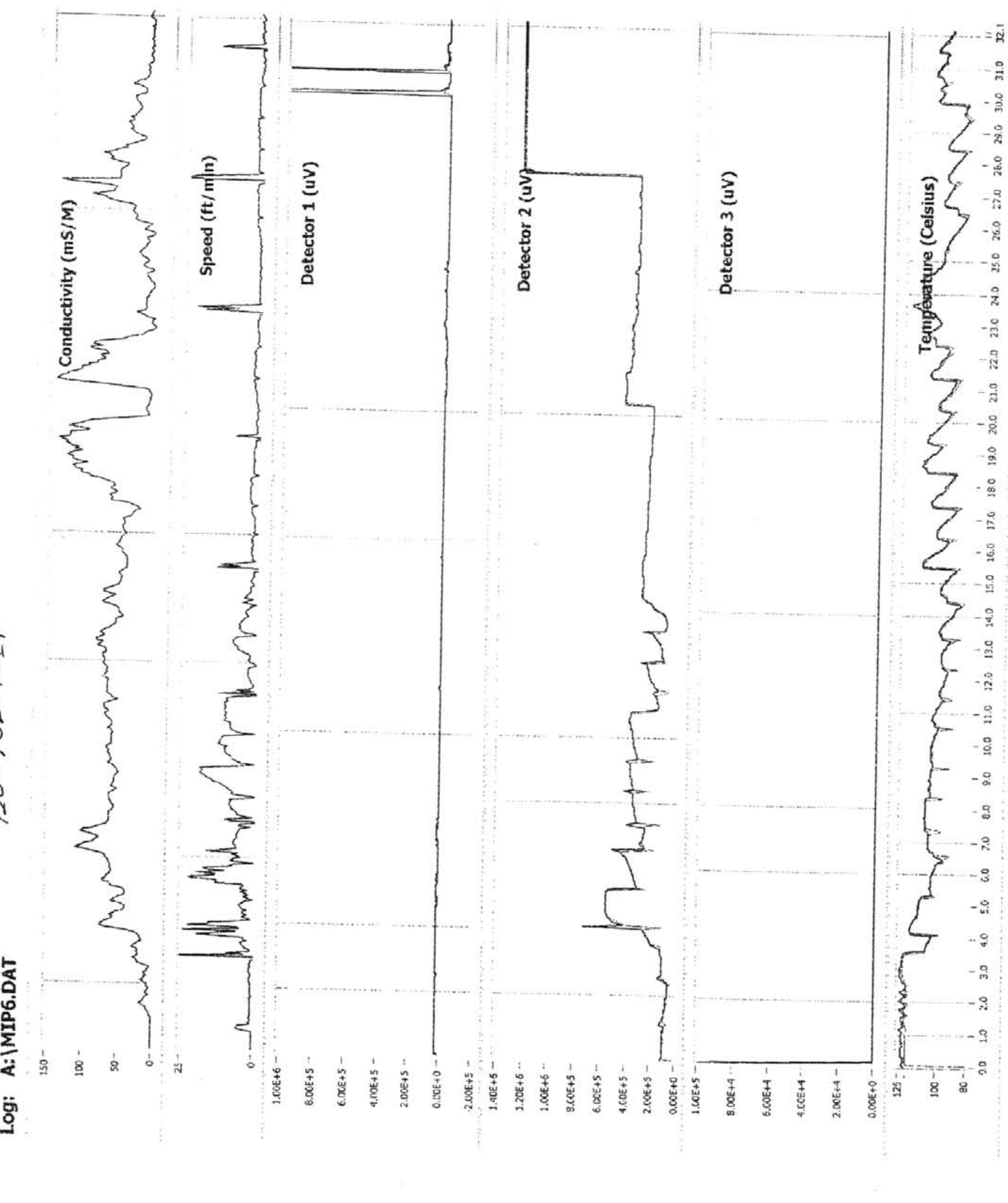

Log: A:\MIP4.DAT
001-204-MIP
Conductivity (mS/M)
Speed (ft/min)
Detector 1 (uV)
Detector 2 (uV)
Detector 3 (uV)
Temperature (Celsius)

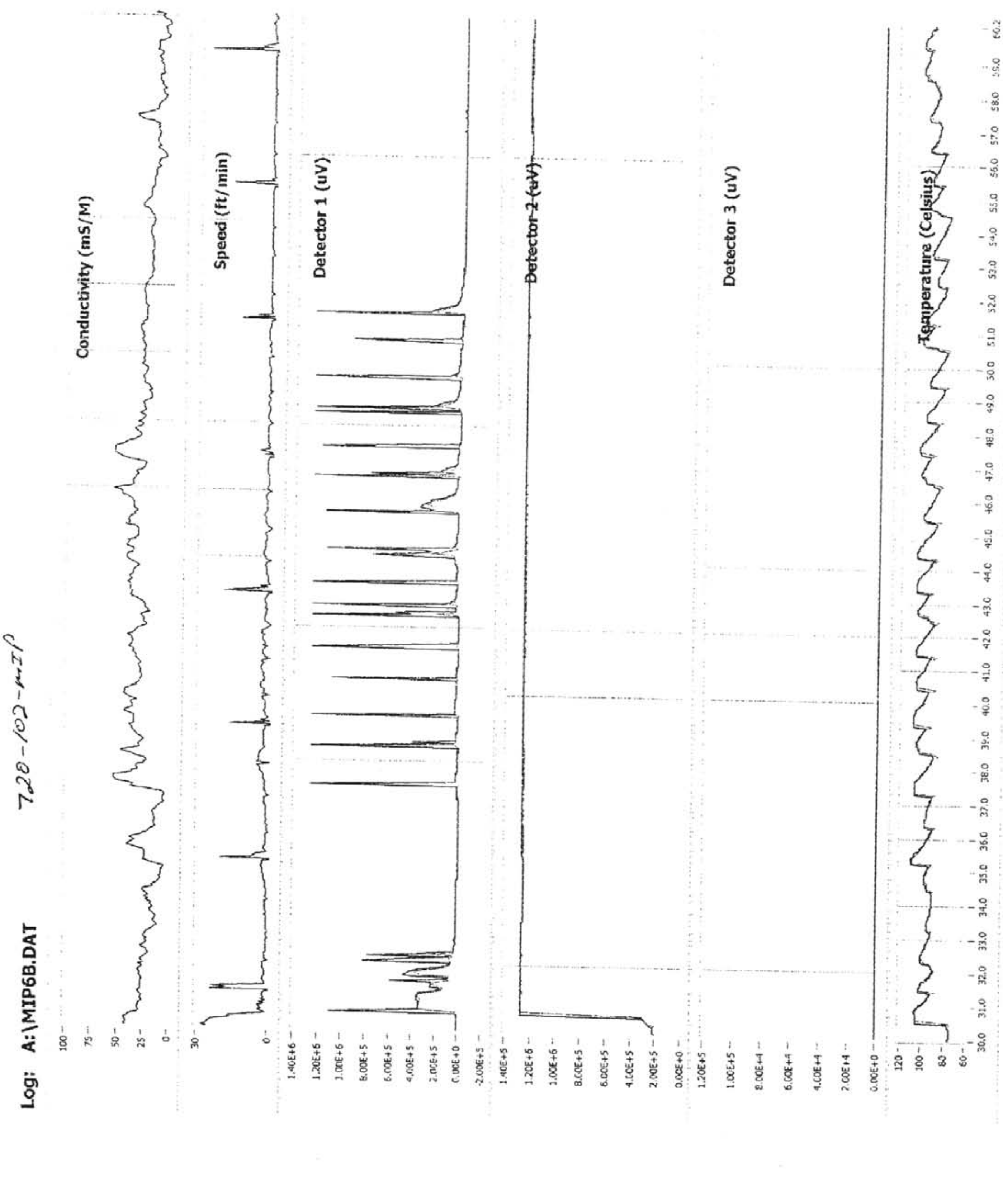


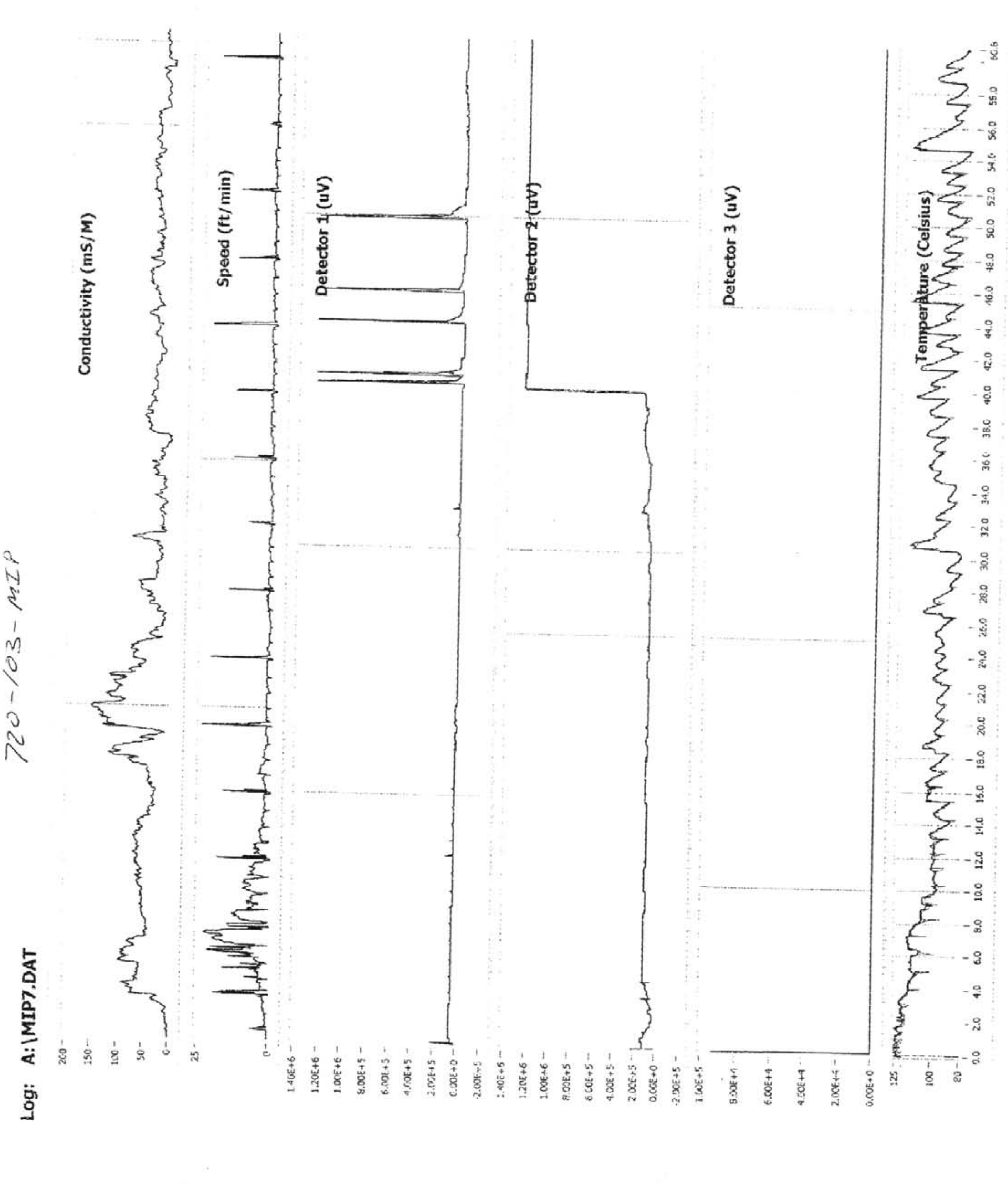
Log: A:\MIP3.DAT
001-205-MIP
Conductivity (mS/M)
Speed (ft/min)
Detector 1 (uV)
Detector 2 (uV)
Detector 3 (uV)
Temperature (Celsius)


Log: A:\MIP10.DAT
720-101-MIP
Conductivity (mS/M)
Speed (ft/min)
Detector 1 (uV)
Detector 2 (uV)
Detector 3 (uV)
Temperature (Celsius)

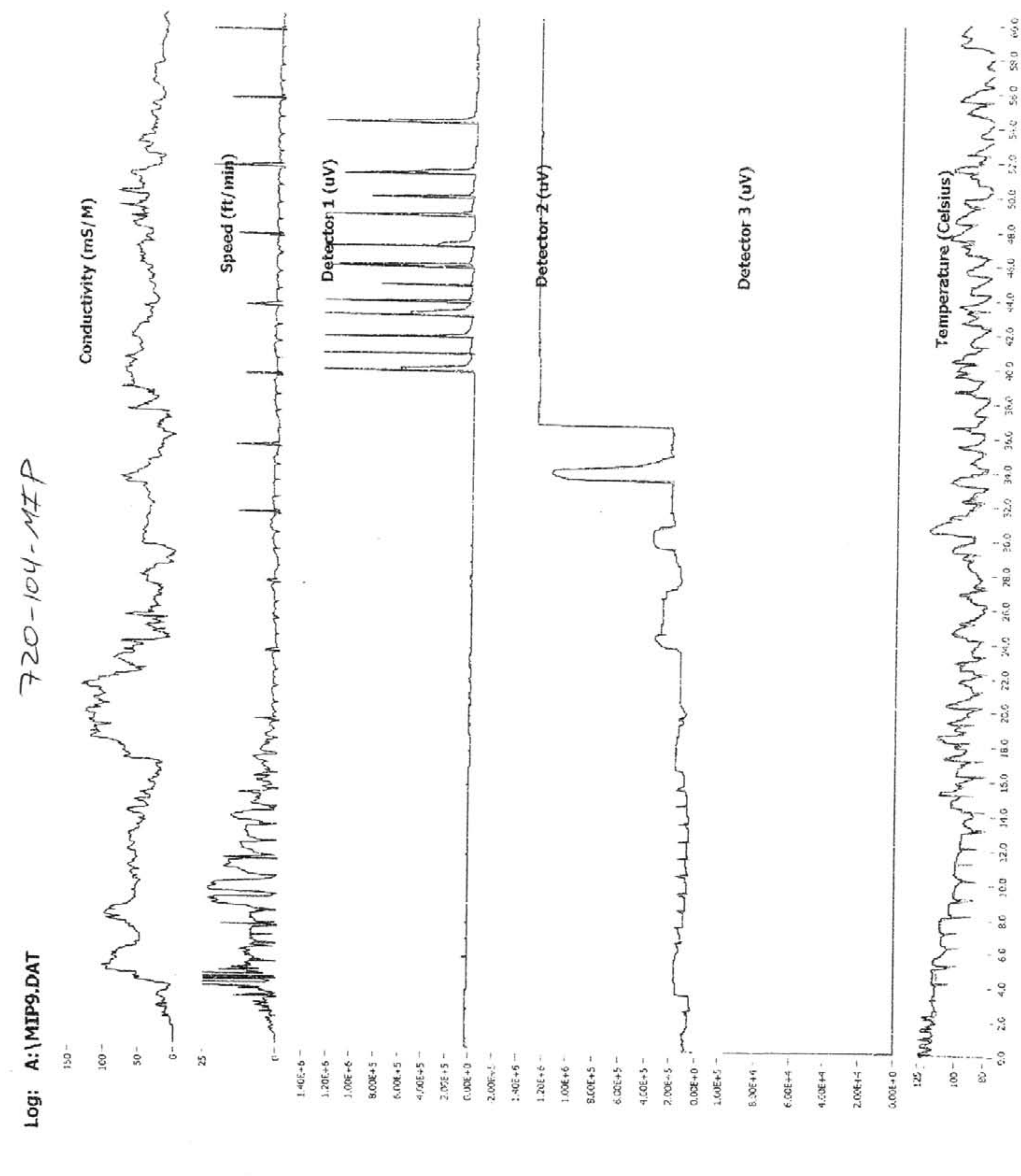

Log: A:\MIP10B.DAT
720-101-MIP rerun for refusal on 5/11/04
Conductivity (mS/M)
Speed (ft/min)
Detector 1 (uV)
Detector 2 (uV)
Detector 3 (uV)
Temperature (Celsius)

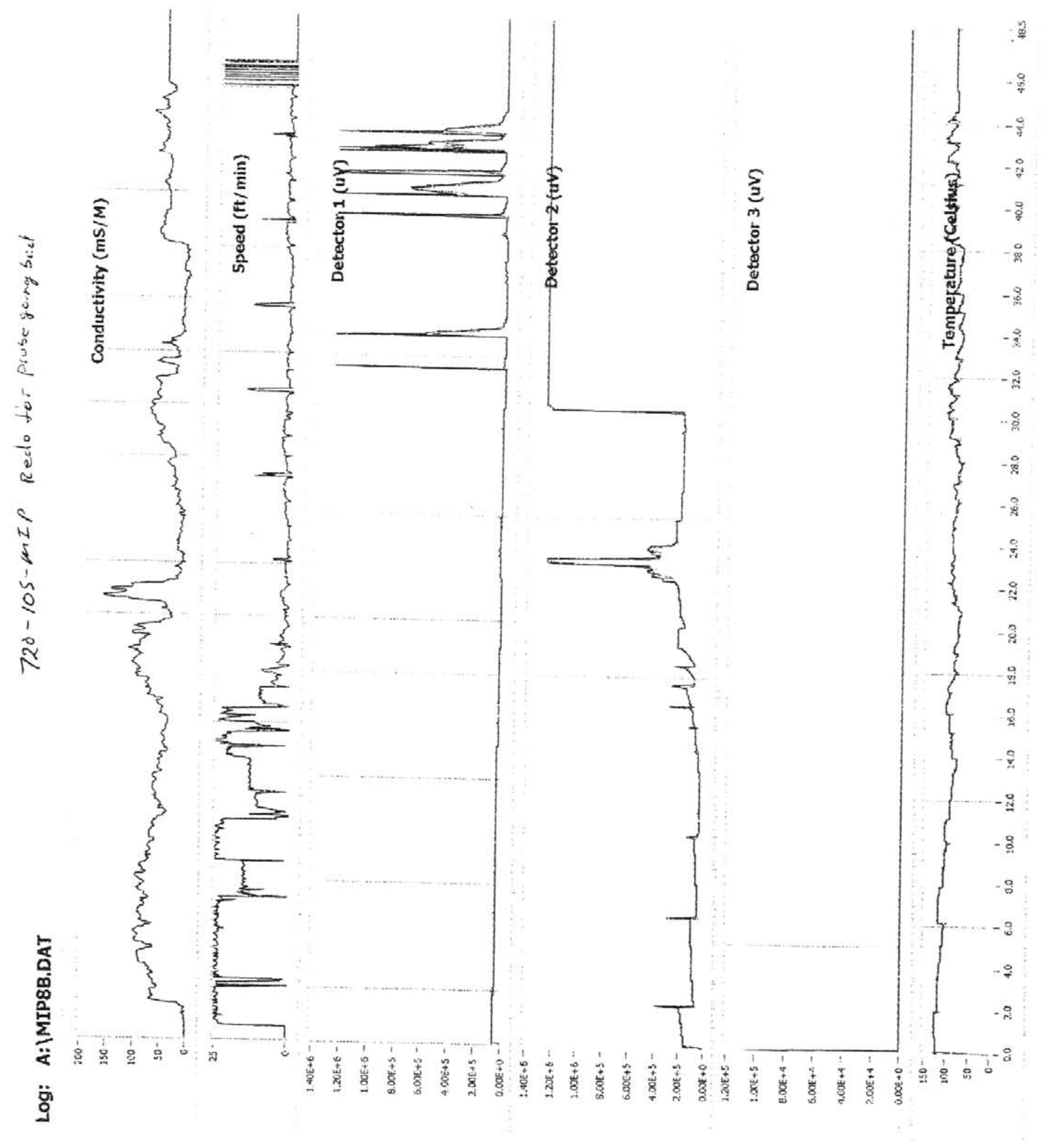

Log: A:\MIP6.DAT
720-102-MIP
Conductivity (mS/M)
Speed (ft/min)
Detector 1 (uV)
Detector 2 (uV)
Detector 3 (uV)
Temperature (Celsius)

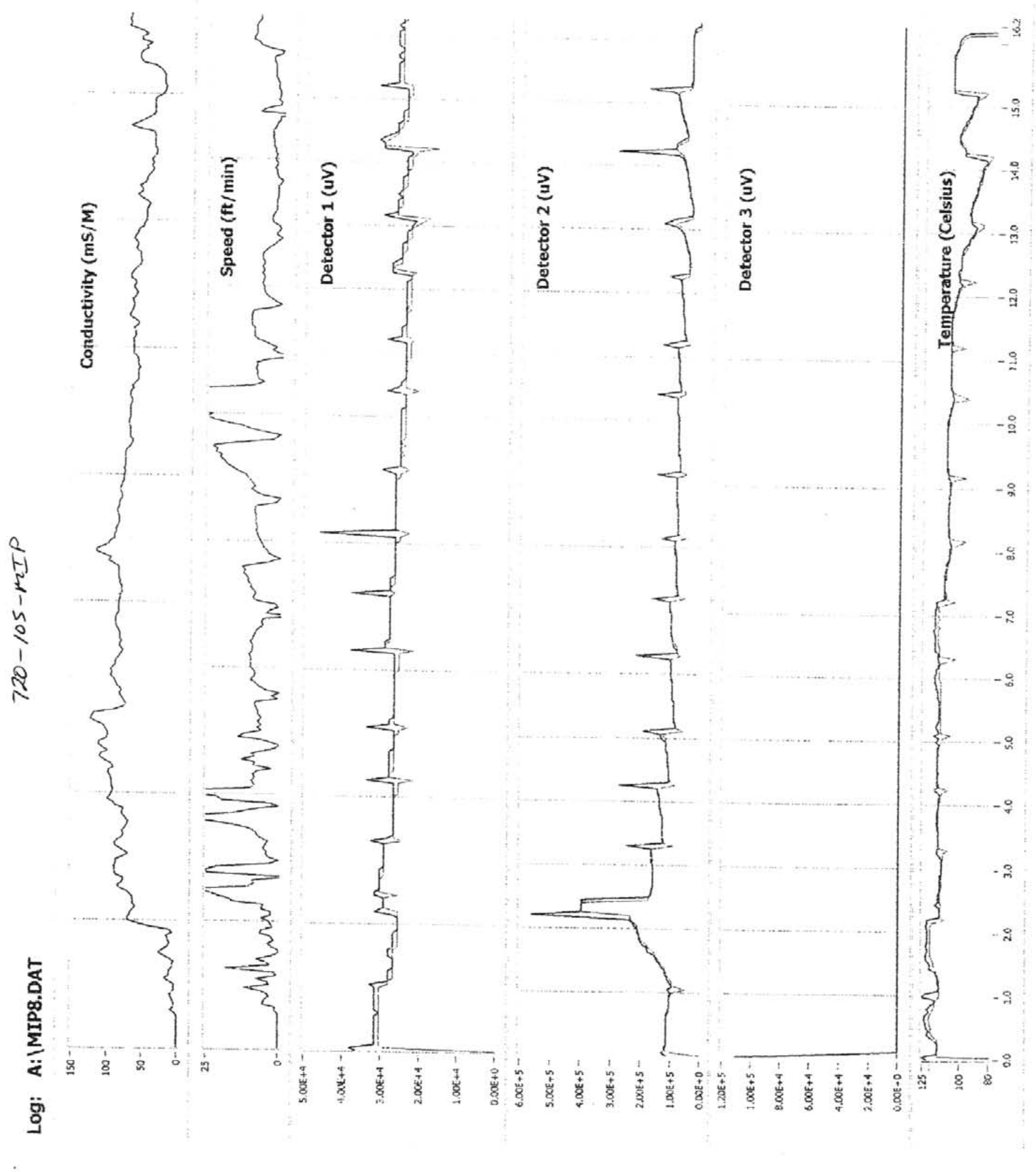

Log: A:\MIP6B.DAT
720-102-MIP
Conductivity (mS/M)
Speed (ft/min)
Detector 1 (uV)
Detector 2 (uV)
Detector 3 (uV)
Temperature (Celsius)



Log: A:\MIP7.DAT
720-103-MIP
Conductivity (mS/M)
Speed (ft/min)
Detector 1 (uV)
Detector 2 (uV)
Detector 3 (uV)
Temperature (Celsius)

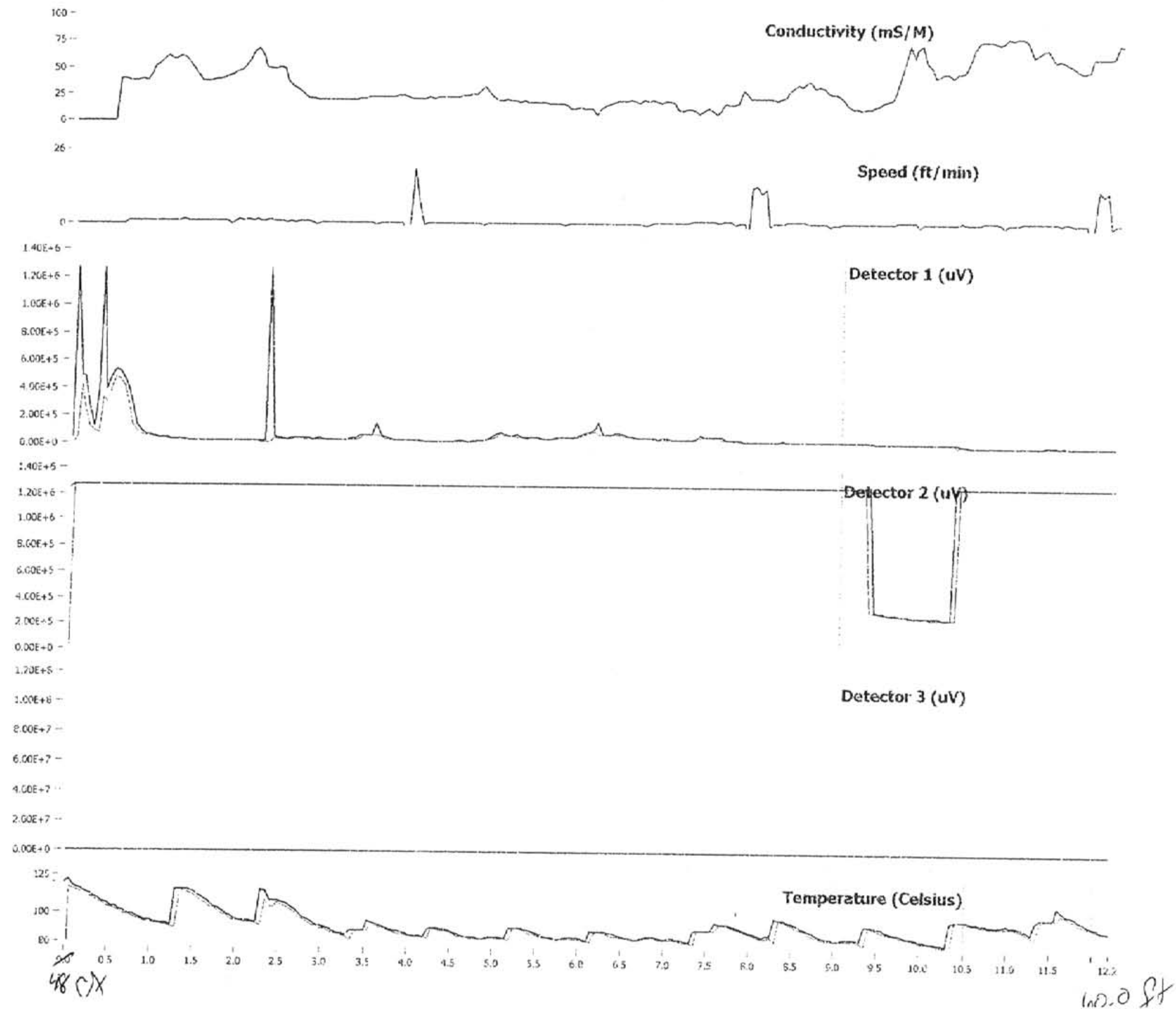

Log: A:\MIP9.DAT
720-104-MIP
Conductivity (mS/M)
Speed (ft/min)
Detector 1 (uV)
Detector 2 (uV)
Detector 3 (uV)
Temperature (Celsius)

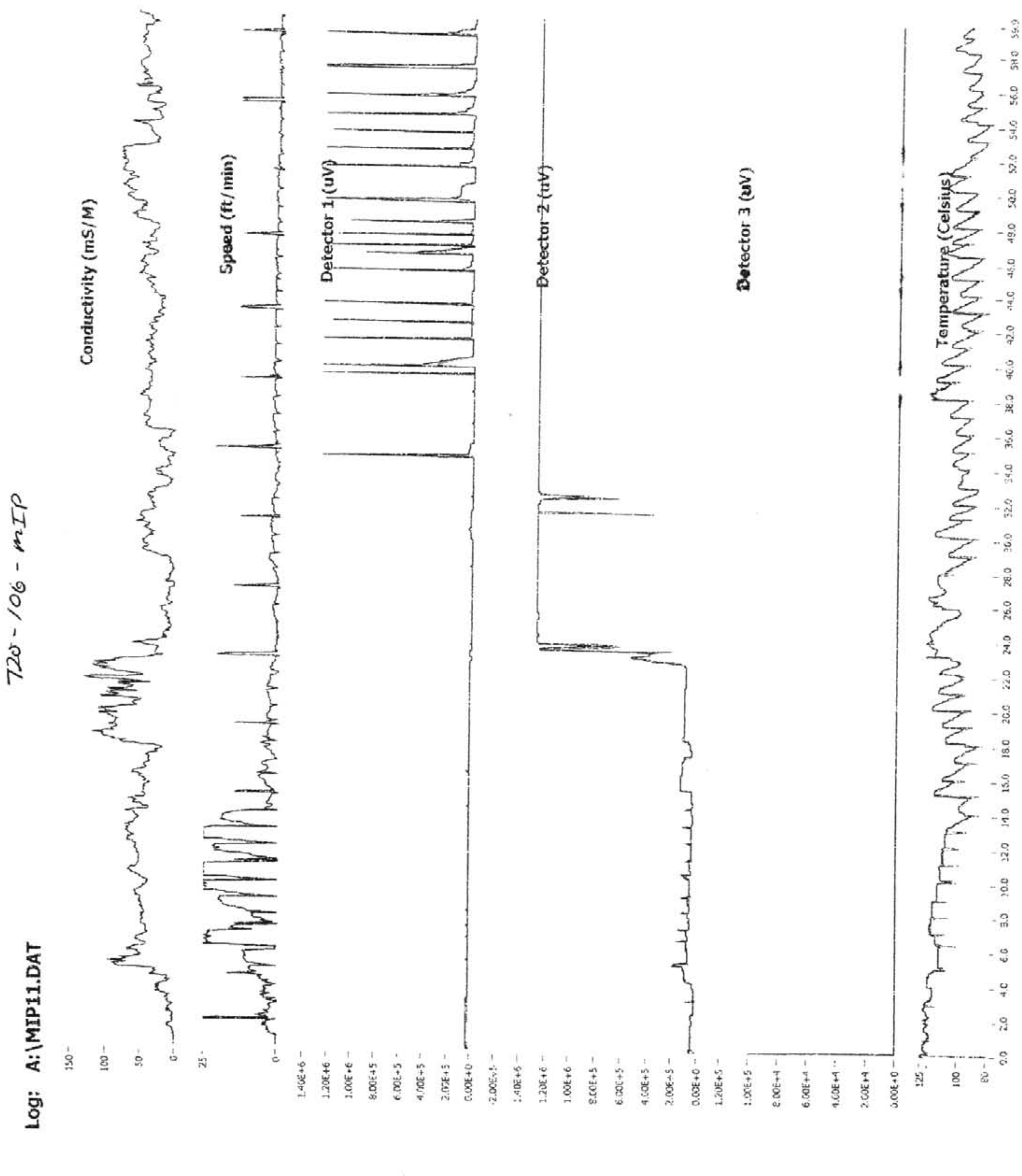

720-105-MIP Redo for Pulse going bad
Log: A:\MIP8B.DAT
Conductivity (mS/M)
Speed (ft/min)
Detector 1 (uV)
Detector 2 (uV)
Detector 3 (uV)
Temperature (Celsius)

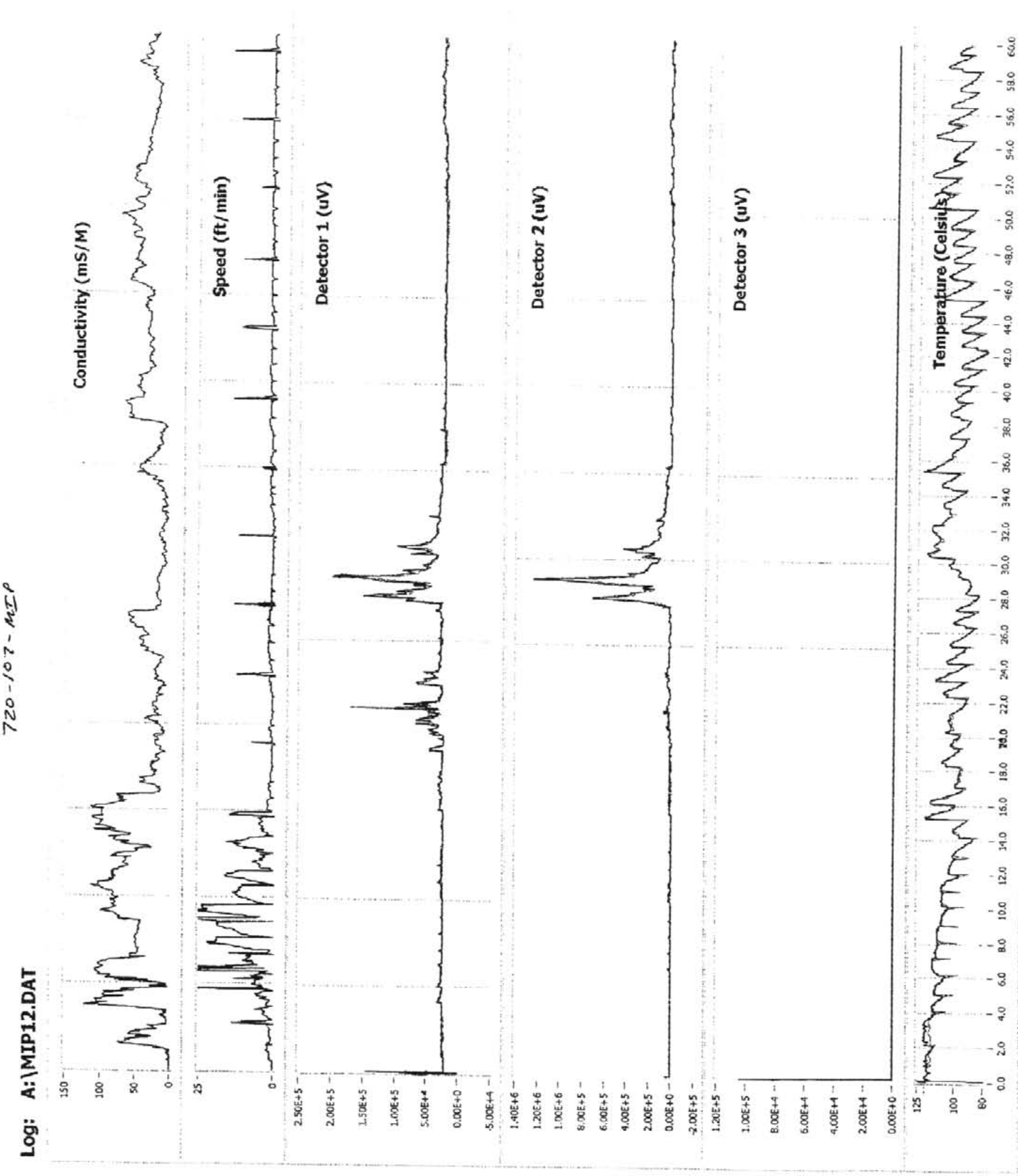

Log: A:\MIP8.DAT
720-105-MIP
Conductivity (mS/M)
Speed (ft/min)
Detector 1 (uV)
Detector 2 (uV)
Detector 3 (uV)
Temperature (Celsius)
150
100
50
0
25
0
5.00E+4
4.00E+4
3.00E+4
2.00E+4
1.00E+4
0.00E+0
6.00E+5
5.00E+5
4.00E+5
3.00E+5
2.00E+5
1.00E+5
0.00E+0
1.20E+5
1.00E+5
8.00E+4
6.00E+4
4.00E+4
2.00E+4
0.00E+0
125
100
80
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
16.2

Log: A:\MIP8C.DAT

720-105-MIP (cont) 48-60




Log: A:\MIP11.DAT
720 - 106 - MIP
Conductivity (mS/M)
Speed (ft/min)
Detector 1 (uV)
Detector 2 (uV)
Detector 3 (uV)
Temperature (Celsius)


720-107-MIP
Log: A:\MIP12.DAT
Conductivity (mS/M)
Speed (ft/min)
Detector 1 (uV)
Detector 2 (uV)
Detector 3 (uV)
Temperature (Celsius)

APPENDIX D

ADDENDUM

THIS PAGE INTENTIONALLY LEFT BLANK .

P•E•S

Environmental Consulting & Mobile Laboratory Services

Plains Environmental Services

P.O. Box 6288 • Salina, KS 67401-0288 • (785) 827-4545
Fax (785) 827-4582 • www.plainsenv.com

September 13, 2004

SAIC
175 Freedom Blvd.
Kevil, Kentucky 42053

Attn: Bruce Ford

Re: MIP data from the Paducah Gas Diffusion Plant project.

Dear Mr. Ford:

Plains Environmental Services (PES) has completed an MIP project in conjunction with Miller Drilling at the Paducah Gas Diffusion Plant near Paducah, KY. The project took place between the dates of April 29 through May 20, 2004. PES used a Geoprobe MIP system to record soil conductivity data and the presence of total volatile organic compounds (VOCs) in real-time. The carrier gas flow was split with one-half going directly to two VOC detectors (PID/ECD) and one-half going to a sorbent trap. The sorbent trap was connected to a gas chromatograph (GC) and desorbed into the GC for contaminant identification. This technique provided information on the analytes present and the mass of each analyte diffusing across the MIP membrane.

Several calibration steps were used to provide information on the mass transfer of VOCs from the subsurface formation. To monitor the efficiency of the MIP membrane, a sanity test was preformed at each location before advancing the MIP probe. The response numbers were compared with the original response of a new membrane. This test was used to determine when membrane replacement was necessary. A second calibration procedure was used to provide initial calibration and continuing calibration of the GC analytical system. This system was responsible for quantifying and identifying individual analytes that were collected on the sorbent trap.

In conclusion, no problems were encountered with the MIP or GC analytical systems. The correlation between MIP responses and actual GC results were consistent with each other. In comparing on-site analytical results with off-site analyses, a significant difference was noticed for MIP location 001-201-MIP at the 0-30 ft. interval. The compounds identified by the laboratory were not detected by the MIP system. No explanation is apparent without knowing how sample handling and off-site analyses were performed.

PLAINS ENVIRONMENTAL SERVICES

Lynn R. Newcomer
President

Darin DeGruson
Project Chemist

THIS PAGE INTENTIONALLY LEFT BLANK.

APPENDIX E

LITHOLOGIC LOGS AND WELL CONSTRUCTION DIAGRAMS, GROUNDWATER SAMPLE STABILIZATION LOGS, AND WELL DEVELOPMENT LOGS

THIS PAGE INTENTIONALLY LEFT BLANK.

SWMU 1

THIS PAGE INTENTIONALLY LEFT BLANK.

LITHOLOGIC LOG

LITHOLOGIC LOG	BORING/WELL NO: 001-201	PAGE 1 of 1
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site:SWMU 001
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: Bryan Willis
Drill Start (time/date): 12:43 on 05-26-04	Drill End (time/date): 11:40 on 05-28-04	Borehole Dia: 2 inch
Drill Method/Rig Type: DPT		Total Depth: 60 ft
Logged By: K. Davis/Bill Joyce	Coordinates: E -6929.0 N -1722.51	Protective Level: D

DEPTH (ft)	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	COMMENTS
		--	--		
5	001-201– 5 ft			SILT, massive, pale brown (10 YR 6/3) with some very dark gray (10 YR 3/1) blebs, firm moist.	
		--	--		
10	001-201 –10 ft			SILT, massive, light yellowish brown (10 YR 6/4) trace chert pebbles (0.3-in diameter), rounded, slightly firm, moist.	
		--	--		
15	001-201 –15 ft			SILT, sandy (20%), fine; light gray (10 YR 7/1) with gray (10 YR 6/1) mottling, firm, moist.	
		--	--		
20	001-201 –20 ft			Interbedded GRAVEL (1.0 to 1.5-in diameter), rounded, sand (40%), coarse, subangular, brownish yellow (10 YR 6/6); and silt, light gray (10 YR 7/1), hard, moist.	
		--	--		
25	001-201-25 ft			SILT, clayey, light gray (10 YR 7/1) mottled with brownish yellow (10 YR 6/6), soft, moist.	
		--	--		
30	001-201-30 ft			SILT slightly clayey; light brown (5 YR 6/4) to light brown (5 YR 5/6).	Includes light gray (N7) clay stringers.
		--	--		
35	001-201-35 ft			Clayey SILT (50% silt; 50% clay). Silt: light brown (5 YR 5/6); Clay: light gray (N9). Moderate plasticity; moist.	Includes chert gravel, mottled.
		--	--		
40	001-201-40 ft			SAND (silt 20-25%) very fine to fine-grained; well-sorted. Subrounded to subangular; pinkish gray (5 YR 8/1) to very light gray (N8); mottled light brown (5 YR 5/6); moist.	
		--	--		
45	001-201–45 ft			Sandy SILT with clayey silt pockets; light brown (10 YR 5/4) silt; clay light grey (N9) mottled; low plasticity, moist.	
		--	--		
50	001-201-50 ft			Silty CLAY; (silt 10-15%, sand trace) light gray (N7)-medium light gray (N6) with light brown (5 YR 5/6) mottling, medium plasticity, slightly moist. See comments.	trace manganese oxide and iron oxide, firm massive.
		--	--		
	001-201-54 ft			SAND (silt 10-15%) with silty pockets, fine-medium grained, well-sorted, subrounded-subangular, light gray (N7). See comments.	Very light gray (N8), mottled (light brown (5 YR 5/6)) slightly moist, trace manganese oxide.
55					
	001-201-58.7 ft	--	--	SAND (silt 5-10%) medium to fine-grained, well-sorted, subangular-subrounded, moderate yellowish brown (10Y R5/4), chert pocket, trace manganese oxide.	
60	001-201-60 ft			TD 60'	
		--	--		
		--	--		
		--	--		

LITHOLOGIC LOG

LITHOLOGIC LOG	BORING/WELL NO: 001-202	PAGE 1 of 1
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site:SWMU 001
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: Bryan Willis
Drill Start (time/date): 09:15 on 06-09-04	Drill End (time/date): 17:00 on 06-09-04	Borehole Dia: 2 inch
Drill Method/Rig Type: Geoprobe		Total Depth: 60 ft
Logged By: Bill Joyce	Coordinates: E -6859.5 N -1721.93	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
5	▨	001-202– 5 ft	--	--	Sandy SILT (sand 10-15%) pale yellowish brown (10 YR 6/2) with light brown (5 YR 5/6) moderate plasticity, slightly moist, soft, trace oxides, slightly clayey.		
	▨	001-202 –8.3 ft	--	--	Sandy SILT (sand 10-15%) moderate yellowish brown (10 YR 5/9) – grayish orange (10 YR 7/9), poor plasticity, slightly moist-dry, soft, abndt oxides.		
10							
	▨	001-202 –14.4 ft	--	--	Sandy SILT (sand 10-15% with sandier pockets) moderate yellowish brown (10 YR 7/4) with some light brown (5 YR 5/6), poor plasticity, slightly moist-dry, soft, abndt oxides, sand increasing.		
15							
	▨	001-202 –18.5 ft	--	--	Silty SAND (silt 5-10%) medium-coarse grained, poorly sorted, subangular-subrounded, moderate yellowish brown (10 YR 5/4) – pale yellowish brown (10 YR 6/2) with light brown (5 YR 5/6), moist-wet, abndt iron oxides.		
20							
	▨	001-202-23.8 ft	--	--	Sandy CLAY (sand 5-10%) with cleaner sections (22.8' – 23.3') dark yellowish orange (10 YR 6/6) with very light gray (N8), good plasticity, soft, malleable, slightly moist – moist, contact at 22.5' with sands above).		
25							
	▨	001-202-29.3 ft	--	--	Silty SAND with clay pockets (silt 20-25%) fine-very fine grained, well-sorted, subangular-subrounded, dark yellowish orange (10 YR 6/6) – light brown (5 YR 5/6) with very light gray (N8), slightly moist, soft		
30							
35	▨	001-202-35 ft	--	--	SAND (silt 5-10%) medium-fine grained, well sorted, subangular-subrounded, light brown (5 YR 5/6) – grayish orange (10 YR 7/4), slightly moist, trace mang. oxide.		
	▨	001-202-38.7 ft	--	--	Silty SAND with clay (silt 20-25% clay content increases towards the end of the section) fine-very fine-grained, well sorted, subangular-subrounded, light brown (5 YR 5/6) with very light gray (N8), slightly moist, soft, good plasticity with the higher clay content, trace iron oxide.		
40							
45	▨	001-202–45 ft	--	--	Silty SAND (with clayier pockets) (silt 15-20%) medium-fine grained, well sorted, subangular-subrounded, very light gray (N8) with light brown (5 YR 5/6), slightly moist-dry, trace iron oxide staining.		
50	▨	001-202-50 ft	--	--			
	▨	001-202-54.2 ft	--	--	is well-sorted, but includes pockets of fractured chert,		
55					grayish orange (10 YR 7/4) – very pale orange (10 YR 8/2), moist-slightly moist, trace mang. oxide.		
60	▨	001-202-60 ft	--	--	SAND (silt 5-10%) medium-fine grained, moderately sorted, subangular-subrounded, pale yellowish brown (10 YR 6/2) – light brown)5 YR 5/6), saturated – wet, some coarse-very coarse grained sand, trace mang. oxide. TD 60'.		
			--	--			
			--	--			
	▨		--	--			

LITHOLOGIC LOG	BORING/WELL NO: 001-203	PAGE 1 of 1
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site:SWMU 001
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: Bryan Willis
Drill Start (time/date): 17:05 on 05-27-04	Drill End (time/date): 10:15 on 05-28-04	Borehole Dia: 2 inch
Drill Method/Rig Type: DPT		Total Depth: 60 ft
Logged By: K. Davis/Bill Joyce	Coordinates: E -6772.5 N -1722.51	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
5		001-203– 5 ft	--	--	Silty CLAY (silt 30-35%) Pale yellowish brown (10 YR 6/2) friable grading to moderate plasticity; dry grading to slightly moist moderately firm.		
10		001-203 –10 ft	--	--	Clayey SILT (clay 30-35%); moderate yellowish brown (10 YR 5/4) with some pale yellowish brown (10 YR 6/2); poor plasticity, slightly moist, soft.		
15		001-203 –13.9 ft	--	--	Clayey SILT (as above) grading to silty SAND (at 13.4), fine to medium-grained, well-sorted, subangular to subrounded, moderate yellowish brown (10 YR 5/4) with some light brown (5 YR 5/6), slightly moist, trace manganese oxide		
20		001-203 –18.1 ft	--	--	Silty SAND (silt 10-15%) medium to coarse-grained with cobbles, granules and gravel, see comments.		poorly-sorted, subangular to subrounded, moderate yellowish brown (10 YR 5/4) – pale yellowish brown (10 YR 6/2) with some light brown (5 YR 5/6), slightly moist to dry, slightly consolidated.
25		001-203-24.1 ft	--	--	Silty CLAY with sandy pockets (silt 20-25%) includes cert pockets. Light grey (N7), mottled with light brown (5 YR 5/6), good plasticity, moist, soft, trace of iron oxide and manganese oxide.		
30		001-203-29.5 ft	--	--	Silty SAND (silt 25-30%), includes a clay pocket section (28.5 – 29.0) cemented some with iron oxide and manganese oxide. See comments.		Fine to very fine-grained, well-sorted, subangular to subrounded, light brown (5 YR 5/6) to light brown (5 YR 6/4), slightly moist.
35		001-203-34.1 ft	--	--	SAND (silt 5-10%) medium-grained, well-sorted, subangular to subrounded, light brown (5 YR 5/6) with some light brown (5 YR 6/4), slightly moist.		
40		001-203-38.5 ft	--	--	Interbedded SAND and CLAY (0.1-0.3 in thickness). See comments.		Silty SAND (silt 10-15%) medium to coarse-grained with chert pockets, moderately sorted, subangular to subrounded, light brown (5 YR 5/6) to light brown (5 YR 6/4), slightly moist. Silty CLAY light gray (N7) to very light gray (N8), good plasticity, slightly moist to moist, soft.
45		001-203–44.5 ft	--	--	SAND (silt 20-25%) medium to fine-grained, moderate to well-sorted, subangular to subrounded, very pale orange (10YR 8/2) with some light brown (5 YR 5/6), slightly moist to dry.		
50		001-203-49.4 ft	--	--	SAND (silt 15%) medium to fine-grained, moderate to well-sorted, subangular to subrounded, very pale orange (10 YR 8/2) to grayish orange (10 YR 7/4), slightly moist, pockets of manganese oxide (black).		
55		001-203-54.4 ft	--	--	SAND (silt 15% with pockets of greater silt 20-25%), medium grained, moderate to well-sorted, subangular to subrounded, see comments.		mottled, light brown (5 YR 5/6) – grayish orange (10 YR 7/9), very pale orange (10 YR 8/2) with pale red (5 R 6/2), and moderate red (5 R 4/6) slightly moist, trace oxides.
60		001-203-59 ft	--	--	SAND (silt 15% with siltier pockets) medium-grained with gravel and pieces of broken chert, poorly sorted, subangular, light brown (5 YR 5/6) to light brown (5 YR 6/4), moist to wet, trace oxides. TD 60'.		
			--	--			
			--	--			
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: 001-204	PAGE 1 of 1
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site:SWMU 001
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: Bryan Willis
Drill Start (time/date): 08:12 on 06-10-04	Drill End (time/date): 10:40 on 06-11-04	Borehole Dia: 2 inch
Drill Method/Rig Type: Geoprobe		Total Depth: 60 ft
Logged By: Bill Joyce	Coordinates: E -6859.5 N -1703.04	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
5		001-204– 5 ft	--	--	Sandy SILT (sand 10-15%, clay 5%), pale yellowish brown (10 YR 6/2) – light brown (5 YR 5/6), poor plasticity, dry-slightly moist, soft, trace oxides		
10		001-204 –9.1 ft	--	--	Sandy SILT (sand 10-15%), moderate yellowish brown (10 YR 5/4), moderate-poor plasticity, slightly moist, soft, trace mang. oxide.		
15		001-204 –14.2 ft	--	--	Silty SAND (silt 10-15%), medium-coarse grained with some gravel (fracture rock), moderate – poorly sorted subangular-subrounded, moderate yellowish brown (10 YR 5/4) – pale yellowish brown (10 YR 6/2) with light brown (5 YR 5/6), moist – wet.		
20		001-204 –18.2 ft	--	--	SAND with silt pockets (silt 5-10%) coarse-very coarse grained with cobbles and gravel (fractured rock) poorly sorted, subangular-angular, moderate yellowish brown (10 YR 5/4) – pale yellowish brown (10 YR 6/2) – light brown (5 YR 5/6), moist, abndt oxides (mang. oxide and iron oxide).		
25		001-204-25 ft	--	--	Sandy SILT (sand 15-20%) very light gray (N8) and dark yellowish orange (10 YR 6/6) moderate plasticity, slightly moist, soft, pockets of gravel (fractured rock), some iron oxides.		
30		001-204-30 ft	--	--	SAND (silt 5-10%) medium-grained, well-sorted, subangular-subrounded, light brown (5 YR 5/6) with pale yellowish brown (10 YR 6/2), slightly moist, trace mang. oxide.		
35		001-204-35 ft	--	--	SAND (silt 5-10%) medium-grained, well-sorted, subangular-subrounded, light brown (5 YR 5/6) – moderate yellowish brown (10 YR 5/4) – pale yellowish brown (10 YR 6/2), slightly moist.		
40		001-204-40 ft	--	--	Sandy SILT (sand 15-20%), pale yellowish brown (10 YR 6/2) – very pale orange (10 YR 8/2) with light brown (5 YR 5/6), good plasticity, moist, very soft.		Outside of sample rods wet – probable perch water zone.
45		001-204–45 ft	--	--	SAND (silt 10-15%) medium-fine-grained, well-sorted, subangular-subrounded, very pale orange (10 YR 8/2) – grayish orange (10 YR 7/4) with light brown (5 YR 5/6), slightly moist, occ. siltier pockets, trace mang. oxide.		
50		001-204-49.3 ft	--	--	SAND (silt 5-10%) medium-coarse grained with pockets of fractured rock (chert) base sand is moderately sorted, subangular-subrounded, light brown (5 YR 5/6) with some very pale orange (10 YR 8/2), slightly moist, some iron oxide staining.		
55		001-204-55 ft	--	--	SAND (silt 5-10%, clayey pocket from 54.7 – 54.9'), medium-coarse-grained, well-sorted, subangular-subrounded, light brown (5 YR 5/6) – grayish orange (10 YR 7/4), wet-saturated, trace mang. oxide.		
60		001-204-59 ft	--	--	SAND (silt trace – 5%) coarse – very coarse grained with cobbles and gravel and fractured rock, poorly sorted, subangular-angular, wet-moist, pockets of iron oxide and mang. oxide. TD 60'.		
			--	--			
			--	--			
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: 001-205	PAGE 1 of 1
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site:SWMU 001
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: Bryan Willis
Drill Start (time/date): 08:24 on 06-02-04	Drill End (time/date): 14:25 on 06-02-04	Borehole Dia: 2 inch
Drill Method/Rig Type: Geoprobe		Total Depth: 60 ft
Logged By: K. Davis	Coordinates: E -6859.5 N -1757.33	Protective Level: D

DEPTH (ft)	SAMPLE NUMBER	VOC	RAD	LITHOLOGIC DESCRIPTION	COMMENTS
5	001-205– 5 ft	--	--	Sandy SILT (sand 5-10%), pale yellowish brown (10 YR 6/2) with some moderate yellowish brown (10 YR 5/4), poor plasticity, dry, slightly moist, soft, friable.	
10	001-205 –9.3 ft	--	--	SILT (sand trace -5%), moderate yellowish brown (10 YR 5/4) with pale yellowish brown (10 YR 6/2), moderate-poor plasticity, slightly moist-dry, soft, friable, trace oxides.	
15	001-205 –15 ft	--	--	Silty SAND (silt 25-30% includes clayey pocket) very fine-fine grained, well sorted, subangular-subrounded, moderate yellowish brown (10 YR 5/4)-moderate brown (5 YR 4/4) slightly moist, iron oxide staining.	
20	001-205 –19 ft	--	--	Silty SAND (silt 15-20%, includes clayey pockets), fine-medium grained with some cobbles, moderately sorted, subangular-subrounded, moderate brown (5 YR 4/8)- light brown (5 YR 5/6) with light gray(N7), slightly moist.	
25	001-205-23.7 ft	--	--	Silty SAND (silt 20-25%) medium coarse grained with cobbles, granules, and gravel, poorly sorted subangular-subrounded, moderate brown (5 YR 4/4)-light brown (5 YR 5/6) slightly moist-dry.	
30	001-205-29.3 ft	--	--	Sandy SILT grading to a silty SAND, sand is fine-very fine grained, well sorted, subangular-subrounded light brown (5 YR 5/6) -grayish orange (10 YR 7/4) with very pale orange (10 YR 8/2), slightly moist, more clayey pockets.	Silt content decreases as sand increases.
35	001-205-35 ft	--	--	Sandy SILT (sand 15-20% some clayey pockets) moderate yellowish brown (10 YR 5/4) - light brown (5 YR 5/6) with some light gray (N7), moderate-poor plasticity, slightly moist, firm, massive.	Lithology same as sample at 30'.
40	001-205-40 ft	--	--	Silty SAND (silt 20-25% occ, clayey pockets) fine-very fine grained, well sorted with some pockets of cobbles and gravel, subangular-subrounded, slightly moist, firm, massive moderate yellowish brown (10 YR 5/4), cont. in comments…	
45	001-205–45 ft	--	--	Sandy CLAY with pockets of silty sand (sand in clay 5-10%) very light gray (N8)-light gray (N7) with grayish orange (10 YR 7/7) and light brown (5 YR 5/6), cont. in comments…	good plasticity, slightly moist, soft-slightly firm, includes silty sand pockets.
50	001-205-49.6 ft	--	--	Interbedded CLAY and slightly silty SAND. Clay: (sand 5-10%) light gray (N7) with moderate red (5 R 4/6) mottling, good plasticity slightly moist, soft. Sand: (silt 10-15%), cont. in comments…	medium-fine grained, moderate-well sorted subangular-subrounded, light brown (5YR 5/6)-very pale orange (10 YR 8/2), dry, some oxide staining.
55	001-205-55 ft	--	--	yellowish orange (10 YR 6/6) moderate plasticity,	From 54.6-55.0, abundant mang. oxide mixed with clay, iron oxide staining.
60	001-205-59.1 ft	--	--	SAND (silt 5-10%) medium-coarse grained, well sorted. Subangular-subrounded, dark yellowish orange (10 YR 7/9) -very pale orange (10 YR 8/2), wet-moist trace mang. oxide. TD 60'	
		--	--		
		--	--		
		--	--		

THIS PAGE INTENTIONALLY LEFT BLANK.

SWMU 4

THIS PAGE INTENTIONALLY LEFT BLANK.

LITHOLOGIC LOG	BORING/WELL NO: 004-101	PAGE 1 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: David Gentry
Drill Start (time/date): 09:00 on 04-30-04	Drill End (time/date): 14:37 on 05-05-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 76.5 ft
Logged By: K. Davis	Coordinates: E ~-5808 N ~-1256	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
			--	--			
5		004-101– 5 ft			SILT, slightly clayey, light gray (10YR7/1), loose consistency, wet.		
			--	--			
10		004-101 –10 ft			No sample.		
			--	--			
15		004-101 –15 ft			loose consistency, wet.		Trace fine sand.
			--	--			
20		004-101 –20 ft			SILT, as above		
			--	--			
25		004-101-25 ft					15% medium sand & 5% fine gravel
			--	--			
30		004-101-30 ft			GRAVEL, sandy and silty, light yellowish brown (10YR 6/4), loose consistency, wet.		10 % sand and 10 % silt. Gravel is poorly sorted (up to 1/2-in. diameter), rounded to subangular
			--	--			
35		004-101-35 ft			SILT, sandy, light yellowish brown (10Y R6/4), loose consistency, wet.		10 - 15 % medium sand
			--	--			
40		004-101-40 ft			SILT, sandy, as above.		5 - 10 % medium sand
			--	--			
45		004-101–45 ft			SILT, sandy, as above.		5 % medium sand
			--	--			
50		004-101-50 ft			SILT, sandy, as above.		5 % medium sand
			--	--			
55		004-101-55 ft			SILT, sandy, as above.		10 % medium sand
			--	--			
60		004-101-60 ft			Fine SAND, silty, brownish yellow (10Y R6/6), loose consistency, wet.		
			--	--			
65		004-101-65 ft			Fine to medium SAND, light yellowish brown (10Y R6/4), loose consistency, wet.		
			--	--			
70		004-101-70 ft			Medium SAND (70%), coarse sand (30%), brownish yellow (10Y R6/6), soft consistency, wet.		Trace very small pebbles.
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: 004-101	PAGE 2 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: David Gentry
Drill Start (time/date): 09:00 on 04-30-04	Drill End (time/date): 14:37 on 05-05-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 76.5 ft
Logged By: K. Davis	Coordinates: E ~-5808 N ~-1256	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
			--	--	Gravelly, coarse to very coarse SAND, (60%), 40% gravel (up to ½ in. diameter), yellowish brown (10YR5/4), loose consistency, moist. TD 76.5'.		
75		004-101– 75 ft	--	--			
80			--	--			
85			--	--			
90			--	--			
95			--	--			
100			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: 004-102	PAGE 1 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: David Gentry
Drill Start (time/date): 08:12 on 06-29-04	Drill End (time/date): 15:15 on 06-29-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 91 ft
Logged By: K. Davis	Coordinates: E ~-5816 N ~-1367	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/ SAFETY VOC	HEALTH/ SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
			--	--			
5		004-102– 5 ft			10% fine sand, black (10YR 2/1); and		
			--	--			
10		004-102 –10 ft			SILT, light brownish gray (10YR 6/2), very soft, wet.		
			--	--			
15		004-102 –15 ft			SILT, pale brown (10YR 6/3), very soft, wet.		
			--	--			
20		004-102 –20 ft					
			--	--			
25		004-102-25 ft			Very fine SAND, brownish yellow (10YR 6/8); with trace very coarse sand, subrounded; loose, wet.		
			--	--			
30		004-102-30 ft			Very fine SAND, brownish yellow (10YR 6/8), loose, wet.		
			--	--			
35		004-102-35 ft			Very fine SAND, brownish yellow (10YR 6/8), loose, wet.		
			--	--			
40		004-102-40 ft			Very fine SAND, brownish yellow (10YR 6/8), loose, wet.		
			--	--			
45		004-102–45 ft			SILT, brownish yellow (10YR 6/8), loose, wet.		
			--	--			
50		004-102-50 ft			SILT, brownish yellow (10YR 6/8), loose, wet.		
			--	--			
55		004-102-55 ft					
			--	--			
60		004-102-60 ft					
			--	--			
65		004-102-65 ft					
			--	--			
70		004-102-70 ft			Medium-to-coarse SAND, subangular, chert, yellowish brown (10YR 5/8), loose, wet.		
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: 004-102	PAGE 2 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: David Gentry
Drill Start (time/date): 08:12 on 06-29-04	Drill End (time/date): 15:15 on 06-29-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram/ Geoprobe		Total Depth: 91 ft
Logged By: K. Davis	Coordinates: E ~-5816 N ~-1367	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
75	/////	004-102– 75 ft	--	--	Medium-to-coarse SAND, subangular, chert, yellowish brown (10YR 5/8), loose, wet.		
80	/////	004-102--80 ft	--	--	Medium-to-coarse SAND as above but with trace gravel, up to 1/2-in diameter, rounded, chert.		
85	/////	004-102--85 ft	--	--	Medium-to-coarse SAND as at 70 ft.		
90	/////	004-102--90 ft	--	--	Fine-to-medium SAND with 10% gravel, up to 1/2-in diameter, rounded, chert; yellowish brown (10YR 5/8), loose, wet.		At 91': Lithology is SILT, slightly clayey, dark yellowish brown (10YR 3/6), soft, wet.
			--	--			
95	/////		--	--			
100	/////		--	--			
	/////		--	--			
	/////		--	--			
	/////		--	--			
	/////		--	--			
	/////		--	--			
	/////		--	--			
	/////		--	--			
	/////		--	--			

LITHOLOGIC LOG	BORING/WELL NO: 004-103	
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: David Gentry
Drill Start (time/date): 10:25 on 07-28-04	Drill End (time/date): 17:23 on 07-28-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 100 ft
Logged By: B. Joyce	Coordinates: E ~-5810 N ~-1570	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
5		004-103– 5 ft			Top Soil: Sand SILT (sand 25-30%), moderate yellowish brown (10 YR 5/4), loose, wet.		
10		004-103 –10 ft			SILT with clay (15-20%), grayish orange (10 YR 7/4), soft, malleable, wet.		
15		004-103 –15 ft			SILT with sand (15-20%) grayish orange (10 YR 7/4), soft, malleable, wet.		
20		004-103 –20 ft			Sandy SILT (sand 30-35%) grayish orange (10 YR 7/4), soft loose, wet.		
25		004-103-25 ft			Silty SAND (silt 25-30%) fine-medium-coarse grained with consolidated pieces, grayish orange (10 YR 7/4), loose, wet.		
30		004-103-30 ft			Sandy SILT (sand 35-40%), grayish orange (10 YR 7/4) – moderate yellowish brown (10 YR 5/4), soft, loose, wet.		
35		004-103-35 ft			Silty SAND with clay (silt 30-35%, clay 5-10%) fine-medium grained with consolidated pieces, grayish orange (10 YR 7/4) – moderate yellowish brown (10 YR 5/4), loose, wet.		
40		004-103-40 ft			Silty SAND (silt 20-25%) fine-medium grained, well sorted, light brown (5 YR 5/6), loose, wet.		
45		004-103–45 ft			Silty SAND (silt 30-35%, clay-trace) fine-medium grained well sorted, light brown (5 YR 5/6), loose, wet.		
50		004-103-50 ft			Silty SAND (silt 30-35%) fine-medium grained, well sorted, light brown (5 YR 5/6)-moderate yellowish brown (10 YR 5/4), loose, wet.		
55		004-103-55 ft			SAND (silt 5-10%) fine-medium grained, well sorted, moderate yellowish brown (10 YR 5/4), loose, wet		
60		004-103-60 ft			SAND (silt 5-10%) medium-fine grained, well sorted, moderate yellowish brown (10 YR 5/4), loose, wet.		
65		004-103-65 ft			SAND (silt 5%) medium-coarse-very coarse grained with some gravel, moderately sorted, moderate yellowish brown (10 YR 5/4), loose, wet.		
70		004-103-70 ft			Gravelly SAND, coarse-very coarse-granules with gravel chert, poorly sorted, moderate yellowish brown (10 YR 5/4), loose, wet.		

LITHOLOGIC LOG	BORING/WELL NO: 004-103	PAGE 2 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: David Gentry
Drill Start (time/date): 10:25 on 07-28-04	Drill End (time/date): 17:23 on 07-28-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 100 ft
Logged By: K. Davis	Coordinates: E ~-5810 N ~-1570	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
75		004-103– 75 ft			Gravelly SAND, as above; with larger size.		
80		004-103 –80 ft			Gravelly SAND, very coarse-granules-gravel, poorly sorted, moderate brown (5 YR 4/9), loose, wet.		
85		004-103 –85 ft			Gravelly SAND, as above, smaller size, getting sandier, moderate yellowish brown (10 YR 5/4).		
90		004-103 –90 ft			Gravelly SAND, as above, larger size, light brown (5 YR 5/6).		
95		004-103-95 ft			Gravelly SAND fine-medium-coarse grained with gravel, poorly sorted, light brown (5 YR 5/6), loose, wet.		
100		004-103-100 ft			SAND with clay, fine-medium grained, well-sorted, dark yellowish orange (10 YR 6/6), loose, wet.		McNairy Formation at 100'.
105				--	--		
				--	--		
				--	--		
				--	--		
				--	--		
				--	--		
				--	--		
				--	--		

LITHOLOGIC LOG	BORING/WELL NO: 004-104	PAGE 1 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: David Gentry
Drill Start (time/date): 08:50 on 05-06-04	Drill End (time/date): 16:20 on 05-12-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 95 ft
Logged By: K. Davis	Coordinates: E ~-5804 N ~-1740	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
			--	--			
5		004-104– 5 ft			SILT, light gray (10YR7/1), loose consistency, wet		
			--	--			
10		004-104 –10 ft			SILT, as above		
			--	--			
15		004-104 –15 ft					Trace medium sand
			--	--			
20		004-104 –20 ft			SILT, as above		10% medium sand and trace coarse sand
			--	--			
25		004-104-25 ft			brown (10YR7/4), loose consistency,		
			--	--			
30		004-104-30 ft			SAND, fine-to-medium (80%), silty (20%), very pale brown (10YR7/4), loose consistency, wet.		
			--	--			
35		004-104-35 ft			SAND as above, but with trace coarse sand		
			--	--			
40		004-104-40 ft			SILT, very pale brown (10YR7/4), loose consistency, wet.		
			--	--			
45		004-104–45 ft			SILT, as above.		
			--	--			
50		004-104-50 ft			SILT, as above but with 5% medium-to-coarse sand.		
			--	--			
55		004-104-55 ft					
			--	--			
60		004-104-60 ft					
			--	--			
65		004-104-65 ft					
			--	--			
70		004-104-70 ft			SAND, fine, pale brown (10YR6/3), loose consistency, wet.		
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: 004-104	PAGE 2 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: David Gentry
Drill Start (time/date): 08:50 on 05-06-04	Drill End (time/date): 16:20 on 05-12-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram/ Geoprobe		Total Depth: 95 ft
Logged By: K. Davis	Coordinates: E ~-5804 N ~-1740	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/ SAFETY VOC	HEALTH/ SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
			--	--			
75		004-104– 75 ft	--	--	GRAVEL (50%), up to 1.2-in diameter, subangular, chert; SAND (50%), fine-to-medium; yellowish brown (10YR5/6), loose consistency, wet.		
80		004-104--80 ft	--	--	SAND, medium (90%), coarse (10%), yellowish brown (10YR5/6), soft, wet		
85		004-104--85 ft	--	--	SAND as above		
90		004-104--90 ft	--	--	SAND as above but with 15% coarse sand and 5% gravel (subangular, cherty)		Pin breaks on drill rig.
95		004-104-95 ft	--	--	GRAVEL (80%), up to 2-in. diameter, subangular to angular, chert; fine sand (20%); yellowish brown (10YR5/6), loose consistency, wet. TD 95'.		Refusal hit at 95'.
100			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: 004-105	PAGE 1 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: David Gentry
Drill Start (time/date): 08:24 on 07-10-04	Drill End (time/date): 14:33 on 07-10-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 102 ft
Logged By: B. Joyce	Coordinates: E ~-6510 N ~-1211	Protective Level: B

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
			--	--			
5		004-105– 5 ft	--	--	Clayey SILT pale yellowish brown (10YR 6/2), good plasticity, soft, malleable.		
10		004-105 –10 ft	--	--	Silty SAND (silt 30-40%) fine grained, grayish orange (10YR 7/4), loose, wet.		
15		004-105 –15 ft	--	--	SAND fine grained, grayish orange (10YR 7/4), loose, wet.		
20		004-105 –20 ft	--	--	SAND fine-medium-coarse grained with consolidated pieces, poorly sorted, dark yellowish orange (10YR 6/6), loose, wet.		
25		004-105-25 ft	--	--	Silty SAND with clay (15-20%) medium grained, dark yellowish orange (10YR 6/6)--light brown (5YR 5/6), loose, wet.		Clay as solid pieces.
30		004-105-30 ft	--	--	Silty SAND fine-medium grained, dark yellowish orange (10YR 6/6), loose, wet.		
35		004-105-35 ft	--	--	Silty SAND fine-medium grained with coarser pieves, dark yellowish orange (10YR 6/6), loose, wet.		
40		004-105-40 ft	--	--	Silty SAND (silt 10-15%) fine grained, dark yellowish orange (10YR 6/6), loose, wet.		
45		004-105–45 ft	--	--	SAND fine grained, dark yellowish orange (10YR 6/6), loose, wet.		
50		004-105-50 ft	--	--			
55		004-105-55 ft	--	--	SAND with some clay (5%) fine grained, moderate yellowish brown (10YR 5/4), loose, wet.		
60		004-105-60 ft	--	--	Silty SAND (clay-trace) medium grained, moderate yellowish brown (10YR 5/4), loose, wet.		
65		004-105-65 ft	--	--	Gravel SAND (hit gravel at 60.5') poorly sorted grain size (large pieces), chert, moderate yellowish brown (10YR 5/4), loose, wet.		
70		004-105-70 ft	--	--	Gravel SAND poorly sorted grain size, moderate brown (5YR 4/4), chert, loose, wet.		

LITHOLOGIC LOG	BORING/WELL NO: 004-105	PAGE 2 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: David Gentry
Drill Start (time/date): 08:24 on 07-10-04	Drill End (time/date): 14:33 on 07-10-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 102 ft
Logged By: B. Joyce	Coordinates: E ~-6510 N ~-1211	Protective Level: B

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
75		004-105– 75 ft	--	--	Gravel SAND poorly sorted grain size, large rock pieces, dusky brown (5YR 2/2), loose, wet.		
80		004-105 –80 ft	--	--	Gravel SAND poorly sorted grain size, moderate brown (5YR 4/4), loose, wet.		
85		004-105 –85 ft	--	--	Gravel SAND, poorly sorted grain size but getting smaller some silt included, moderate brown (5YR 4/4)--light brown (5YR 5/6), loose, wet.		
90		004-105 –90 ft	--	--	Gravel SAND poorly sorted grain size but gravel is smaller some silt, light brown (5YR 5/6), loose, wet.		
95		004-105 –95 ft	--	--	Silty SAND with gravel, fine grained light brown (5YR 5/6), loose, wet.		Drilling response indicated a fine sand.
100		004-105–100 ft	--	--	SAND, very fine grain--fine grained, light brown (5YR 6/4), loose, wet. TD 102'.		McNairy contact at 102'.
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: 004-106	PAGE 1 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: D. Gentry
Drill Start (time/date): 09:24 on 07-12-04	Drill End (time/date): 10:52 on 07-13-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 103 ft
Logged By: B. Joyce	Coordinates: E ~-6510 N ~-1289	Protective Level: B

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
5		004-106– 5 ft	--	--	Sandy SILT pale yellowish brown (10YR 6/2) soft, loose, wet.		
10		004-106 –10 ft	--	--	Sandy SILT grayish orange (10YR 7/4) soft, loose, wet.		
15		004-106 –15 ft	--	--	Sandy SILT grayish orange (10YR 7/4) soft, loose, wet.		
20		004-106 –20 ft	--	--	Silty SAND fine, some consolidated pieces, grayish orange (10YR 7/4) loose, wet.		
25		004-106-25 ft	--	--	SAND slightly silty, medium grained, some consolidated pieces, dark yellowish orange (10YR 6/6) loose, wet.		
30		004-106-30 ft	--	--	SAND with some clay, fine grained, dark yellowish orange (10YR 6/6) loose, wet.		
35		004-106-35 ft	--	--	Silty SAND fine grained, moderate yellowish brown (10YR 5/4) loose, wet.		
40		004-106-40 ft	--	--	Silty SAND with clay (clay pieces) medium grained, well sorted, dark yellowish orange (10YR 6/6), loose, wet.		
45		004-106–45 ft	--	--	SAND medium grained, well sorted, dark yellowish orange (10YR 6/6) loose, wet.		
50		004-106-50 ft	--	--			
55		004-106-55 ft	--	--			
60		004-106-60 ft	--	--	Silty SAND medium grained dark yellowish orange (10YR 6/6) loose, wet.		
65		004-106-65 ft	--	--	Gravel SAND, poorly sorted grain size (some very large) chert, light brown (5YR 5/6) loose, wet.		Drilling response seemed like gravel at 64'.
70		004-106-70 ft	--	--			
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: 004-106	PAGE 2 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: D. Gentry
Drill Start (time/date): 09:24 on 07-12-04	Drill End (time/date): 10:52 on 07-13-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 103 ft
Logged By: B. Joyce	Coordinates: E ~-6510 N ~-1289	Protective Level: B

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
			--	--			
75		004-106– 75 ft			Gravel SAND poorly sorted grain size, size decreasing moderate brown (5YR 4/4) loose, wet.		
			--	--			
80		004-106 –80 ft			Gravel SAND, as above.		
			--	--			
85		004-106 –85 ft			Gravel SAND poorly sorted grain size, moderate brown (5YR 4/4) light brown (5YR 5/6) loose, wet.		
			--	--			
90		004-106 –90 ft			Gravel SAND, as above.		
			--	--			
95		004-106 –95 ft			SAND with gravel, medium grained, light brown (5YR 5/6) loose, wet.		
			--	--			
100		004-106–100 ft			SAND with some gravel, medium grained, light brown (5YR 5/6) loose, wet.		
			--	--	TD 103'.		McNairy contact at 103 ft.
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: 004-107	PAGE 1 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: D. Gentry
Drill Start (time/date): 16:36 on 07-13-04	Drill End (time/date): 08:11 on 07-15-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 103 ft
Logged By: B. Joyce	Coordinates: E ~-6510 N ~-1382	Protective Level: B

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
			--	--			
5	/////	004-107– 5 ft	--	--	SAND medium-coarse grained, some consolidated pieces, light brown (5YR 5/6) loose, wet.		
10	/////	004-107 –10 ft	--	--			
15	/////	004-107 –15 ft	--	--	SILT with some sand, grayish orange (10YR 7/4) loose, wet.		
20	/////	004-107 –20 ft	--	--	Silty SAND fine grained, well sorted, grayish orange (10YR 7/4) loose, wet.		
25	/////	004-107-25 ft	--	--	Silty SAND with clay, fine grained, grayish orange (10YR 7/4), loose, wet.		
30	/////	004-107-30 ft	--	--	SAND fine grained, moderate brown (5YR 4/4) loose, wet.		
35	/////	004-107-35 ft	--	--			
40	/////	004-107-40 ft	--	--	CLAY with sand, dark yellowish orange (10YR 6/6) good plasticity, soft, moist.		
45	/////	004-107–45 ft	--	--	SAND with silt (15-20%) fine sand, dark yellowish orange (10YR 6/6) loose, wet.		
50	/////	004-107-50 ft	--	--	Slightly silty SAND fine grained, dark yellowish orange (10YR 6/6) loose, wet.		
55	/////	004-107-55 ft	--	--	Slightly silty SAND medium grained, moderate yellowish brown (10YR 5/4) loose, wet.		
60	/////	004-107-60 ft	--	--	moderate yellowish brown (10YR 5/4)		
65	/////	004-107-65 ft	--	--	Gravel SAND ,poorly sorted grain size (some very large) moderate yellowish brown(10YR 5/4) loose, wet.		Drilling response for gravel at 62’.
70	/////	004-107-70 ft	--	--	Gravel SAND, as above.		

LITHOLOGIC LOG	BORING/WELL NO: 004-107	PAGE 2 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: D. Gentry
Drill Start (time/date): 16:36 on 07-13-04	Drill End (time/date): 08:11 on 07-15-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 103 ft
Logged By: B. Joyce	Coordinates: E ~-6510 N ~-1382	Protective Level: B

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
			--	--			
75		004-107– 75 ft			Gravel SAND as above.		
			--	--			
80		004-107 –80 ft			Gravel SAND poorly sorted grain size, size is decreasing moderate brown (5YR 4/4) loose, wet..		
			--	--			
85		004-107 –85 ft			Gravel SAND poorly sorted grain size, size is decreasing with more medium-coarse grained sand, light brown (5YR 5/6) loose, wet.		
			--	--			
90		004-107 –90 ft			Gravel SAND, as above.		
			--	--			
95		004-107 –95 ft			Gravel SAND with finer sand poorly sorter grain size moderate brown (5YR 3/4) very wet, loose.		
			--	--			
100		004-107–100 ft			SAND fine grained with some gravel, light brown (5YR 5/6) loose, wet.		McNairy contact at 103 ft.
			--	--	TD 103'.		
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: 004-108	PAGE 1 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: D. Gentry
Drill Start (time/date): 13:20 on 07-19-04	Drill End (time/date): 16:31 on 07-20-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 102 ft
Logged By: B. Joyce	Coordinates: E ~-6510 N ~-1467	Protective Level: B

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/ SAFETY VOC	HEALTH/ SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
			--	--			
5		004-108– 5 ft			CLAY with sand (rock), light brown (5YR 5/6), soft, malleable, wet.		
			--	--			
10		004-108 –10 ft			SILT with fine sand (30-35%) soft, loose, wet, grayish orange (10YR7/4).		
			--	--	SAND with silt (30-35%) fine grained, well sorted, grayish orange (10YR 7/4), loose, wet.		
15		004-108 –15 ft					
			--	--	SAND (silt 10-15%) medium-fine grained with some consolidated pieces, occ. coarse grained, dark yellowish orange (10YR 6/6), loose, wet.		
20		004-108 –20 ft					
			--	--	CLAY with sand (25-30%) dark yellowish orange (10YR 6/6) with clay pale reddish brown (10YR 5/4) soft, malleable, loose, wet.		
25		004-108-25 ft					
			--	--	Silty SAND with clay (silt 30-35%) fine-medium grained dark yellowish orange (10YR 6/6) – light brown (5YR 5/6) loose, wet.		
30		004-108-30 ft					
			--	--	Slightly silty SAND medium-fine grained, dark yellowish orange (10YR 6/6)-light brown (5YR 5/6), loose, wet.		
35		004-108-35 ft					
			--	--	Silty SAND (silt 30-35%) (clay-trace), medium-fine grained, dark yellowish orange (10YR 6/6), loose, wet.		
40		004-108-40 ft					
			--	--	Slightly silty SAND, medium-fine grained with some consolidated pieces, dark yellowish orange (10YR 6/6) loose, wet.		
45		004-108–45 ft					
			--	--	SAND fine grained, well sorted, moderate yellowish brown (10YR 5/4), loose, wet.		
50		004-108-50 ft					
			--	--	SAND medium-fine grained well sorted moderate yellowish brown (10YR 5/4) loose, wet.		
55		004-108-55 ft					
			--	--	Silty SAND (silt 40-45%) fine grained, well sorted, moderate yellowish brown (10YR 5/4) loose, wet.		
60		004-108-60 ft					
			--	--	SAND medium-coarse-very coarse grained with consolidated pieces, poorly sorted moderate yellowish brown (10YR 5/4) loose, wet.		Hit gravel at 63' based on drilling.
65		004-108-65 ft					
			--	--	Gravel SAND, large pieces chert, moderate brown (5YR 4/4), loose, wet.		
70		004-108-70 ft					
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: 004-108	PAGE 2 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: D. Gentry
Drill Start (time/date): 13:20 on 07-19-04	Drill End (time/date): 16:31 on 07-20-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 102 ft
Logged By: B. Joyce	Coordinates: E ~-6510 N ~-1467	Protective Level: B

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
			--	--			
75		004-108– 75 ft			Gravel SAND, as above with some coarse-very coarse grained.		
			--	--			
80		004-108 –80 ft			Gravel SAND, as above.		
			--	--			
85		004-108 –85 ft			Gravel SAND with sand medium-coarse grained (maybe sandstone) light brown (5YR 5/6)-dark yellowish orange (10YR 6/6), loose, wet.		
			--	--			
90		004-108 –90 ft			Gravel SAND, as above.		
			--	--			
95		004-108 –95 ft			Gravel SAND, as above.		
			--	--			
100		004-108–100 ft			No lithologic description available. TD 102'.		Gravel in bag not representative. Drilled like a fine sand. McNairy contact at 102 ft.
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: 004-109	PAGE 1 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: D. Gentry
Drill Start (time/date): 07:55 on 07-22-04	Drill End (time/date): 08:58 on 07-23-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 103 ft
Logged By: B. Joyce	Coordinates: E ~-6510 N ~-1571	Protective Level: B

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
5		004-109– 5 ft	--	--	SAND (silt 15-15%) medium-coarse grained with consolidated pieces, light brown (5YR 5/6) poorly sorted, loose, wet.		
10		004-109 –10 ft	--	--	SILT (sand 10-15%), moderate yellowish brown (10YR 5/4), soft, malleable, wet, trace of clay.		
15		004-109 –15 ft	--	--	Silty SAND (silt 25-30%) medium-coarse grained with consolidated pieces, poorly sorted, moderate yellowish brown (10YR5/4) loose, wet.		
20		004-109 –20 ft	--	--	Sandy SILT (sand 20-25%) (clay trace-5%) fine-medium grained with some consolidated pieces, moderate yellowish brown (10YR 5/4) loose, wet.		
25		004-109-25 ft	--	--	Silty SAND (silt 10-15%) fine-medium grained, well sorted, light brown (5 YR 5/6) loose, wet.		
30		004-109-30 ft	--	--	Silty CLAY (sand-trace) moderate brown (5YR 4/4)-light brown (5YR 5/6), good plasticity, soft, malleable, wet.		
35		004-109-35 ft	--	--	Silty SAND (silt 15-20%) fine-medium grained, well sorted, grayish orange (10YR 7/4), loose, wet.		
40		004-109-40 ft	--	--	Silty SAND (silt 15-20%) medium-coarse grained with some fractured rock, poorly sorted grayish orange (10 YR 7/4) moderate yellowish brown (10 YR 5/4) loose, wet.		
45		004-109–45 ft	--	--	Silty SAND (silt 25-30%, clay 5-10%) fine grained, well sorted, grayish orange (10YR 7/4), loose, wet.		
50		004-109-50 ft	--	--	SAND (silt 10%) fine grained, well sorted, dark yellowish orange (10YR 6/6), loose, wet.		
55		004-109-55 ft	--	--	SAND (silt 10-15%) fine-medium grained, well sorted, dark yellowish orange (10YR 6/6), loose, wet.		
60		004-109-60 ft	--	--	No lithologic description for this sample. The description for this interval is probably similar to the 55' interval.		Sample had gravel in it but the gravel was not encountered until 63' based on the drilling response. The sample was probably caught late. Hit gravel at 63' based on drilling.
65		004-109-65 ft	--	--	Gravelly SAND medium-coarse grained with gravel, chert, light brown (5YR 5/6), loose, wet.		
70		004-109-70 ft	--	--	Gravelly SAND, gravel getting smaller in size, chert, poorly sorted, moderate brown (5YR 4/4)-light brown (5YR 5/6) loose, wet.		

LITHOLOGIC LOG	BORING/WELL NO: 004-109	PAGE 2 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: D. Gentry
Drill Start (time/date): 07:55 on 07-22-04	Drill End (time/date): 08:58 on 07-23-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 103 ft
Logged By: B. Joyce	Coordinates: E ~-6510 N ~-1571	Protective Level: B

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
			--	--			
75		004-109– 75 ft			Gravelly SAND, as above.		
			--	--	Gravelly SAND, larger size. Very coarse grained-granules-gravel, poorly sorted, moderate brown (5YR 4/4), loose, wet.		
80		004-109 –80 ft					
			--	--			
85		004-109 –85 ft			Gravelly SAND, as above but darker color, moderate brown (5YR 3/4).		May be oxide layer.
			--	--	Gravelly SAND, size is decreasing, getting sandier, poorly sorted, light brown (5YR 5/6), loose, wet.		
90		004-109 –90 ft					
			--	--	SAND with some gravel, medium-coarse-very coarse grained, moderately sorted, light brown (5YR 5/6), loose, wet.		
95		004-109 –95 ft					
			--	--	SAND (silt 5-10%), fine grained, well sorted, light brown (5YR 5/6), loose, wet.		
100		004-109–100 ft					
			--	--	TD 103'.		McNairy contact at 102.5 ft.
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: 004-110	PAGE 1 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: D. Gentry
Drill Start (time/date): 14:35 on 07-26-04	Drill End (time/date): 15:12 on 07-27-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 103 ft
Logged By: B. Joyce	Coordinates: E ~-6400 N ~-1633	Protective Level: B

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
			--	--	Top Soil. SILT with clay (5-10%) moderate yellowish brown (10YR 5/9) – dark yellowish brown (10 YR 4/2), unconsolidated, loose, wet, trace of sand.		
5		004-109– 5 ft	--	--	SILT with sand (10-15%) sand is fine-grained, soft, loose, wet, grayish orange (10 YR 7/4).		
10		004-109 –10 ft	--	--	SILT (sand 5-10%) grayish orange (10 YR 7/4) – moderate yellowish brown (10 YR 5/4), soft malleable, loose, wet.		
15		004-109 –15 ft	--	--	Silty SAND (silt 35-40%) fine-medium-coarse-very coarse grained with consolidated pieces, poorly sorted, grayish orange (10YR 7/4) – moderate yellowish brown (10YR 5/4), loose, wet.		
20		004-109 –20 ft	--	--	Silty SAND (silt 35-40%) fine-medium grained, with consolidated pieces, moderately sorted, grayish orange (10 YR 7/4), loose, wet.		
25		004-109-25 ft	--	--			
30		004-109-30 ft	--	--	Silty SAND (silt 35-40%) fine-medium grained, well sorted, moderate yellowish brown (10 YR 5/4) loose, wet.		
35		004-109-35 ft	--	--	SILT (sand 10-15%) moderate yellowish brown (10 YR 5/4) – grayish orange (10 YR 7/4) soft, loose, wet.		
40		004-109-40 ft	--	--	grained) grayish orange (10 YR 7/4),		
45		004-109–45 ft	--	--	Silty SAND (silt 25-30%) fine-medium grained, well sorted, grayish orange (10YR 7/4) – dark yellowish orange (10 YR 6/6), loose, wet.		
50		004-109-50 ft	--	--	SAND (silt 5-10%) fine-medium grained, well sorted, dark yellowish orange (10YR 6/6), loose, wet.		
55		004-109-55 ft	--	--	Silty SAND (silt 25-30%) fine-medium grained, well sorted, dark yellowish orange (10YR 6/6), loose, wet.		
60		004-109-60 ft	--	--	SAND (silt 10-15%) medium-coarse-very coarse grained, with rock, poorly sorted, dark yellowish orange (10YR 6/6), loose, wet.		
65		004-109-65 ft	--	--	Gravelly SAND, large size chert, poorly sorted, dark yellowish orange (10 YR 6/6) – light brown (5 YR 5/6), loose, wet.		
70		004-109-70 ft	--	--	Gravelly SAND, smaller size, very coarse grained with granules and gravel chert, poorly sorted, moderate yellowish brown (10 YR 5/4) – light brown (5YR 5/6), loose, wet.		

LITHOLOGIC LOG	BORING/WELL NO: 004-110	PAGE 2 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: D. Gentry
Drill Start (time/date): 14:35 on 07-26-04	Drill End (time/date): 15:12 on 07-27-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 103 ft
Logged By: B. Joyce	Coordinates: E ~-6400 N ~-1633	Protective Level: B

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
			--	--			
75		004-109– 75 ft			Gravelly SAND, as above.		
			--	--			
80		004-109 –80 ft			Gravelly SAND, as above. Slightly larger size, more sand.		
			--	--			
85		004-109 –85 ft			Gravelly SAND, more sand, medium-coarse-very coarse grained with granules and gravel, poorly sorted, moderate yellowish brown (10 YR 5/4) – light brown (5 YR 5/6), loose wet.		
			--	--			
90		004-109 –90 ft			Gravelly SAND, as above.		
			--	--			
95		004-109 –95 ft			SAND medium-coarse-very coarse grained, with occ. gravel, same color.		
			--	--			
100		004-109–100 ft			Silty SAND (silt 20-25%, clay - trace), medium-coarse grained, well sorted, light brown (5YR 5/6), loose, wet. TD 103'.		Top of McNairy ~101 ft.
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: MW414	PAGE 1 of 3
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: Nick Letsch
Drill Start (time/date): 09:24 on 09-01-04	Drill End (time/date): 08:44 on 09-02-04	Borehole Dia: 8 inch
Drill Method/Rig Type: Rotary Sonic		Total Depth:79 ft
Logged By: K. Davis	Coordinates: E ~-6531 N ~-1216	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE RECOVERY	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
0		6.8'			0.0-1.2': Clayey, silty GRAVEL (fill); gravel is 1" dia., well rounded, chert; yellowish brown (10YR5/8), medium density, moist. 1.2-2.3': Clayey SILT, light gray (10YR7/1), hard, slightly moist, medium plasticity. 2.3-3.0': Clayey SILT, as above, but w/blebs of manganese staining. 3.0-6.8': Clayey SILT, mottled light gray (10YR7/1) & brownish yellow (10YR6/8), low to medium plasticity, soft, moist.		
5							
10		10.0'			9.0-14.1' SILT, light gray (10 YR7/1) w/some blebs of brownish yellow (10YR6/8), low plasticity, medium density, moist.		
15					14.1-19.0' SILT, as above, but with gravel. Gravel increases downward from tr. to approx. 25% from 18-20'. Gravel is 0.5-1.0" dia., subangular to subrounded, chert and siltstone (?). Note1: some manganese staining at 15.1-15.5'. Note2: brownish yellow staining is commonly limonite cementation around gravel.		
20		3.5'			19.0-22.2': Gravelly SAND w/silt; sand (55%), medium, rounded, well sorted; gravel (35%), 0.5-1.5" dia., rounded to subangular, chert; silt (10%); massive, brownish yellow (10YR6/6), dense, wet. 22.2-22.5': SAND, medium, rounded, well sorted; trace gravel; massive, brownish yellow (10YR6/6), medium density, moist.		
25							
30		10.0'			29.0-30.7': SILT, brownish yellow (10YR6/8), low plasticity, moderate density, moist. 30.7-36.5': SAND, medium, well sorted, brownish yellow (10YR6/8), soft, moist.		
35							

LITHOLOGIC LOG	BORING/WELL NO: MW414	PAGE 2 of 3
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: Nick Letsch
Drill Start (time/date): 09:24 on 09-01-04	Drill End (time/date): 08:44 on 09-02-04	Borehole Dia: 8 inch
Drill Method/Rig Type: Rotary Sonic		Total Depth:79 ft
Logged By: K. Davis	Coordinates: E ~-6531 N ~-1216	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE RECOVERY	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
40		9.8'			36.5-37.9': SAND, as above w/20% gravel. Gravel is 1" dia., rounded, chert. 37.9-39.0': Slightly clayey SILT; pale brown (10YR6/3), medium plasticity, soft, moist. 39.0-39.4': Slough.		
45					39.4-45.8': SILT grading downward to v. fine sand, yellow (10YR7/8), low plasticity, moderately hard, moist.		
50		6.9'			45.8-46.0': Fine SAND, as above, but w/ heavy manganese staining. 46.0-47.2': Fine SAND, clayey, brownish yellow (10YR6/8), hard, slightly plastic, moist. 47.2-48.8': Fine to medium SAND, massive, yellow (10YR7/6), soft, moist. 49.0-52.0': Fine SAND, well-sorted, quartz w/ 5-10% mica (muscovite?); silty, massive, brownish yellow (10YR6/8), soft, moist.		
55					52.0-55.9': Fine to medium SAND, well-sorted, quartz w/ tr mica as above, massive, brownish yellow (10YR6/8), soft, wet.		
60		6.8'			59.0-61.2': Fine to medium SAND, well sorted, rounded, quartz; massive, brownish yellow (10YR6/6), loose, soft, wet. 61.2-62.3': Silty fine SAND, well sorted, quartz; massive, brownish yellow (10YR6/6), slightly plastic, soft, wet. 62.3-63.1': Medium SAND, well sorted, rounded, quartz; interlayered light gray (10YR7/1) and brownish yellow (10YR6/6), loose, soft, wet.		Top of RGA @ 62.3'
65					63.1-65.8': Poorly sorted sandy GRAVEL; gravel (55%), 0.2-1.2" dia., rounded, chert; medium sand (45%), rounded, quartz; massive, yellowish brown (10YR5/6), unconsolidated/loose, wet.		
70		5.0'			69.0-74.0': Poorly sorted sandy GRAVEL, as above.		

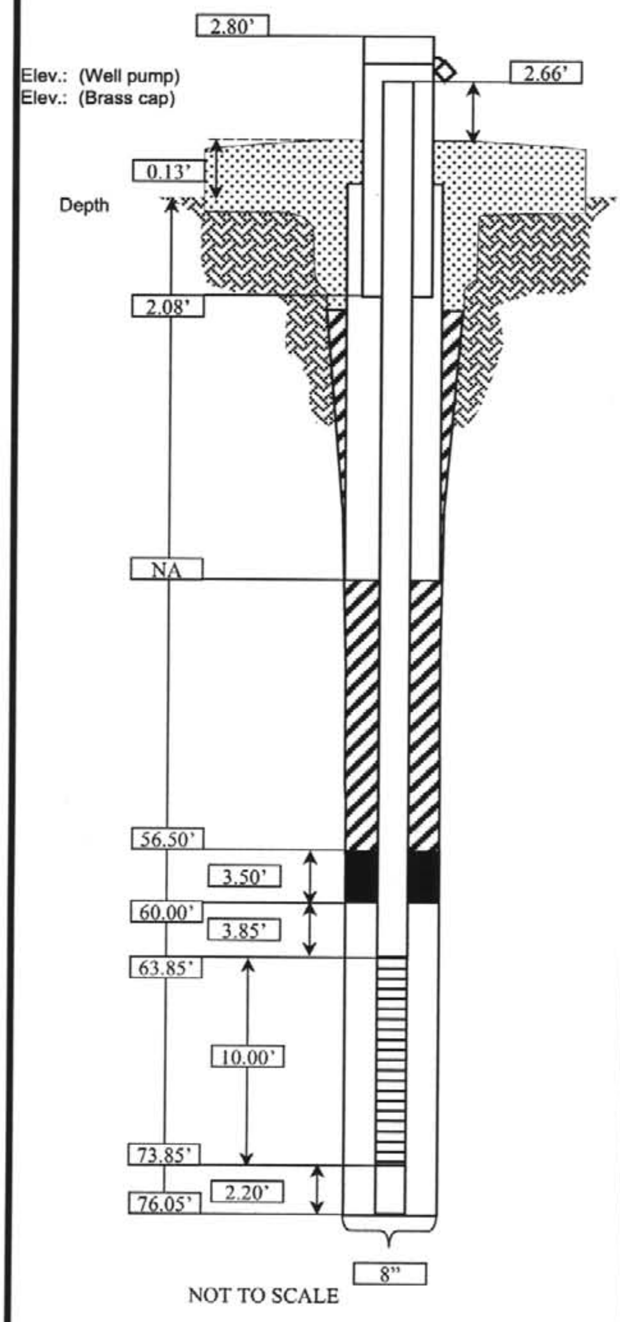
LITHOLOGIC LOG	BORING/WELL NO: MW414	PAGE 3 of 3
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: Nick Letsch
Drill Start (time/date): 09:24 on 09-01-04	Drill End (time/date): 08:44 on 09-02-04	Borehole Dia: 8 inch
Drill Method/Rig Type: Rotary Sonic		Total Depth:79 ft
Logged By: K. Davis	Coordinates: E ~-6531 N ~-1216	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE RECOVERY	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
75							
							Total Depth – 79.0'
80							
85							
90							
95							
100							

DOCUMENT No.

Well No. MW 414	Installation: Paducah Gaseous Diffusion Plant	
Project No. DO 186	Client/Project: USDOE/BJC/PGDP Site Investigation of SW Plume	Site: C-747 Contaminated Burial Yd.

Contractor: SAIC	Drill Contractor: Miller Government Services
Start Date: 9/1/2004 @ 09:24	End Date: 9/3/2004 @ 09:09



Well Coord: N ~ - 1220

W ~ 6531

Protective Casing
Material Type: Steel
Diameter: 8-in
Depth BGS: 2.08' Weep Hole? (Y / N): Yes
Guard Posts (Y / N): Yes
No: 4 Type: Steel

Surface Pad
Composition and Size: Concrete, 4 ft x 4 ft

Riser Pipe
Type: SCH 40 PVC
Diameter: 4-in.
Total Depth (Ground surface to TOS): 63.85'
Ventilated Cap (Y / N): Yes

Grout
Composition & Proportions: Bentonite Grout
Grout Type: Pure Gold
Weight (lbs/gal.): ~9.8
% Solids: 30
Tremied (Y / N): Yes
Interval BGS: 2.08' – 56.50'

Centralizers (Y / N): Yes
Depth(s): 74.95'

Seal
Type: Shur-Pel 3/8-inch Bentonite Pellets
Source: Drillers Services, Inc.
Setup/Hydration Time: 19.3 hr Vol. Fluid Added: N/A
Tremied (Y / N): Yes

Filter Pack
Graduation Designation: #1
Grain Size: Project File
Type: #1 Filter Sand
Amt. Used: 550 lb
Tremied (Y / N): Yes
Source: Drillers Services, Inc.
Grain Size Dist: Project File

Screen
Type: SCH 40 PVC
Diameter: 4-in.
Length: 10-ft
Slot Size and Type: 0.010 Horizontal Slot
Interval BGS: 63.85' – 73.85'

Isolation Casing (Y / N): No
Type:
Diameter:
Total Length:

Sump (Y / N): Yes
Interval BGS: 73.85' – 76.05'
Bottom Cap (Y / N): Yes

Backfill Plug
Material: N/A
Setup/Hydration Time: N/A
Tremied (Y / N): N/A

U. S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Monitoring Well 414 Construction Log

FIGURE No.
DATE 09-17-04

LITHOLOGIC LOG	BORING/WELL NO: MW414A	PAGE 1 of 3
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: Nick Letsch
Drill Start (time/date): 13:46 on 08-25-04	Drill End (time/date): 17:07 on 08-26-04	Borehole Dia: 8 inch
Drill Method/Rig Type: Rotary Sonic		Total Depth:79 ft
Logged By: B. Joyce	Coordinates: E ~-6531 N ~-1216	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE RECOVERY	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
0–5		0.7'			0.0-0.5' Top Soil: SAND (silt 15-20%, clay tr-5%) med. to coarse to v. coarse gr. w/ cobbles & gravel, poorly sorted, subrounded to subangular, pale yellowish br. (10YR6/2) to mod. yellowish br. (10YR5/4), wet to v. moist. 0.5-0.7' SILT, light gray (N7) to v. light gray, low plasticity, firm, dry.		
5–10		9.5'			9.0-15.5' SILT (clay tr-5% as pockets) grayish orange (10YR7/4) w/ light brown (5YR5/6) poor plasticity, slightly moist grading to dry, friable, includes manganese oxide pockets.		
10–15					15.5-18.5' Silty SAND w/clay (silt 15-20% clay 15-20%) clay in matrix, med. to coarse to v. coarse gr. w/ cobbles & rock, poorly-sorted, subrounded to subangular, light br. (5YR5/6) w/ lt gray (N7) to v. lt gray (N8) matrix, firm to hard, slightly moist to dry, well-compacted.		
15–20		10.0'			19.0-20.3' SAND (silt 10-15% clay 5%) w/ abundant manganese oxide & iron oxide, med. to coarse to v. coarse-grained w/ cobbles & gravel, poorly sorted, subangular to subrounded, moderate brown (5 YR 4/4) to moderate brown (5 YR 3/4) to black (N1), dry, consolidated to well consolid. w/clay in matrix.		
20–25					20.3-25.0': SILT with sand pockets (sand 15-20%, clay tr-5%), light brown (5YR5/6) to pale reddish brown (10 R 5/4), slightly moist to friable, good plasticity, malleable when moist.		
25–30		10.0'			25.0-29.0': Silty SAND (silt 25-30%, clay tr-5%), medium to coarse to very coarse grained, well-sorted, subrounded to subangular, light brown (5YR5/6) to dark yellowish orange (10 YR 6/6) with some very light gray (N8), slightly moist to dry, abundant manganese oxide. 29.0-31.5': Sandy SILT (sand 30-35%), light brown (5YR5/6) to dark yellowish orange (10YR6/6) to very pale orange (10YR8/2), mottled, moderate plasticity, slightly moist, mostly friable.		
30–35					31.5-37.5': SAND (silt 5-10%) medium to coarse grained grading to coarse to very coarse grained with some cobbles, well-sorted, subrounded to subangular, moderate yellowish brown (10YR5/4) to dark yellowish orange (10YR6/6), slightly moist to moist, unconsolidated, includes pockets of manganese oxide.		
35							

LITHOLOGIC LOG	BORING/WELL NO: MW414A	PAGE 2 of 3
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: Nick Letsch
Drill Start (time/date): 13:46 on 08-25-04	Drill End (time/date): 17:07 on 08-26-04	Borehole Dia: 8 inch
Drill Method/Rig Type: Rotary Sonic		Total Depth:79 ft
Logged By: B. Joyce	Coordinates: E ~-6531 N ~-1216	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE RECOVERY	HEALTH/ SAFETY VOC	HEALTH/ SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
					37.5-39.0': SILT (sand 10-15%) dark yellowish orange (10YR6/6), good plasticity, well consolidated, firm to hard, slightly moist.		
40		10.0'			39.0-44.0': Sandy SILT (sand 35-40%) light brown (5YR6/6) to dark yellowish orange (10YR6/6) with very pale orange (10YR8/2), poor plasticity, slightly moist to dry, firm to hard.		
45					44.0-49.0': Silty SAND (silt 35-40%) medium to coarse grained, well-sorted, subrounded to subangular, light brown (5YR6/6) to dark yellowish orange (10YR6/6) slightly moist to dry, trace manganese oxide layer from 45.3-45.5', well consolidated.		
50		10.0'			49.0-51.5': Silty SAND (silt 35-40%) medium to fine grained, well-sorted, subrounded to subangular, light brown (5YR5/6) to grayish orange (10YR7/4), moist, v. soft, good plasticity, trace manganese oxide.		0.1 ppm hit with PID
					51.5-53.2': SAND (silt 10-15%) medium to coarse grained, well-sorted, subrounded to subangular, grayish orange (10YR7/4) to dark yellowish brown (10YR4/2), moist to wet, abundant manganese oxide & iron oxide.		
55					53.2-59.0': Silty SAND (silt 20-25% w/ siltier pockets) medium to fine-grained, well sorted, subrounded to subangular, grayish orange (10YR7/4) to light brown (5YR5/6), moist, soft, trace manganese & iron oxides.		
60		8.0'			59.0-62.2': SAND (silt 10-15% to 30-35%, varying) med. to coarse grained, well sorted, subrounded to subangular, grayish orange (10YR7/4) to dark yellowish brown (10YR6/6) w/ some light brown (5YR5/6), moist to wet, trace manganese oxide.		
					62.2-63.0': CLAY w/sand pockets, pinkish gray (5YR8/1) to v. light gray (N8), good plasticity, moist, soft, malleable.		Top of RGA @ 63'
65					63.0-65.0': Gravelly SAND, coarse to v. coarse grained w/cobbles & gravel, poorly-sorted, subrounded to subangular, moderate yellowish brown (10YR5/4), chert, wet, includes manganese oxide.		
70					69.0-76.0': Gravelly SAND, coarse to v. coarse grained w/cobbles & gravel, poorly sorted, subrounded to subangular, moderate yellowish brown (10YR5/4), wet to saturated.		

LITHOLOGIC LOG	BORING/WELL NO: MW414A	PAGE 3 of 3
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: Nick Letsch
Drill Start (time/date): 13:46 on 08-25-04	Drill End (time/date): 17:07 on 08-26-04	Borehole Dia: 8 inch
Drill Method/Rig Type: Rotary Sonic		Total Depth:79 ft
Logged By: B. Joyce	Coordinates: E ~-6531 N ~-1216	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE RECOVERY	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
		7.0'					
75							
							Total Depth – 79.0'
80							
85							
90							
95							
100							

LITHOLOGIC LOG	BORING/WELL NO: MW415	PAGE 1 of 3
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: Nick Letsch
Drill Start (time/date): 12:15 on 09-07-04	Drill End (time/date): 10:55 on 09-08-04	Borehole Dia: 8 inch
Drill Method/Rig Type: Rotary Sonic		Total Depth:104 ft
Logged By: K. Davis	Coordinates: E ~-6531 N ~-1206	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE RECOVERY	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
0–5		7.0'			0.0-0.9' Clayey Sandy SILT w/some rounded, chert gravel (10-15%), yellowish red (7.5 YR 5/6), med plasticity, soft, wet. 0.9-1.6': SILT, light gray (10YR7/1) w/some small blebs of manganese (black) staining, non-plastic, hard, moist. 1.6-2.5': SILT, mottled, light gray (10YR7/1) and brownish yellow (10YR6/8) w/large blebs of manganese (black) staining, low plasticity, mod. hard, moist. 2.5-7.0': SILT, brownish yellow (10YR6/6) w/some lt gray (10YR7/1) mottling, low plasticity, moderately hard, wet.		
10		8.0'			9.0-14.9': SILT, light gray (10YR7/1) w/ brownish yellow (10YR6/6) & black (10 YR 2/1) (manganese) mottling, slightly plastic, moderately hard, wet; tr. chert pebbles, well-rounded.		
15					14.9-17.0' silty (20%), gravelly (20%) SAND, fine grained; gravel is 0.3-1.0" dia., sub-angular to rounded, chert; massive brownish yellow (10YR6/6), low plasticity, hard, wet.		
20		7.2'			19.0-24.2' silty (20%), gravelly (20%) SAND, fine-grained, as above. Grading downward to clayey GRAVEL (clay 40%), gravel is 0.3-1.2" dia., subangular to subrounded, chert; yellowish brown (10 YR 5/6), unconsolidated/ friable, wet.		
25					24.2-26.2': Sandy SILT; sand (~20%), fine grained; laminated reddish yellow (7.5 YR 7/8) & light gray (7.5 YR 7/1), low plasticity, soft, moist.		
30		10.5'			29.0-32.2': SILT; yellow (10YR7/8) with some light gray (10YR7/1) mottling and little manganese (black) staining, low plasticity, moderately hard, moist. 32.2-34.6': SAND; fine grained, massive, very pale brown (10YR7/3), unconsolidated, moderately hard, moist.		
35							

LITHOLOGIC LOG		BORING/WELL NO: MW415	PAGE 2 of 3
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY			Site: SWMU 004
Project No: DO 186		Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC		Drill Contractor: Miller Govt Services	Driller: Nick Letsch
Drill Start (time/date): 12:15 on 09-07-04		Drill End (time/date): 12:00 on 09-08-04	Borehole Dia: 8 inch
Drill Method/Rig Type: Rotary Sonic			Total Depth:104 ft
Logged By: K. Davis		Coordinates: E ~-6531 N ~-1206	Protective Level: D

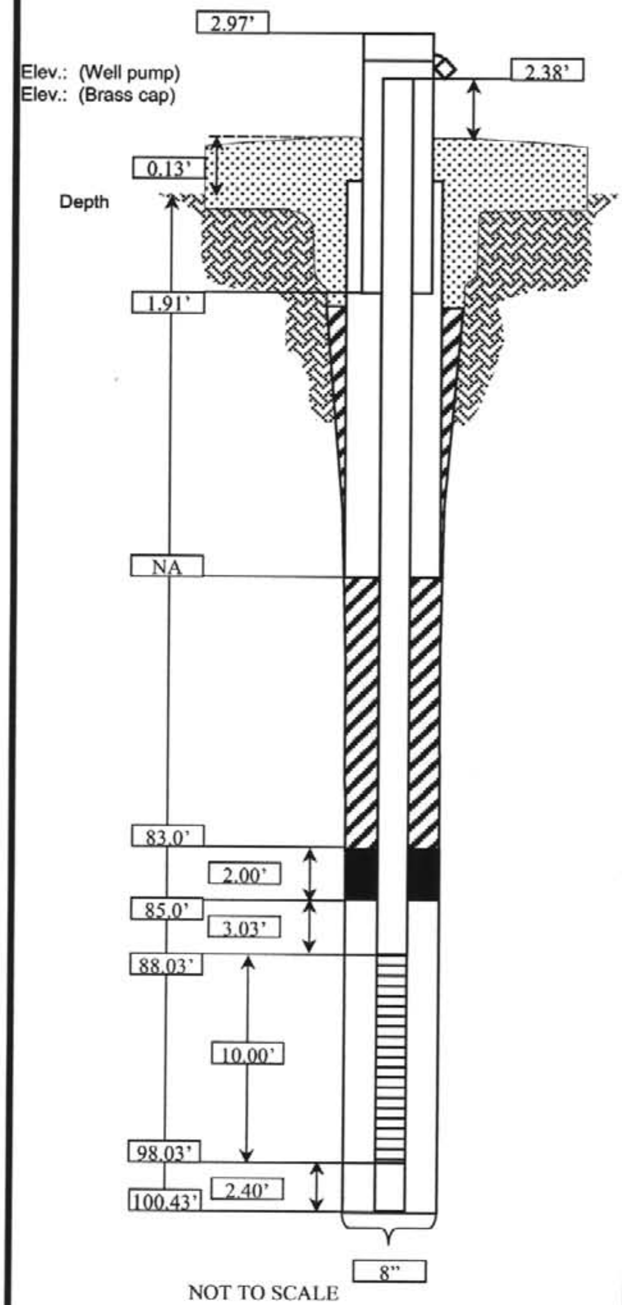
DEPTH (ft)	SAMPLE INTERVAL	SAMPLE RECOVERY	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
					34.6-38.8': SAND; fine grained, as above, but with coarse sand/gravel increasing downward from trace to 15%, gravel ranges up to 0.4" dia., rounded to well rounded, chert.		
		7.9'			38.8-39.5': Clayey SILT; massive, brownish yellow (10 YR 6/6), medium plasticity, soft to moderately hard, moist.		
40					39.0-46.5': SILT; brownish yellow (10YR6/8) with little light gray (10YR7/1) mottling, medium plasticity, moderately hard, moist.		
45					46.5-46.7': SILT; with distinct bands of limonite(?) yellow (10YR7/8) and manganese(?) black (10YR2/1) cementation, non-plastic, hard, dry. 46.7-46.9': SAND; fine grained, massive, light gray (10YR7/1), unconsolidated/friable, soft, moist.		
50		9.0'			49.0-51.5': Silty SAND, fine grained, massive, brownish yellow (10YR6/8), low plasticity, moderately soft, wet. Note:mica (muscovite?) tr-2%. 51.5-53.5': Silty SAND, fine grained, as above, but stained with manganese(?) blebs/cementation. 53.5-58.0': Silty SAND, fine grained, massive, brownish yellow (10YR6/8), low plasticity, soft, wet.		
55							
60		7.0'			59.0-61.1': Silty SAND, fine-grained, as above. 61.6-61.7': Sandy SILT, sand is fine grained, colored as above, non-plastic, hard, wet. 61.7-62.8': SAND, fine grained, massive, colored as above, loose consistency, soft, wet. 62.8-66.0': Gravelly SAND, sand is bimodal, 35 % fine grained (quartz w/tr-2% mica/ muscovite), 30% very coarse grained, subrounded, chert; gravel (35%) ranges from 0.4" dia., subangular, chert to 1.5" dia., well rounded, chert; brownish yellow (10YR6/6), loose consistency, wet.		Top of RGA @ 62.8'
65							
70		6.0'			69.0-69.9': Slough, SAND is poorly sorted, fine to coarse grained, quartz; brownish yellow (10YR6/6), loose consistency, wet.		

LITHOLOGIC LOG	BORING/WELL NO: MW415	PAGE 3 of 3
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: Nick Letsch
Drill Start (time/date): 12:15 on 09-07-04	Drill End (time/date): 12:00 on 09-08-04	Borehole Dia: 8 inch
Drill Method/Rig Type: Rotary Sonic		Total Depth:104 ft
Logged By: K. Davis	Coordinates: E ~-6531 N ~-1206	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE RECOVERY	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
		7.0'			69.9-73.9': Gravelly SAND, fine grained, quartz (50%); coarse grained, well rounded, chert (10%); gravel (40%) ranges from 0.3"-1.2" dia., well rounded to subrounded, chert; brownish yellow (10YR6/6), loose consistency, wet.		
75					73.9-75.0': Gravelly SAND, as above, but gravel ranges up to 2.5" dia. and colored yellowish brown (10YR5/6).		
80		6.4'			79.0-83.3': Gravelly SAND, sand is bimodal – 50% fine sand, quartz and 10% very coarse sand, subrounded to subangular, chert; gravel ranges from 0.4" dia., subrounded to subangular to 2" dia., well rounded, chert; brownish yellow (10YR6/6), unconsolidated/ loose, wet.		
					83.3-84.2': Gravelly SAND, as above but brown (10YR4/3).		
85					84.2-85.4': Clayey sandy GRAVEL: clay (30%) fills most of gravel interstices; sand (20%) is fine grained quartz with tr of mica (muscovite?); gravel (50%) ranges from 0.3" to 1.2" dia., rounded to well rounded; brownish yellow (10YR6/6), unconsolidated, wet.		
90		8.0'			89.0-96.0': Gravelly SAND, massive, as at 79 -83.3'.		
95					96.0-97.0': SAND, very fine grained, quartz w/ approx. 10% opaque minerals, massive, very pale brown (10YR7/3), loose, soft, wet.		
							Top of McNairy @ 98'
100		4.5'			99.0-103.5': SAND, very fine grained, quartz with 2-5% opaque minerals; very pale brown (10YR7/3), massive but for infrequent laminations of yellowish red (5YR5/8) sand and light gray (5YR7/1) clay, loose, soft, wet.		
							Total Depth 104'

DOCUMENT No.

Well No. MW 415	Installation: Paducah Gaseous Diffusion Plant	
Project No. DO 186	Client/Project: USDOE/BJC/PGDP Site Investigation of SW Plume	Site: C-747 Contaminated Burial Yd.
Contractor: SAIC	Drill Contractor: Miller Government Services	
Start Date: 9/7/2004 @ 11:50	End Date: 9/9/2004 @ 09:01	



Well Coord: N ~ - 1206
W ~ 6531

Protective Casing
Material Type: Steel
Diameter: 8-in
Depth BGS: 1.91' Weep Hole? (Y / N): Yes
Guard Posts (Y / N): Yes
No: 4 Type: Steel

Surface Pad
Composition and Size: Concrete, 4 ft x 4 ft

Riser Pipe
Type: SCH 40 PVC
Diameter: 4-in.
Total Depth (Ground surface to TOS): 88.03'
Ventilated Cap (Y / N): Yes

Grout
Composition & Proportions: Bentonite Grout
Grout Type: Pure Gold
Weight (lbs/gal.): ~10.0
% Solids: 30
Tremied (Y / N): Yes
Interval BGS: 1.91' – 83.0'

Centralizers (Y / N): Yes
Depth(s): 99.23'

Seal
Type: Shur-Pel 3/8-inch Bentonite Pellets
Source: Drillers Services, Inc.
Setup/Hydration Time: 17.5 hr Vol. Fluid Added: N/A
Tremied (Y / N): Yes

Filter Pack
Graduation Designation: #1
Grain Size: Project File
Type: #1 Filter Sand
Amt. Used: 550 lb
Tremied (Y / N): Yes
Source: Drillers Services, Inc.
Grain Size Dist: Project File

Screen
Type: SCH 40 PVC
Diameter: 4-in.
Length: 10-ft
Slot Size and Type: 0.010 Horizontal Slot
Interval BGS: 88.03' – 98.03'

Isolation Casing (Y / N): No
Type:
Diameter:
Total Length:

Sump (Y / N): Yes
Interval BGS: 98.03' – 100.43'
Bottom Cap (Y / N): Yes

Backfill Plug
Material: N/A
Setup/Hydration Time: N/A
Tremied (Y / N): N/A

U. S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Monitoring Well 415 Construction Log

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

FIGURE No.
DATE 09-17-04

LITHOLOGIC LOG	BORING/WELL NO: MW416	PAGE 1 of 3
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: Nick Letsch
Drill Start (time/date): 14:46 on 09-09-04	Drill End (time/date): 09:25 on 09-10-04	Borehole Dia: 8 inch
Drill Method/Rig Type: Rotary Sonic		Total Depth:79 ft
Logged By: K. Davis	Coordinates: E ~-6559.5 N ~-1472	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE RECOVERY	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
0-5		5.0'			0.0-0.5' SILT, yellowish brown (10YR5/4), low to medium plasticity, moderately hard, wet, abundant rootlets 0.5-2.0': Gravelly SILT with some clay; gravel is 0.2-1.2" dia., well rounded, mostly chert, gavel is approx. 30% of interval, colored as above, med. plasticity, loosely consolidated, wet. 2.0-5.0': SILT, light gray (10YR7/1) with some brownish yellow (10YR6/6) mottling and manganese staining (black), non-plastic, moderately hard, slightly moist.		
9-10		8.0'			9.0-17.0': SILT, massive, light yellowish brown (10YR6/4) mottled with light gray (10YR7/1) and with few streaks of manganese (black) staining, non-plastic, moderately hard, moist.		
19-20		8.4'			19.0-21.3' SAND, fine-grained, massive, brownish yellow (10YR6/6), loose consistency, moderately hard, wet. 21.3-23.1': Gravelly clayey SAND: approx 20% gravel, gravel ranges 0.5-1.0" dia., subangular to subrounded, chert: sand is bimodal, majority of sand is fine grained, quartz; approx 10%-15% of interval is coarse to very coarse sand, well rounded, chert; clay is approx 10-15% of interval: yellowish brown (10YR5/8), medium plasticity, hard, wet. 23.1-24.2': Silty CLAY, massive, brownish yellow (10YR6/8), plastic, hard, moist. 24.2-24.8': Gravelly clayey SAND as at 21.3-23.1' 24.8-27.4': Clayey SILT, brownish yellow (10YR6/8), hard, medium plasticity, moist.		
29-35		9.0'			29.0-30.2': Slightly clayey SILT, massive, mottled reddish yellow (7.5YR6/8) and yellow (10YR7/8), low plasticity, medium hardness, moist. 30.2-36.2': SILT, fine sand content increases downward from 0-20%, yellowish brown (10YR5/8), low to medium plasticity, hard, moist.		

LITHOLOGIC LOG	BORING/WELL NO: MW416	PAGE 2 of 3
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: Nick Letsch
Drill Start (time/date): 14:46 on 09-09-04	Drill End (time/date): 09:25 on 09-10-04	Borehole Dia: 8 inch
Drill Method/Rig Type: Rotary Sonic		Total Depth:79 ft
Logged By: K. Davis	Coordinates: E ~-6559.5 N ~-1472	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE RECOVERY	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
					36.2-38.0': SAND; fine grained, massive, light gray (10YR7/1), loose consistency, moderately hard, moist.		
40		8.1'			39.0-39.4': SAND, as at 36.2-38.0' 39.4-41.8': Gravelly SAND; poorly sorted, sand (65%) ranges from very fine (quartz) to coarse (chert, well rounded); gravel (35%) ranges up to 2" dia., well rounded, chert; pale brown (10YR6/3), loose consistency, moist. 41.8-42.2': SAND, fine grained, massive, light gray (10YR7/1), loose consistency, moderately hard, moist. 42.2-42.9': Clayey gravelly SAND; clay (~20%); gravel (~20%) is approx. 0.4" dia., well-rounded; sand (~60%), fine grained, quartz; light brownish gray (10YR 6/2), low plasticity, hard, moist.		
45					42.9-47.1': SILT, massive, yellow (10YR7/8), non-plastic, hard, moist.		
50		8.4'			49.0-51.5': SILT as at 42.9-47.1'		
					51.5-56.0': SAND, fine grained, massive, brownish yellow (10YR6/8), loose consistency, soft, wet.		
55					56.0-57.4': SAND, fine grained, as above, but with manganese (black) staining distributed throughout interval. 59.0-61.2': SAND, fine, massive, brownish yellow (10YR6/6), loose, med. hardness, wet: becomes slightly clayey (approx. 5-10% clay) w/ depth.		Trace gravel, 1" dia., well rounded, chert.
60		9.5'			61.2-62.5': SAND, fine w/some gravel (approx. 20%): gravel ranges 0.5-1.0" dia., rounded, chert; massive, yellowish brown (10YR5/4), loose consist., soft, wet. 62.5-64.0': SAND, fine, w/ some (10%) silt, massive, brownish yellow (10YR6/8), loose consist., soft, wet. 64.0-65.3': Silty (20%) SAND, fine; massive, colored as above, non-plastic, soft, wet.		Trace gravel, 1" dia., rounded, chert.
65					65.3-65.9': Sandy GRAVEL: sand (40%) is coarse to v. coarse, subangular, chert; gravel (60%) is 0.5" dia., subangular, chert; massive, grayish brown (10 YR5/2) (stained w/ manganese), loose, wet. 65.9-66.5': Silty (10-20%) SAND, (60-70%), fine, w/ some (20%) gravel: gravel is 1-1.2" dia., rounded, chert; massive, brownish yellow (10YR6/8), non-plastic, soft, wet.		Top of RGA @ 65.3'
70		8.0'			66.5-68.5': Gravelly SAND, fine: gravel (40%) ranges 0.75", subangular to 1.2", rounded, chert; massive, yellowish brown (10YR5/6), loose, wet.		

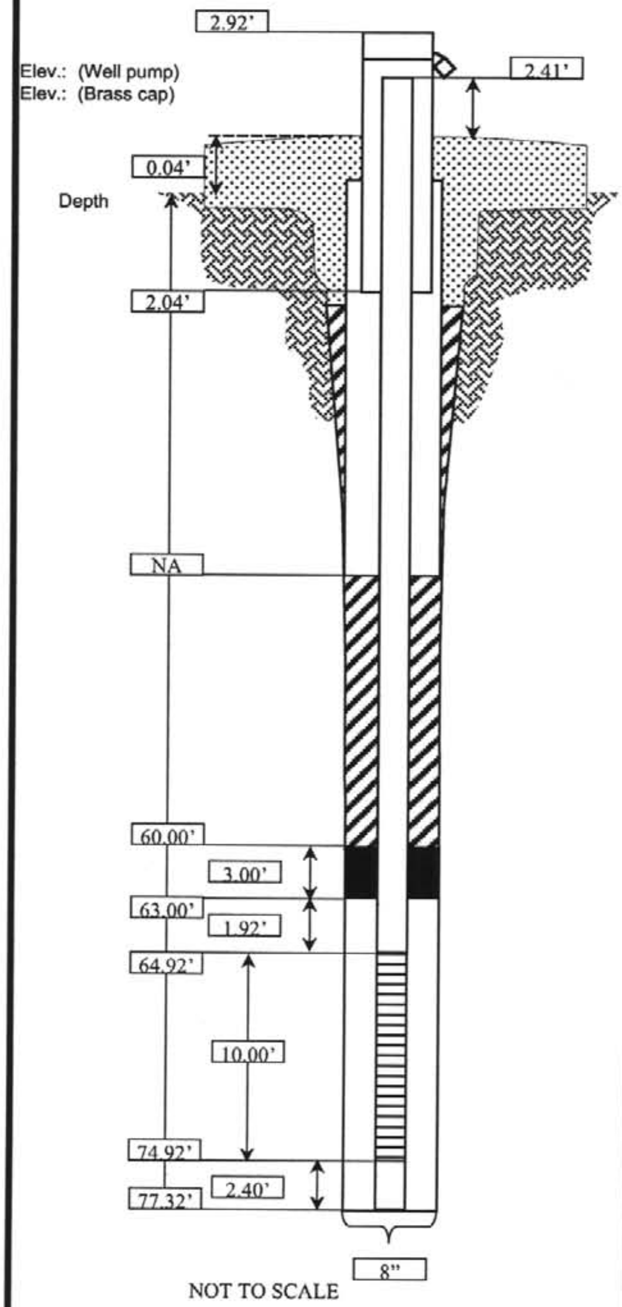
LITHOLOGIC LOG	BORING/WELL NO: MW416	PAGE 3 of 3
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: Nick Letsch
Drill Start (time/date): 14:46 on 09-09-04	Drill End (time/date): 09:25 on 09-10-04	Borehole Dia: 8 inch
Drill Method/Rig Type: Rotary Sonic		Total Depth:79 ft
Logged By: K. Davis	Coordinates: E ~-6559.5 N ~-1472	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE RECOVERY	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
70–75		8.0'			69.0-73.1': Gravelly SAND: sand is bimodal, 50% fine sand, quartz, 10% coarse to v. coarse sand, subangular, chert; gravel (40%) ranges 0.5" dia., subangular chert & well-rounded, quartz or feldspar to 2" dia., rounded to well rounded, chert; massive yellowish brown (10YR5/6), loose, wet. 73.1-77.0': Gravelly SAND, as above. Top 0.4' is fining upward sequence.		
75–80							Total Depth – 79'
80–85							
85–90							
90–95							
95–100							
100–							

DOCUMENT No.

Well No. MW 416	Installation: Paducah Gaseous Diffusion Plant	
Project No. DO 186	Client/Project: USDOE/BJC/PGDP Site Investigation of SW Plume	Site: C-747 Contaminated Burial Yd.

Contractor: SAIC	Drill Contractor: Miller Government Services
Start Date: 9/9/2004 @ 14:46	End Date: 9/13/2004 @ 13:56



Well Coord: N ~ - 1472
W ~ 6559.5

Protective Casing
Material Type: Steel
Diameter: 8-in
Depth BGS: 2.04' Weep Hole? (Y / N): Yes
Guard Posts (Y / N): Yes
No: 4 Type: Steel

Surface Pad
Composition and Size: Concrete, 4 ft x 4 ft

Riser Pipe
Type: SCH 40 PVC
Diameter: 4-in.
Total Depth (Ground surface to TOS): 64.59'
Ventilated Cap (Y / N): Yes

Grout
Composition & Proportions: Bentonite Grout
Grout Type: Pure Gold
Weight (lbs/gal.): ~ 9.9
% Solids: 30
Tremied (Y / N): Yes
Interval BGS: 2.04' – 60.00'

Centralizers (Y / N): Yes
Depth(s): 76.12'

Seal
Type: Shur-Pel 3/8-inch Bentonite Pellets
Source: Drillers Services, Inc.
Setup/Hydration Time: 72 hr Vol. Fluid Added: N/A
Tremied (Y / N): Yes

Filter Pack
Graduation Designation: #1
Grain Size: Project File
Type: #1 Filter Sand
Amt. Used: 400 lb
Tremied (Y / N): Yes
Source: Drillers Services, Inc.
Grain Size Dist: Project File

Screen
Type: SCH 40 PVC
Diameter: 4-in.
Length: 10-ft
Slot Size and Type: 0.010 Horizontal Slot
Interval BGS: 64.92' – 74.92'

Isolation Casing (Y / N): No
Type:
Diameter:
Total Length:

Sump (Y / N): Yes
Interval BGS: 74.92' – 77.32'
Bottom Cap (Y / N): Yes

Backfill Plug
Material: N/A
Setup/Hydration Time: N/A
Tremied (Y / N): N/A

U. S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Monitoring Well 416 Construction Log

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

FIGURE No.
DATE 09-17-04

LITHOLOGIC LOG		BORING/WELL NO: MW417	PAGE 1 of 3
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY			Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume		
Contractor: SAIC	Drill Contractor: Miller Govt Services		Driller: Nick Letsch
Drill Start (time/date): 09:09 on 09-14-04	Drill End (time/date): 13:48 on 09-16-04		Borehole Dia: 8 inch
Drill Method/Rig Type: Rotary Sonic			Total Depth: 109 ft
Logged By: K. Davis	Coordinates: E ~-6559.5 N ~-1462		Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE RECOVERY	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
0		4.3'			0.0-0.5' Slightly clayey, gravely SILT; gravel (20%) is 0.3–0.5" dia., subangular; yellowish brown (10YR5/6), slightly plastic, soft, wet 0.5-4.3': SILT, light gray (10YR7/1) with blebs and streaks of brownish yellow (10YR6/6), non-plastic, moderately hard, moist.		
5							
10		6.0'			9.0-14.7': SILT as above but with abundant black staining (manganese). 14.7-15.0': Sand, fine grained, well sorted, massive, brownish yellow (10YR6/6), hard, loose, wet.		
15							
20		9.0'			19.0-20.1': SILT with some blebs of fine sand, massive, brownish yellow (10YR6/6), loose, soft, wet. 20.1-20.9': SAND, fine grained, massive, light gray (10YR7/1), nonplastic, hard, moist 20.9-21.9': SILT, massive, light gray (10YR7/1), nonplastic, hard, moist 21.9-24.9': Slightly clayey, gravelly SAND; gravel (40%) ranges from 0.5" dia., subangular to 2-inch dia., rounded, chert; sand is fine grained; massive, reddish yellow (7.5YR6/6), slightly plastic, wet.		
25					24.9-28.9': SILT, massive, brownish yellow (10YR6/8), nonplastic, hard, moist		
30		10.0'			29.0-37.0': SILT, reddish yellow (7.5YR7/8) grading downward to brownish yellow (10YR6/8), nonplastic, moderately hard, moist.		Massive but for zone of intense manganese staining (black) at 31.9-32.1'
35							

LITHOLOGIC LOG	BORING/WELL NO: MW417	PAGE 2 of 3
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: Nick Letsch
Drill Start (time/date): 09:09 on 09-14-04	Drill End (time/date): 13:48 on 09-16-04	Borehole Dia: 8 inch
Drill Method/Rig Type: Rotary Sonic		Total Depth: 109 ft
Logged By: K. Davis	Coordinates: E ~-6559.5 N ~-1462	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE RECOVERY	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
					37.0-39.0': SAND; fine grained, massive, light gray (5YR7/1), loose, soft, moist.		
40		8.8'			39.0-41.8': Gravelly SAND; gravel (40%) ranges 0.3-0.7" dia., subangular to subrounded, chert; sand is bimodal; 10% coarse grained sand, well rounded, chert; 50% fine grained sand, quartz GRADING DOWNWARD TO slightly clayey, gravelly SAND (sand and gravel as above): light gray (10YR7/1), loose to slightly plastic, moist.		
45					41.8-47.8': SILT, light yellowish brown (10YR6/4) with laminations of yellow (10YR7/8), nonplastic, moderately hard, moist.		
50		5.9'			49.0-51.4': Sandy SILT; sand (~20%) is fine grained; massive, reddish yellow (7.5YR7/6), slightly plastic, moderately hard, very moist.		
					51.4-53.0': SAND, fine grained, massive, reddish yellow (7.5YR7/6), loose, hard, moist.		Trace gravel, 2" dia., rounded, chert.
					53.0-53.4': SAND, fine grained, as above but with heavy manganese staining.		
55					53.4-54.9': SAND, fine grained, very pale brown (10YR7/4) with laminations defined by manganese staining (black), loose, soft, very moist.		
							Some gravel horizons have manganese (black) staining.
60		9.0'			59.0-68.0': SAND, fine grained; with some (approx 20%) gravel, 1.0-2.5" dia., well rounded, chert, typically localized in discrete horizons; and also containing blebs of clayey sand; massive, pale brown (10YR6/3), loose, soft, wet		
65							
70		7.1'					

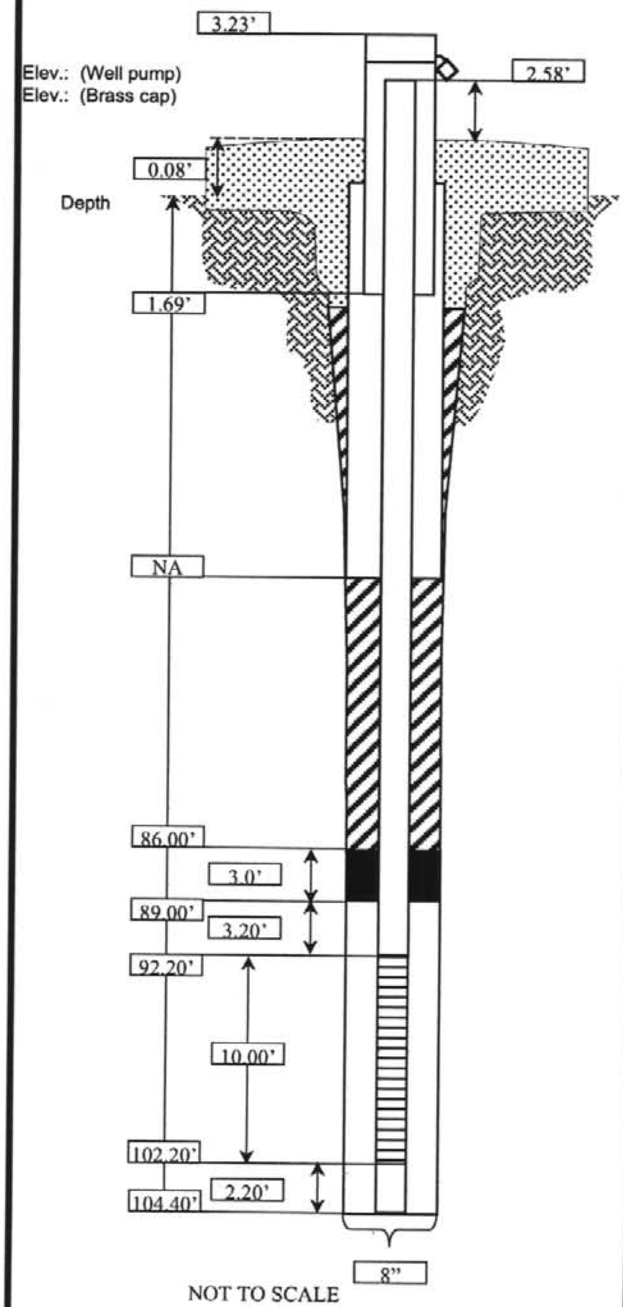
LITHOLOGIC LOG	BORING/WELL NO: MW417	PAGE 3 of 3
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 004
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: Nick Letsch
Drill Start (time/date): 09:09 on 09-14-04	Drill End (time/date): 13:48 on 09-16-04	Borehole Dia: 8 inch
Drill Method/Rig Type: Rotary Sonic		Total Depth:109 ft
Logged By: K. Davis	Coordinates: E ~-6559.5 N ~-1462	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE RECOVERY	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
69–75		8.0'			69.0-76.1': Gravelly SAND: gravel (40%) ranges 0.7-1.5" dia., subrounded to subangular, chert; sand is fine grained, quartz with trace of coarse grained, chert; massive, brownish yellow (10YR6/6), loose, soft, wet.		
79–85		5.5'			79.0-84.5': Gravelly SAND: gravel (~30%) ranges 0.4-2.5" dia., rounded to well rounded, chert; sand is bimodal; fine sand (50%) is quartz, coarse to very coarse sand (20%) is subrounded to subangular, chert; massive, brownish yellow (10YR6/6), loose, soft, wet.		
89–95		6.0'			89.0-95.0': Gravelly SAND: gravel (~30%) ranges 0.4-2.5" dia., subrounded to subangular, chert; sand is bimodal; fine sand (50%) is quartz, coarse to very coarse sand (20%) is subrounded to subangular, chert; massive, brownish yellow (10YR6/6), loose, soft, wet.		
99–109		8.3'			99.0-101.8': Gravelly SAND: gravel (~40%) ranges 0.4-1.2" dia., rounded to well rounded, chert; sand is bimodal; fine sand (~60%) is quartz with trace of opaque minerals and trace of mica (muscovite?); massive, predominantly brownish yellow (10YR6/6), loose, wet. 101.8-105.0': SAND, very fine grained, massive, reddish yellow (7.5YR8/6), loose, soft, wet 105.0-106.8': very fine Sand as above but very pale brown (10YR7/3) 106.8-107.3': Clay, massive, bluish gray (Gley 2 5/1), plastic, moderately hard, moist.		A few gravel interstices are filled by light gray (10YR7/1) SILT Lower Continental Deposits/ McNairy Formation contact = 101.8 ft Total Depth – 109'

DOCUMENT No.

Well No. MW 417	Installation: Paducah Gaseous Diffusion Plant	
Project No. DO 186	Client/Project: USDOE/BJC/PGDP Site Investigation of SW Plume	Site: C-747 Contaminated Burial Yd.

Contractor: SAIC	Drill Contractor: Miller Government Services
Start Date: 9/14/2004 @ 09:09	End Date: 9/17/2004 @ 10:00



Well Coord: N ~ -1462
W ~ 6559.5

Protective Casing
Material Type: Steel
Diameter: 8-in
Depth BGS: 1.69'
Weep Hole? (Y / N): Yes
Guard Posts (Y / N): Yes
No: 4
Type: Steel

Surface Pad
Composition and Size: Concrete, 4 ft x 4 ft

Riser Pipe
Type: SCH 40 PVC
Diameter: 4-in.
Total Depth (Ground surface to TOS): 92.20'
Ventilated Cap (Y / N): Yes

Grout
Composition & Proportions: Bentonite Grout
Grout Type: Pure Gold
Weight (lbs/gal.): ~ 9.9
% Solids: 30
Tremied (Y / N): Yes
Interval BGS: 1.69' – 86.00'

Centralizers (Y / N): Yes
Depth(s): 103.40'

Seal
Type: Shur-Pel 3/8-inch Bentonite Pellets
Source: Drillers Services, Inc.
Setup/Hydration Time: 15.7 hr
Vol. Fluid Added: N/A
Tremied (Y / N): Yes

Filter Pack
Graduation Designation: #1
Grain Size: Project File
Type: #1 Filter Sand
Amt. Used: 633 lb
Tremied (Y / N): Yes
Source: Drillers Services, Inc.
Grain Size Dist: Project File

Screen
Type: SCH 40 PVC
Diameter: 4-in.
Length: 10-ft
Slot Size and Type: 0.010 Horizontal Slot
Interval BGS: 92.20' – 102.20'

Isolation Casing (Y / N): No
Type:
Diameter:
Total Length:

Sump (Y / N): Yes
Interval BGS: 102.20' – 104.40'
Bottom Cap (Y / N): Yes

Backfill Plug
Material: N/A
Setup/Hydration Time: N/A
Tremied (Y / N): N/A

U. S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS
Bechtel Jacobs Company LLC
BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Monitoring Well 417 Construction Log

SAIC
Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

FIGURE No.
DATE 09-17-04

THIS PAGE INTENTIONALLY LEFT BLANK.

C-720 AREA

THIS PAGE INTENTIONALLY LEFT BLANK.

LITHOLOGIC LOG	BORING/WELL NO: 720-101	PAGE 1 of 1
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: C-720
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: B. Willis
Drill Start (time/date): 12:48 on 06-23-04	Drill End (time/date): 09:49 on 06-24-04	Borehole Dia: 2 inch
Drill Method/Rig Type: Geoprobe		Total Depth: 60 ft
Logged By: B. Joyce	Coordinates: E ~-5122.5 N ~-2085	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
		720-101– 3.2 ft			some light brown (5YR5/6), poor plasticity, dry to		
5							
10		720-101 –9.6 ft			SILT (clay-trace) pale yellowish brown (10YR6/2) to light brownish gray (5YR6/2) w/ light brown (5YR5/6), poor plasticity, dry to slightly moist, friable.		
15		720-101-14.4 ft			SILT, with equal pockets of CLAY, poor plasticity, dry friable. Silt: light brown (5YR5/6) to moderate yellowish brown (10YR5/4). Clay: light gray (N7).		
20		720-101-19.5 ft			CLAY with silt (silt 15-20% in pockets), clay is light gray (N7) to very light gray (N8), silt is light brown (5YR5/6) to moderate yellowish brown (10YR5/4), poor plasticity, firm to hard, dry to slightly moist, solid section, trace iron oxide.		
25		720-101-24.6 ft					
30		720-101-29.5 ft			Clayey SAND (clay 20-25% mostly in pockets and matrix), medium to coarse-grained, moderately-sorted, cont. in comments…		brownish gray (5YR6/1), subangular to
35		720-101-34 ft			SAND (silt 5-10%), medium to coarse to very coarse grained w/ cobbles, gravel & fractured rock, poorly sorted, cont. in comments…		slightly moist to dry, subangular to subrounded, light brown (5YR 5/6) to moderate yellowish brown (10YR 5/4), moderately consolidated.
40		720-101-40 ft					
45					Silty SAND with clay (silt 15-20%, clay in sections 25-30%), medium to fine-grained, well-sorted, subangular to subrounded, light brown (5YR5/6) to pale yellowish brown (10YR6/2), slightly moist, firm, solid section.		
50		720-101-49.3 ft			Silty SAND (silt 15-20%), medium-grained, well-sorted, subangular to subrounded, light brown (5YR5/6) to pale yellowish brown (10YR6/2), slightly moist, firm, solid section.		
55		720-101-54.5 ft			Silty SAND (silt 20-25%), medium-grained, well-sorted, subangular to subrounded, dark yellowish orange (10YR6/6) with light brown (5YR5/6) slightly moist, soft, section is firm to hard.		
60		720-101-59.5 ft			Silty SAND with clay pockets (silt 10-15% clay 5-10% as pockets in section), medium-grained, well-sorted, subangular to subrounded, pinkish gray (5YR8/1) with light brown (5YR5/6), slightly moist, firm section, trace mang. oxide) TD 60’		

LITHOLOGIC LOG	BORING/WELL NO: 720-102	PAGE 1 of 1
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: C-720
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: B. Willis
Drill Start (time/date): 13:10 on 06-14-04	Drill End (time/date): 15:30 on 06-15-04	Borehole Dia: 2 inch
Drill Method/Rig Type: Geoprobe		Total Depth: 60 ft
Logged By: B. Joyce	Coordinates: E ~-5121.5 N ~-2117	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
		720-102– 2 ft	--	--	1.0-1.3’: SILT with gravel and fractured rock 1.3-2.0’: CLAY, light gray (N7) to very light gray (N8), poor plasticity, dry-slightly moist, friable, clean.		
5		720-102– 7 ft	--	--	SILT (sand 5-10%), pale yellowish brown (10 YR 6/2) to moderate yellowish brown (10 YR 5/4) with some light brown (5 YR 5/6), poor to moderate plasticity, slightly moist, soft, abndt iron oxide.		
10		720-102 –13.8 ft	--	--	Sandy SILT (sand 15%), moderate yellowish brown (10 YR 5/4) to light brown (5YR 5/6), moderate to poor plasticity, slightly moist, soft, trace iron oxide.		Includes some very light gray (N8) clay pockets (13.0-13.1’ and 13.6-13.8’)
15		720-102 –18.5 ft	--	--	CLAY (sand 5% with sandier pockets) light brownish gray (5YR 6/1) to light gray (N7) with light brown (5 YR 5/6), good plasticity, soft, malleable, trace oxides, slightly moist to moist.		Gravel and fractured rock sand from 18.5’ to 18.8’.
20		720-102-24.3 ft	--	--	SAND (silt 5-10%, clay trace-5% in matrix) medium to coarse to very coarse grained with cobbles gravel and fractured rock, poorly sorted, subangular to subrounded, slightly moist, some iron oxide, light brown (5YR5/6) to moderate yellowish brown (10YR5/4).		
25		720-102-29.5 ft	--	--	CLAY (sand 5% with a pocket of sand from 29.4-29.5’) light gray (N7) with grayish orange (10 YR 7/4) light brown (5 YR 5/6) sand pocket good plasticity, slightly moist, soft, trace oxides..		Lost bottom 0.5’ when extruding the tube.
30		720-102-34 ft	--	--	SAND (silt 5-10%, clay 5-10% as pockets in matrix) medium coarse-very coarse grained with cobbles, gravel, and fractured rock, poorly sorted, subangular-subrounded, slightly moist, some iron oxide, light brown (5YR 5/6)- moderate yellowish brown (10YR 5/4) with light gray (N7).		Occ. pockets of clay.
35		720-102-40 ft	--	--	SILT (sand 5-10%) pale yellowish brown (10YR 6/2) with some light brown (5YR 5/6), good plasticity, moist, very soft, malleable.		
40		720-102–45 ft	--	--	Very Sandy SILT (sand 25-30%, clay 5-10% in matrix in pockets) pale yellowish brown (10YR 6/2) with light brown (5YR 5/6) moderate plasticity, slightly moist, soft.		
45		720-102-50 ft	--	--	SAND (silt 10-15%) medium grained, well sorted, moist-wet, trace mang. oxide, pockets of iron oxide, subangular to subrounded, dark yellowish orange (10 YR 6/6) to pale yellowish brown (10 YR 6/2), slightly moist.		
50		720-102-54.3 ft	--	--	SAND (silt (5-10%) with occ. siltier zone (15-20%), medium to coarse to very coarse grained with cobbles, gravels, and fractured chert, poorly sorted, subangular to subrounded, pale yellowish brown (10 YR 6/2) with light brown (5 YR 5/6), moist to wet, trace mang. oxide, pockets of iron oxide.		
55		720-102-59 ft	--	--	CLAY (sand trace-5% in sections) grayish orange (10YR 7/4), very good plasticity, moist, very soft, malleable, trace mang. oxide staining. TD 60’		
60			--	--			
			--	--			
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: 720-103	PAGE 1 of 1
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: C-720
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: B. Willis
Drill Start (time/date): 09:48 on 06-16-04	Drill End (time/date): 16:38 on 06-16-04	Borehole Dia: 2 inch
Drill Method/Rig Type: Geoprobe		Total Depth: 60 ft
Logged By: B. Joyce	Coordinates: E ~-5093.5 N ~-2117	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
		720-103– 3.5 ft			(N8) with light brown (5YR 5/6) mottling, poor		
5							
10		720-103 –10 ft			Silty CLAY (silt 20-25%) light brownish gray (5YR 6/1) - light brown (5YR 5/6), poor plasticity, dry, friable, section is firm.		
15		720-103-14.5 ft			Sandy SILT (sand 15-20%) grayish orange (10YR 7/4) - light brown (5YR 5/6) poor plasticity, very dry, friable section very firm, crumbles when shaved off the section.		
20		720-103-18.8 ft			CLAY with silt and sand slay matrix-light gray (N7)-light brown (5YR 5/6) poor plasticity, slightly moist, included sand (40-45%) medium-coarse grained with cobbles and gravel poorly sorted, subangular-subrounded, included siltier sections.		
25					24-24.2' CLAY light gray (N7) good plasticity, moist, soft, malleable. 24.2-24.7: SAND (silt 10-15%) medium-coarse-very coarse grained with cobbles and gravel poorly sorted, subangular-subrounded, moderate brown (5YR 4/4)-light brown (5YR 5/6) well consolidated, slightly moist. 24.7-25.0 CLAY, as above with sand (40-45%)		
30		720-103-30 ft			SAND (silt 10-15% with siltier (15-20%) sections) medium grained, well sorted, cont. in comments…		(10YR5/4) with some light brownish gray
35		720-103-34.3 ft			Silty SAND with clay pockets (silt 5-10%, clay 10-15% as pockets) medium to coarse to very coarse grained with cobbles, gravel and fractured rock, poorly sorted, cont. in comments...		subangular to subrounded, moderate brown (5YR 4/4)-light brown (5YR 5/6) with light gray (N7) (clay pockets), slightly moist, well consolidated in sections, some iron oxide.
40		720-103-40 ft					
45		720-103–45 ft			Clayey SAND (silt 5-10%, clay 35-40% in matrix and in pockets) medium-fine grained, well sorted, cont. in comments…		
		720-103-49.3 ft			sorted, subangular to subrounded, grayish orange		
50							
55		720-103-54.4 ft			SAND (silt 5%) medium to coarse to very coarse grained with cobbles, gravel, and fractured rock, poorly sorted, cont. in comments...		moderate yellowish brown (10YR 5/4) slightly
60		720-103-60 ft			Sandy CLAY (sand 35-40%) very pale orange (10YR 8/2) to pinkish gray (5YR 8/1), good plasticity, slightly moist to moist, soft, malleable, sand in matrix of clay. TD 60'		

LITHOLOGIC LOG

LITHOLOGIC LOG	BORING/WELL NO: 720-104	PAGE 1 of 1
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: C-720
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: B. Willis
Drill Start (time/date): 10:00 on 06-17-04	Drill End (time/date): 16:38 on 06-17-04	Borehole Dia: 2 inch
Drill Method/Rig Type: Geoprobe		Total Depth: 60 ft
Logged By: B. Joyce	Coordinates: E ~-5066.5 N ~-2117	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
		720-104– 3.3 ft					
5							
		720-104 –9.3 ft					
10							
		720-104-14 ft			subangular, light brown (5YR 5/6) to light brown		
15							
20					Clayey SILT (clay 35-40% as clay pockets) light brown (5YR 5/6) to moderate brown (5YR 4/4), poor plasticity, dry to slightly moist, firm to hard, abndt iron oxide, large clay pocket.		
25		720-104-24.3 ft			SAND (silt 5-10%, clay 10-15%) medium to coarse to very coarse grained w/ pockets of cobbles, gravel and fractured rock, poorly sorted, subangular to subrounded, cont. in comments…		
30		720-104-28.4 ft			Silty SAND with clay sections (silt 15-20% in matrix, clay 25-30% in sections) medium to coarse grained, well sorted, subangular to subrounded, light brown (5YR 5/6) to grayish orange (10YR 7/4) w light gray (N7) in clay sections, slightly moist, trace iron oxide.		basically alternating sand, silt, clay sections with varying degrees of each.
35					SAND (silt 10-15%) medium to coarse grained w/ pocket of cobbles, gravel, and fractured rock, poorly sorted, subangular to subrounded light brown (5YR 5/6) to pale yellowish brown (10YR 6/2), slightly moist, some iron oxide.		
40		720-104-40 ft			Silty SAND with clay pockets (silt 20-25%, clay 25-30% in matrix from 39.0-39.3) medium to coarse grained, well-sorted, subangular to subrounded, moderate yellowish brown (10YR 5/4) to pale yellowish brown (10YR 6/2), moist, soft.		
45					Clayey SILT (clay 10-15%, sand 5-10%) light gray (N7) to pale yellowish brown (10YR 6/2) w/ light brown (5YR 5/6), good plasticity, moist, soft, malleable, trace iron oxide.		
50		720-104-50 ft			Silty SAND (silt 10-15%, clay in matrix in sections 10-15%), medium grained, well-sorted, subangular to subrounded, pale yellowish brown (10YR6/2) w/ some light brown (5YR5/6), moist, soft, trace iron oxide.		
55		720-104-53.6 ft			SAND (silt 5-10%, clay 10-15% in pocket) medium to coarse grained w/ pocket of cobbles and gravel, well sorted in matrix, subangular to subrounded, grayish orange (10YR 7/4) to very pale orange (10YR 8/2) w/ light brown (5YR 5/6) moist, trace iron oxide.		
60		720-104-60 ft			Sandy CLAY (sand 10-15% with sections as high as 30-35%), grayish orange (10YR 7/4), good plasticity, moist, soft, malleable, solid section. TD 60'		

LITHOLOGIC LOG	BORING/WELL NO: 720-105	PAGE 1 of 1
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: C-720
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: B. Willis
Drill Start (time/date): 09:31 on 06-18-04	Drill End (time/date): 16:30 on 06-21-04	Borehole Dia: 2 inch
Drill Method/Rig Type: Geoprobe		Total Depth: 60 ft
Logged By: K. Davis/B. Joyce	Coordinates: E ~-5037.5 N ~-2116	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
		720-105– 3.1 ft			2.0-2.9': Slightly clayey SILT, bluish gray (GLEY2 5/1) soft, moist. 2.9-3.1: Slightly clayey SILT, brownish yellow (10YR 6/6), soft moist.		
5							
		720-105 –9 ft			SILT, light gray (10YR7/1) mottled with brownish yellow (10YR6/6), soft, moist.		
10							
		720-105-14.2 ft			13.2-13.7': SILT, as above. 13.7-14.2': Clayey SAND, fine, brownish yellow (10YR6/6), hard, moist.		
15							
20		720-105-19.9 ft			SILT, light gray (10YR7/1), mottled with brownish yellow (10YR6/8), hard, slightly moist.		
25		720-105-24.6 ft			SAND (silt 5-10%), medium to coarse to very coarse grained, w/ cobbles, gravel & fractured rock, poorly-sorted, subangular to subrounded, light brown (5YR5/6) to dark yellowish brown (10YR4/2), slightly moist to dry, trace iron oxide.		
		720-105-28.6 ft			CLAY (sand trace-5%), grayish orange (10YR7/4) to yellowish gray (5Y7/2), good plasticity, slightly moist, soft, solid section, trace mang. oxide.		
30							
		720-105-33.7 ft			SAND (silt 5-10%, clay 5-10% as pockets not in matrix) medium to coarse to very coarse grained w/ cobbles, gravel, & fractured rock, poorly sorted, subangular to subrounded, light brown (5YR 5/6) to pale yellowish brown (10YR 6/2), slightly moist, trace iron oxide.		
35							
		720-105-39.4 ft			Sandy CLAY (sand 20-30%), light gray (N7) to pale yellowish brown (10 YR 6/2), good plasticity, moist, soft, abdnt sand as pockets throughout section.		
40							
45		720-105–45 ft			Silty clayey SAND (silt 10-15%, clay 5-10%), medium to fine grained, well-sorted, moist, pale yellowish brown (10YR 6/2) to moderate yellowish brown (10YR 5/4) with some light brown(5YR5/6), soft, trace iron oxide.		
50		720-105-50 ft			CLAY with sand (sand 10-15% in pockets sand 49.8'-50.0')), pale yellowish brown (10YR6/2) to moderate yellowish brown (10YR5/4), good plasticity, moist, soft, malleable, trace mang. oxide.		
55		720-105-54.2 ft			SAND with silt (silt 5-10%, with siltier pockets 35-40%), medium to coarse grained, pockets of very coarse grained and fractured rock, moderate-poorly-sorted, subangular to subrounded, grayish orange (10YR7/4) to light brown (5YR5/6), moist to wet.		
60		720-105-60 ft			CLAY with sandy pockets (sand 15%), dark yellowish orange (10YR6/6), to very light gray (N8), moderate plasticity, moist, firm to hard, massive. TD 60'		

LITHOLOGIC LOG	BORING/WELL NO: 720-106	PAGE 1 of 1
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: C-720
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: B. Willis
Drill Start (time/date): 08:25 on 06-22-04	Drill End (time/date): 16:54 on 06-22-04	Borehole Dia: 2 inch
Drill Method/Rig Type: Geoprobe		Total Depth: 60 ft
Logged By: B. Joyce	Coordinates: E ~-5035.5 N ~-2084	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
3.0		720-106– 3.0 ft			SAND (silt 10-15%, clay starting last 0.1'), medium to coarse to very coarse-grained, includes cobbles, gravel and fractured rock, poorly sorted, angular to subrounded, dusky red (5R3/4) to dark reddish brown(10R3/4), wet to moist.		
9.6		720-106 –9.6 ft			8.6-9.1': SILT, pale yellowish brown (10YR6/2) w/ light brown (5YR5/6), poor plasticity, fry, friable. 9.1-9.6': CLAY, medium gray (N5) to light gray (N7), poor plasticity, dry, friable.		
14.2		720-106-14.2 ft			SILT, light brownish gray (5 YR6/1) w/ light brown (5YR5/6), poor plasticity, dry to slightly moist, friable, soft.		
19.4		720-106-19.4 ft			Sandy CLAY (sand 10-15% in pockets), light gray (N7) w/ light brown (5YR5/6) mottling, moderate to poor plasticity, slightly moist to dry, firm, hard.		
24.5		720-106-24.5 ft			SAND (silt 5-10%, clay trace-5% in pockets), medium to coarse to very coarse grained, w/ cobbles, gravel & fractured rock, poorly-sorted, subangular to subrounded, light brown (5YR5/6) to pale yellowish brown (10YR6/2), dry, unconsolidated, trace iron oxide.		
28.5		720-106-28.5 ft			Silty SAND (silt 15-20%), medium to fine grained, well-sorted, slightly moist, light brown (5YR5/6) to with very pale orange (10YR8/2), occ. gravel in section.		
34.5		720-106-34.5 ft			SAND (silt 5-10%), medium to coarse to very coarse grained w/ cobbles & gravel, poorly sorted, subangular to subrounded, light brown (5YR 5/6) to moderate yellowish brown (10YR 5/4), slightly moist, trace oxides.		
40		720-106-40 ft			CLAY (sand 10-15%), light brown (5YR6/4) to light gray (N7), good plasticity, moist, soft, solid section.		
45		720-106–45 ft			CLAY (sand 5-10%), light gray (N7) with light brown (5YR5/6) and light red (5R6/6) mottling, good plasticity, slightly moist, soft, solid firm section, trace mang. and iron oxide.		
50		720-106-50 ft			Silty SAND (silt 10-15% clay trace in pockets), medium-grained, well-sorted, slightly moist, light brown (5YR5/6) to grayish orange (10YR7/4), with light gray (N7) with clay, trace iron oxide.		
55		720-106-55 ft			Clayey SAND (silt 15-20%, clay 20-25% in sections), silt and clay percentages vary throughout the section, medium to coarse grained, moderately-sorted, slightly moist, light brown (5YR5/6) to grayish orange (10YR7/4) with light gray (N7), solid firm section, trace iron oxide.		
60		720-106-60 ft			Clayey SAND (clay 20-25%), medium-grained, well-sorted, slightly moist, pinkish gray (5YR8/1), soft, friable, traces of mica. TD 60'		

LITHOLOGIC LOG	BORING/WELL NO: 720-107	PAGE 1 of 1
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: C-720
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: B. Willis
Drill Start (time/date): 13:15 on 06-24-04	Drill End (time/date): 10:35 on 06-25-04	Borehole Dia: 2 inch
Drill Method/Rig Type: Geoprobe		Total Depth: 60 ft
Logged By: B. Joyce	Coordinates: E ~-5199.5 N ~ -2613	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
		720-107– 3.5 ft					
5							
		720-107 –9.0 ft			SILT, pale yellowish brown(10YR6/2), poor plasticity, dry to slightly moist, soft, friable, very clean.		
10					CLAY (includes cobbles and gravel10%), light gray (N7) with light brown(5YR5/6) and moderate brown (5YR4/4), moderate to poor plasticity, clean clay is soft, section is firm to hard, dry, abdnt iron oxide and mang. oxide in section.		
		720-107-14.5 ft					
15					Silty SAND with clay (silt 10-15%, clay in matrix 10-15%), medium to coarse to very coarse grained with cobbles, gravel and fractured rock, poorly sorted, subrounded to subangular, moderate yellowish brown (10YR5/4) to light brown (5YR5/6), clay is light gray (N7), slightly moist t dry, solid section, trace iron oxide and mang. oxide.		
20		720-107-20 ft					
		720-107-24 ft			SILT (sand 10-15%), pale yellowish brown (10YR6/2) to light brown (5YR5/6), moderate plasticity, slightly moist, soft.		
25							
		720-107-29.1 ft			SAND (silt 5-10%) medium to coarse to very coarse grained with cobbles and gravel, poorly sorted, subangular to subrounded, moist to wet, trace iron oxide.		
30							
		720-107-34.6 ft			(10YR5/4) with light gray (N7), good plasticity, moist,		
35							
40		720-107-40 ft					
45							
50		720-107-50 ft					
		720-107-54.3 ft			Sandy CLAY (sand 10-15%), light brown (5YR5/6) to very light gray (N8), mottled, moderate to poor plasticity, slightly moist to dry, friable, section is firm to hard, massive, some iron oxide.		
55							
60		720-107-60 ft			SAND (silt 10-15%), medium to coarse grained, well-sorted, subangular to subrounded, grayish orange (10YR7/4) to light brown (5YR5/6), slightly moist, trace iron oxide, mica. TD 60'		

LITHOLOGIC LOG	BORING/WELL NO: 720-108	PAGE 1 of 1
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: C-720
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: B. Willis
Drill Start (time/date): 12:28 on 06-28-04	Drill End (time/date): 17:47 on 06-28-04	Borehole Dia: 2 inch
Drill Method/Rig Type: Geoprobe		Total Depth: 60 ft
Logged By: B. Joyce	Coordinates: E ~-5088.5 N ~ -2611	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
5		720-108– 5 ft			SILT, pale yellowish brown (10 YR 6/2) with some light brown (5YR5/6), poor plasticity, dry, soft, friable.		
		720-108 –8.5 ft			SILT (and 5%, clay 5% pocket at 8'), pale yellowish brown(10YR6/2) with light brown (5YR5/6), poor plasticity, dry to slightly moist, soft, friable, trace oxides.		
10		720-108-14.1 ft			Silty SAND (silt 20-25%) medium to fine grained with pocket of cobbles, moderately sorted, subangular to subrounded, very pale orange (10YR8/2) to pale yellowish brown (10YR6/2) with light brown (5YR5/6), dry to slightly moist, abdnt iron oxide.		
15					CLAY with sand and gravel (sand 30-35%), light gray (N7) to medium light gray (N6), slightly moist, moderate plasticity, firm. Sand is light brown (5YR5/6) mostly cobbles, gravel, and fractured rock, some iron oxide, section is well consolidated.		
20		720-108-24.4 ft			Silty SAND (silt 20-25%), medium-grained with occ. gravel, well-sorted, subangular to subrounded, light brown (5 YR 5/6) to dark yellowish orange (10YR6/6) with very light gray (N8), slightly moist, soft, occ. clayey pockets, trace mang. oxide.		
25		720-108-28.8 ft			SAND (silt 5-10%) medium to coarse to very coarse grained with cobbles and gravel, poorly sorted, subangular to subrounded, light brown (5YR5/6) to grayish orange (10YR7/4), slightly moist to moist, trace iron oxide.		
30		720-108-33.7 ft			SAND (silt 5-10%, clay 5% in pockets), medium to coarse to very coarse grained with cobbles, gravel and fractured rock, poorly sorted, subangular to subrounded, light brown (5YR5/6) to grayish orange (10YR7/4), moist to wet, abdnt iron oxide.		
35							
40		720-108-40 ft			Silty SAND (silt 25-30%), medium-grained, well-sorted, subangular to subrounded, grayish orange (10YR7/4) to light brown (5YR5/6), slightly moist, soft.		
45							
50					SAND (silt 5-10%), medium to coarse-grained, well-sorted, subangular to subrounded, very pale orange (10YR8/2) to light brown (5YR5/6), slightly moist to moist, loose sand.		
55		720-108-55 ft			Clayey SAND (clay 15-20% in matrix with clay pockets), medium-grained, well-sorted, subangular to subrounded, very light gray (N8) to very pale orange (10YR8/2) with light brown (5YR5/6) mottling, slightly moist, section is well-consolidated, firm to hard.		
60		720-108-60 ft			Silty SAND (silt 15-20%), medium to coarse grained, well-sorted, subangular to subrounded, light brown (5YR5/6) to grayish orange (10YR7/4), slightly moist. TD 60'		

SWMU 102

THIS PAGE INTENTIONALLY LEFT BLANK.

LITHOLOGIC LOG	BORING/WELL NO: 102-001	PAGE 1 of 1
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 102
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: B. Willis
Drill Start (time/date): 16:20 on 07-01-04	Drill End (time/date): 17:08 on 07-01-04	Borehole Dia: 2 inch
Drill Method/Rig Type: Geoprobe		Total Depth: 20 ft
Logged By: B. Joyce	Coordinates: E ~-4476, N ~ -1872.5	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
5		102-001– 4.2 ft			CLAY, medium light gray (N6) to medium gray (N5), poor plasticity, dry, friable, section is firm.		
10		102-001 –8.8 ft			SILT (sand 10-15%), moderate yellowish brown (10YR5/4) to light brown (5YR5/6), poor to moderate plasticity, slightly moist, friable, trace iron oxide and mang. oxide.		
15		102-001-13.6 ft			SILT (sand 5%), grayish orange (10YR7/4) to light brown (5YR 5/6), no plasticity, friable, dry, section is very hard, trace mang. oxide and iron oxide.		
20		102-001-19.4 ft			18.4-19.1': CLAY, light gray (N7), moderate plasticity, slightly moist, firm to hard section. 19.1-19.4': SAND (silt 10-15%), medium to fine grained, well-sorted, subrounded to subangular, light gray (N7) to very light gray (N8) with some light brown (5YR5/6)., slightly moist to dry.		
25							
30							
35							
40							
45							
50							
55							
60							

LITHOLOGIC LOG	BORING/WELL NO: 102-002	PAGE 1 of 1
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 102
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: B. Willis
Drill Start (time/date): 12:48 on 06-30-04	Drill End (time/date): 13:35 on 06-30-04	Borehole Dia: 2 inch
Drill Method/Rig Type: Geoprobe		Total Depth: 20 ft
Logged By: B. Joyce	Coordinates: E ~-4731, N ~ -1877	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
		102-002– 3.6 ft			SILT (sand 10-15%), moderate yellowish brown (10YR5/4) grading to light olive gray (5Y6/1), very good plasticity, moist, soft.		
5							
		102-002 –8 ft			SILT (sand 5-10%), light olive gray (5Y6/1) to olive gray (5Y4/1), moderate to poor plasticity, slightly moist to dry, friable in sections, soft.		
10							
					SILT (sand 5-10%, clay trace-5% in pockets), moderate yellowish brown (10YR5/4) to light brown (5YR5/6), slightly moist, friable, soft to firm in sections, trace mang. oxide.		
15							
20		102-002-20 ft			19.0-19.5': SAND (silt 15-20%), medium-grained with cobbles and gravel, well-sorted, slightly moist, grayish orange (10YR7/4), subangular to subrounded. 19.5-20.0': SAND (silt 10-15%), medium to coarse to very coarse-grained with cobbles, gravel, and fractured rock, poorly sorted, subangular to subrounded, light brown (5YR5/6) to moderate yellowish brown (10YR5/4), slightly moist. TD 20'.		
25							
30							
35							
40							
45							
50							
55							
60							

LITHOLOGIC LOG	BORING/WELL NO: 102-003	PAGE 1 of 1
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 102
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: B. Willis
Drill Start (time/date): 08:57 on 06-30-04	Drill End (time/date): 09:44 on 06-30-04	Borehole Dia: 2 inch
Drill Method/Rig Type: Geoprobe		Total Depth: 20 ft
Logged By: B. Joyce	Coordinates: E ~-4836, N ~ -1872.5	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
5		102-003– 4.5 ft			SILT (sand 5-10%), pale yellowish brown (10YR6/2) to moderate yellowish brown (10YR5/4), poor plasticity, friable, soft, dry.		
		102-003 –8.3 ft			moderate to poor plasticity, friable, soft, slightly		
10							
		102-003-12.7 ft			SILT (sand 5-10%), moderate yellowish brown (10YR5/4) very good plasticity (gummy),soft, moist, malleable.		
15							
					18.0-18.6': CLAY, light gray (N7), good plasticity, slightly moist, soft, malleable, abdnt rock in clay. 18.6-19.0'; SAND (silt 10-15%), medium to coarse to very coarse-grained with cobbles, gravel, and fractured rock, poorly sorted, subangular to subrounded, light brown (5 YR 5/6), slightly moist. TD 20'.		
20							
25							
30							
35							
40							
45							
50							
55							
60							

LITHOLOGIC LOG	BORING/WELL NO: 102-004	PAGE 1 of 1
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 102
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: B. Willis
Drill Start (time/date): 17:26 on 06-29-04	Drill End (time/date): 18:17 on 06-29-04	Borehole Dia: 2 inch
Drill Method/Rig Type: Geoprobe		Total Depth: 20 ft
Logged By: B. Joyce	Coordinates: E ~-4939, N ~ -1872.5	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
3.3	▨	102-004– 3.3 ft			CLAY with silt pockets (silt 10-15%), light brownish gray (5YR6/1) to light olive gray (5Y6/1) with grayish black (N2) section, poor plasticity, friable, dry.		
8.8	▨	102-004 –8.8 ft			SILT (sand 10-15%), pale yellowish brown (10YR6/2) with light brown (5YR5/6), poor plasticity, slightly moist to dry, friable, soft, trace iron oxide.		
13.7	▨	102-004-13.7 ft			SILT, pale yellowish brown (10YR6/2) to light brown (5YR5/6), poor plasticity, friable, soft, dry.		
20	▨	102-004-20 ft			19.0-19.8': CLAY, light brownish gray (5YR6/1), good plasticity, slightly moist, soft, malleable. 19.8-20.0': SAND (silt 5-10%, clay 5-10% as pockets), medium to coarse to very coarse-grained with cobbles and gravel, poorly sorted, subangular to subrounded, light brown (5YR5/6) to moderate brown (5YR4/4), slightly moist, trace oxide. TD=20'.		

Depth scale: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

LITHOLOGIC LOG	BORING/WELL NO: 102-005	PAGE 1 of 1
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 102
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: B. Willis
Drill Start (time/date): 16:05 on 06-29-04	Drill End (time/date): 16:51 on 06-29-04	Borehole Dia: 2 inch
Drill Method/Rig Type: Geoprobe		Total Depth: 20 ft
Logged By: B. Joyce	Coordinates: E ~-5066, N ~ -1872.5	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
5	▨	102-005– 4.3 ft			SILT, light brownish gray (5YR6/1) to pale yellowish brown (10YR6/2) with light brown (5YR5/6), poor plasticity, friable, soft, dry.		
	▨	102-005 –8.2 ft					
10							
15	▨	102-005-14.3 ft			13.3-13.9': SILT, as above. 13.9-14.3': Silty SAND (silt 35-40%), fine-grained, well-sorted, subangular to subrounded, dark yellowish orange (10YR6/6), dry.		
20	▨	102-005-20 ft			SAND (silt 5-10%), medium to coarse to very coarse grained with cobbles, gravel, and fractured rock, poorly sorted, subangular to subrounded, light brown (5YR5/6) to moderate brown (5YR4/4), slightly moist, trace iron oxide. TD 20'.		
25							
30							
35							
40							
45							
50							
55							
60							

LITHOLOGIC LOG	BORING/WELL NO: 102-006	PAGE 1 of 1
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 102
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: B. Willis
Drill Start (time/date): 12:23 on 06-29-04	Drill End (time/date): 13:07 on 06-29-04	Borehole Dia: 2 inch
Drill Method/Rig Type: Geoprobe		Total Depth: 20 ft
Logged By: B. Joyce	Coordinates: E ~-5816, N ~ -1877	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
5		102-006– 4.3 ft			CLAY, medium light gray (N6), poor plasticity, dry, friable.		
10		102-006 –8.6 ft			SILT light brownish gray (5YR6/1) to pale yellowish brown (10YR6/2) with light brown (5YR5/6), moderate to good plasticity, slightly moist, soft, trace oxides.		
15		102-006-13.8 ft			Silty SAND (silt 20-25%) medium to fine grained, well-sorted, subangular to subrounded, grayish orange (10YR7/4) to very pale orange (10YR8/2) with some light brown (5YR5/6), dry to slightly moist.		
20					18.0-18.4': CLAY, light gray (N7), moderate plasticity, slightly moist, soft. 18.4-18.7': SAND (silt 15-20%), medium to coarse to very coarse grained with cobbles and gravel, poorly sorted, subangular to subrounded, light brown (5YR5/6), slightly moist. 18.7-19.0': CLAY with gravel, medium gray (N5), moderate plasticity, slightly moist, soft clay, large rock included. TD 20'.		
25							
30							
35							
40							
45							
50							
55							
60							

LITHOLOGIC LOG	BORING/WELL NO: 102-007	PAGE 1 of 1
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 102
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: B. Willis
Drill Start (time/date): 14:17 on 06-30-04	Drill End (time/date): 15:15 on 06-30-04	Borehole Dia: 2 inch
Drill Method/Rig Type: Geoprobe		Total Depth: 20 ft
Logged By: B. Joyce	Coordinates: E ~-4708, N ~ -1871.5	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
4	/////	102-007– 4 ft			SILT (clay increases to 10-15%), moderate yellowish brown (10YR5/4) grading to medium light gray (N6), good plasticity, moist grading dry, friable when dry, soft.		
8	/////	102-007 –8 ft			SILT (sand 5%), moderate yellowish brown (10YR5/4), moderate to poor plasticity, slightly moist, friable, soft, trace mang. oxide.		
15	/////	102-007-15 ft			SILT pale yellowish brown (10YR6/2) to light brown (5YR5/6) to grayish orange (10YR7/4), poor plasticity, slightly moist, friable, section is firm to hard, trace mang. oxide.		
19.7	/////	102-007-19.7 ft			SAND (silt 5-10%), medium to fine grained with occ. Some cobble, gravel, and fractured rock, well-sorted, subangular to subrounded, light brown (5YR5/6) to grayish orange (10YR7/4), slightly moist to dry, trace iron oxide. TD 20'.		

LITHOLOGIC LOG	BORING/WELL NO: 102-008	PAGE 1 of 1
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 102
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: GEO	Driller: R. Scott/K. Davis
Drill Start (time/date): 13:57 on 08-19-04	Drill End (time/date): 15:28 on 08-19-04	Borehole Dia: 2 inch
Drill Method/Rig Type: Jackhammer/Geoprobe		Total Depth: 20 ft
Logged By: K. Davis	Coordinates: E ~-4050, N ~ -1877	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
5	4–6	102-008– 6 ft			SILT, gray (10YR 6/1), friable, v. slightly moist. Note: small scale mottling by brownish yellow (10YR 6/6).		
10	8–10	102-008 –10 ft			SILT, gray (10YR 6/1), medium plasticity, moist, trace chert gravel (0.75-in diameter), rounded.		
15	14–16	102-008 –16 ft			14.0-14.8':SILT, yellowish brown (10YR 5/6) with some gray (10YR 5/1) staining (manganese?), friable, slightly moist. 14.8-15.2':SILT, yellowish brown (10YR 5/6) medium plasticity, very moist. 15.2-15.6':SILT, light gray (10YR 7/1) with heavy (10YR 4/1) dark gray staining, friable, slightly moist.		
20	18–20	102-008 –20 ft			SILT, light gray (10YR 7/1), low plasticity, slightly moist. TD = 20'.		
25							
30							
35							
40							
45							
50							
55							
60							

LITHOLOGIC LOG	BORING/WELL NO: 102-009	PAGE 1 of 1
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 102
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: B. Willis
Drill Start (time/date): 09:37 on 07-01-04	Drill End (time/date): 10:35 on 07-01-04	Borehole Dia: 2 inch
Drill Method/Rig Type: Geoprobe		Total Depth: 20 ft
Logged By: B. Joyce	Coordinates: E ~-4542, N ~ -1877	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
4.1		102-009– 4.1 ft			Gravelly SAND (silt 5-10%), medium to coarse to very coarse-grained with cobbles, gravel, and fractured rock, poorly-sorted, angular to subrounded, moderate reddish brown (10R4/6), slightly moist to moist.		
8.7		102-009 –8.7 ft					
15		102-009-15 ft			SILT (sand trace-5%), moderate yellowish brown (10YR5/4), poor to moderate plasticity, slightly moist to dry, friable, soft, trace mang. oxide.		
20		102-009-20 ft			SAND with clay pockets (silt 10-15%), medium to fine-grained with some cobbles and gravel, mostly well-sorted, subangular to subrounded, pale yellowish brown (10YR6/2) to light brown (5YR5/6), slightly moist, trace iron oxide)		

Depth scale (ft): 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

LITHOLOGIC LOG	BORING/WELL NO: 102-010	PAGE 1 of 1
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 102
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: R. Scott/K. Davis
Drill Start (time/date): 08:33 on 08-20-04	Drill End (time/date): 10:20 on 08-20-04	Borehole Dia: 2 inch
Drill Method/Rig Type: Jackhammer/Geoprobe		Total Depth: 20 ft
Logged By: K. Davis	Coordinates: E ~-4177.5, N ~ -1877	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
5	4–6	102-010– 6 ft			4.0-4.7': Clayey SILT, light yellowish brown (10YR 6/4), plastic, wet. 4.7-4.9': Wood fragment (carbonized). 4.9-5.9': Clayey SILT, as above.		
10	8–10	102-010 –10 ft			SILT, light gray (10YR 7/1), nonplastic, moist.		
15	14–16	102-010 –16 ft			Slightly clayey SILT, gray (10YR 6/1) with pockets of black (10YR 2/1) manganese cementation, medium plasticity, moist.		
20					No lithologic description available. TD = 20'.		
25							
30							
35							
40							
45							
50							
55							
60							

LITHOLOGIC LOG	BORING/WELL NO: 102-011	PAGE 1 of 1
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 102
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: B. Willis
Drill Start (time/date): 07:52 on 07-01-04	Drill End (time/date): 08:37 on 07-01-04	Borehole Dia: 2 inch
Drill Method/Rig Type: Geoprobe		Total Depth: 20 ft
Logged By: B. Joyce	Coordinates: E ~-4589, N ~ -1877	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
	▨	102-011– 3.3 ft			SILT (sand 5-10%), moderate yellowish brown (10YR5/4) moderate plasticity, slightly moist, soft, occ. cobbles.		
5							
	▨	102-011 –7.5 ft			SILT, as above, with sand 10-15% and includes some gravel. CLAY pocket from 6.6-6.9': medium light gray (N6), poor plasticity, friable, dry, includes pocket of mang. oxide.		
10							
	▨	102-011-13 ft			SILT with clay (clay 10-15% in pockets), light brown (5YR5/6) to grayish orange (10YR7/4), poor plasticity, friable, dry, trace iron oxide, section is hard.		
15							
20	▨	102-011-20 ft			CLAY with sand (sand 10-15%), medium light gray (N6) to light brownish gray (5YR 6/1), moderate to poor plasticity, slightly moist, firm to hard, sand includes cobbles and gravel.		
25							
30							
35							
40							
45							
50							
55							
60							

LITHOLOGIC LOG	BORING/WELL NO: 102-012	PAGE 1 of 1
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 102
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: B. Willis
Drill Start (time/date): 10:28 on 06-30-04	Drill End (time/date): 11:17 on 06-30-04	Borehole Dia: 2 inch
Drill Method/Rig Type: Geoprobe		Total Depth: 20 ft
Logged By: B. Joyce	Coordinates: E ~-4731, N ~ -1877	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
5	4.4 ft	102-012– 4.4 ft			CLAY (sand 10-15%), medium light gray (N6) to light olive gray (5Y6/1) with some light brown (5YR5/6), very good plasticity, moist, soft, malleable, some gravel included.		
10	8.4 ft	102-012 –8.4 ft			SILT, olive gray (5Y4/1) to light olive gray (5Y6/1), moderate plasticity, slightly friable, soft, moist.		
15	13.9 ft	102-012-13.9 ft			light gray (N8) with some light brown (5YR5/6)		
20	20 ft	102-012-20 ft			Silty SAND (silt 30-35% grading to 10-15%), medium-grained grading to medium to coarse to very coarse grained with cobbles and gravel, grading to poorly sorted, light brown (5YR5/6) to moderate yellowish brown (10YR5/4), subrounded to subangular, slightly moist TD 20'.		
25							
30							
35							
40							
45							
50							
55							
60							

LITHOLOGIC LOG	BORING/WELL NO: 102-013	PAGE 1 of 1
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 102
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: R. Scott/K. Davis
Drill Start (time/date): 09:00 on 08-19-04	Drill End (time/date): 11:05 on 08-19-04	Borehole Dia: 2 inch
Drill Method/Rig Type: Jackhammer/Geoprobe		Total Depth: 20 ft
Logged By: K. Davis	Coordinates: E ~-4101, N ~ -1877	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
5		102-013– 6 ft			SILT, pale brown (10YR 6/3), slightly plastic, slightly moist. 1-in zone of manganese cementation at 4.9 ft (possible fracture).		
10		102-013 –12 ft			SILT, brownish yellow (10YR 6/6), moderate plasticity, moist. Few zones of manganese cementation.		
15		102-013 –16 ft					
20					No lithologic description available. TD = 20'.		
25							
30							
35							
40							
45							
50							
55							
60							

LITHOLOGIC LOG	BORING/WELL NO: 102-014	PAGE 1 of 1
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 102
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: B. Willis
Drill Start (time/date): 13:45 on 08-18-04	Drill End (time/date): 17:34 on 08-18-04	Borehole Dia: 2 inch
Drill Method/Rig Type: Jackhammer/Geoprobe		Total Depth: 20 ft
Logged By: K. Davis	Coordinates: E ~-4300, N ~ -1877	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
5							
		102-014– 6 ft			SILT, dark yellowish brown (10YR4/6), slightly plastic, slightly moist.		
10							
		102-014-14 ft			SILT, brownish yellow (10YR6/6), plastic, slightly moist.		
15							
20		102-014-20 ft			SILT, light gray (10YR7/1), plastic, slightly moist. TD=20'		
25							
30							
35							
40							
45							
50							
55							
60							

LITHOLOGIC LOG	BORING/WELL NO: 102-015	PAGE 1 of 1
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: SWMU 102
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: B. Willis
Drill Start (time/date): 13:41 on 06-29-04	Drill End (time/date): 14:31 on 06-29-04	Borehole Dia: 2 inch
Drill Method/Rig Type: Geoprobe		Total Depth: 20 ft
Logged By: B. Joyce	Coordinates: E ~-5793, N ~ -1877	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/ SAFETY VOC	HEALTH/ SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
5		102-015– 5 ft			CLAY (trace black organic material), medium light gray (N6), poor plasticity, dry, friable.		
		102-015 –8.6 ft			SILT light brownish gray (5YR6/1) to pale yellowish brown (10YR6/2) with light brown (5YR5/6), moderate plasticity, slightly moist, soft, some sand - trace.		
10							
15		102-015-15 ft			Silty SAND (silt 20-25% down to 5-10%), medium to coarse-grained with some gravel, moderate to poorly-sorted, subrounded to subangular, light brown (5YR5/6) to grayish orange (10YR7/4), slightly moist to dry.		
		102-015-19.5 ft			18.5-18.8': SILT, light gray (N7), moderate plasticity, slightly moist, soft. 18.8-19.5': SAND (silt 5-14%), medium to coarse to very coarse grained with cobbles, gravel, and fractured rock, poorly sorted, subangular to subrounded, light brown (5YR5/6) to moderate brown (5YR4/4), slightly moist to moist, trace iron oxide. TD 20'.		
20							
25							
30							
35							
40							
45							
50							
55							
60							

THIS PAGE INTENTIONALLY LEFT BLANK.

SWMU 210

THIS PAGE INTENTIONALLY LEFT BLANK.

LITHOLOGIC LOG	BORING/WELL NO: 210-001	PAGE 1 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Southwest Plume
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: David Gentry
Drill Start (time/date): 08:21 on 06-15-04	Drill End (time/date): 12:57 on 06-17-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 98.5 ft
Logged By: K. Davis	Coordinates: E -7199, N -728	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
			--	--			
5		210-001– 5 ft	--	--	SILT, light yellowish brown (10YR 6/4); with 10% fine sand, black (10YR 2/1); loose consistency, wet.		
10		210-001 –10 ft	--	--	SILT, yellowish brown (10YR 5/6), soft, wet.		
15		210-001 –15 ft	--	--	SILT, yellowish brown (10YR 5/6); with 10% fine sand, black (10YR 2/1); very soft, wet.		
20		210-001 –20 ft	--	--			
25		210-001-25 ft	--	--	SAND, fine, well sorted, brownish yellow (10YR 6/6), loose consistency, wet.		
30		210-001-30 ft	--	--	SAND, very fine, very well sorted, brownish yellow (10YR 6/8), loose consistency, wet.		
35		210-001-35 ft	--	--	SAND, very fine, very well sorted, brownish yellow (10YR 6/8), loose consistency, wet.		
40		210-001-40 ft	--	--	SAND, very fine, very well sorted, brownish yellow (10YR 6/8), loose consistency, wet.		
45		210-001–45 ft	--	--	SAND, very fine, very well sorted, brownish yellow (10YR 6/8), loose consistency, wet.		
50		210-001-50 ft	--	--	SAND, very fine, very well sorted, brownish yellow (10YR 6/8), loose consistency, wet.		
55		210-001-55 ft	--	--	SAND, very fine, very well sorted, brownish yellow (10YR 6/8), loose consistency, wet.		
60		210-001-60 ft	--	--	SAND, very fine, very well sorted, brownish yellow (10YR 6/8), loose consistency, wet.		
65		210-001-65 ft	--	--	SAND, very fine, very well sorted, brownish yellow (10YR 6/8), loose consistency, wet.		
70		210-001-70 ft	--	--	SAND, very fine to very coarse, very poorly sorted rounded, reddish yellow (7.5YR 6/6), loose consistency, wet.		

LITHOLOGIC LOG	BORING/WELL NO: 210-001	PAGE 2 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Southwest Plume
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: David Gentry
Drill Start (time/date): 08:21 on 06-15-04	Drill End (time/date): 12:57 on 06-17-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 98.5 ft
Logged By: K. Davis	Coordinates: E -7199, N -728	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
			--	--	SAND, as above but with 10% gravel (up to 0.75-in diameter), subrounded, chert.		
75		210-001– 75 ft	--	--	SAND, very coarse; with 30% pebbles (up to 0.5-in diameter), subrounded, chert; strong brown (7.5YR 5/8), loose consistency, wet.		
80		210-001 –80 ft	--	--	SAND, coarse; with 10% gravel, subrounded, chert; strong brown (7.5YR 5/8); loose consistency, wet.		
85		210-001 –85 ft	--	--	SAND, very fine, silty; with 20% gravel, subrounded, chert, (mixed by drilling from above interval), brownish yellow (10YR 6/8), loose consistency, wet.		
90		210-001 –90 ft	--	--	SAND, very fine, silty, brownish yellow (10YR 6/8), loose consistency, wet.		
95		210-001-95 ft	--	--	TD 98.5’		
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: 210-002	PAGE 1 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Southwest Plume
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: David Gentry
Drill Start (time/date): 14:15 on 06-10-04	Drill End (time/date): 14:12 on 06-11-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 100 ft
Logged By: K. Davis	Coordinates: E -7199, N -862	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
			--	--			
5		210-002– 5 ft			SILT, yellowish brown (10 YR 5/6), loose consistency, wet.		
			--	--			
10		210-002 –10 ft			SILT, yellowish brown (10 YR 5/6) with trace black (10 YR 2/1) specs (fine sand?), soft, wet.		
			--	--	SILT, as above.		
15		210-002 –15 ft					
			--	--			
20		210-002 –20 ft					
			--	--			
25		210-002-25 ft			SILT with coarse sand, as above.		
			--	--			
30		210-002-30 ft			Silty, fine SAND, yellow (10 YR 7/6), loose, wet.		
			--	--	Silty, fine SAND, as above.		
35		210-002-35 ft					
			--	--			
40		210-002-40 ft			Fine, sandy SILT; reddish yellow (7.5 YR 6/8), loose consistency, wet.		
			--	--			
45		210-002–45 ft			Very fine SAND; reddish yellow (7.5 YR 6/8), loose consistency, wet.		
			--	--	Very fine SAND, as above.		
50		210-002-50 ft					
			--	--	Very fine SAND, as above, but with trace of rounded gravel (1-in diameter).		
55		210-002-55 ft					
			--	--			
60		210-002-60 ft			Very fine SAND, brownish yellow (10 YR 6/6), loose consistency, wet.		
			--	--	Very fine SAND, as above.		
65		210-002-65 ft					
			--	--			
70		210-002-70 ft			Silty (30%), coarse SAND, subrounded, chert, pale brown (10 YR 6/3), loose consistency, wet.		
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: 210-002	PAGE 2 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Southwest Plume
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: David Gentry
Drill Start (time/date): 14:15 on 06-10-04	Drill End (time/date): 14:12 on 06-11-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 100 ft
Logged By: K. Davis	Coordinates: E -7199, N -862	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
			--	--	Silty, coarse SAND, as above, but subangular.		
75		210-002– 75 ft	--	--			
80		210-002 –80 ft	--	--	Silty, coarse SAND, as above.		
85		210-002 –85 ft	--	--	Silty, coarse SAND, as above, but contains 10% well-rounded quartz grains.		
90		210-002 –90 ft	--	--	Moderately sorted SAND, 70% medium and 30% coarse, subangular, pale brown (10 YR 6/3), loose consistency, wet.		
95		210-002-95 ft	--	--	Silty, coarse SAND as at 85 ft but with 20% rounded gravel (up to 0.5-in diameter).		
100		210-002-100 ft	--	--	Moderately sorted SAND, 70% medium and 30% coarse, subangular, brownish yellow (10 YR 6/6), loose consistency, wet. TD 100'.		
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: 210-003	
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Southwest Plume
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: David Gentry
Drill Start (time/date): 09:20 on 06-18-04	Drill End (time/date): 18:00 on 06-21-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 104 ft
Logged By: K. Davis	Coordinates: E -7202, N -1020	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
			--	--			
5		210-003– 5 ft			SILT, yellowish brown (10 YR 5/6), loose consistency, wet.		
			--	--			
10		210-003 –10 ft			SILT, yellowish brown (10 YR 5/6), soft, wet.		
			--	--			
15		210-003 –15 ft			SILT, brownish yellow (10 YR 6/6), soft, wet.		
			--	--			
20		210-003 –20 ft			SAND, fine, brownish yellow (10 YR 6/6), loose consistency, wet.		
			--	--			
25		210-003-25 ft			Slightly clayey SILT with trace of medium sand, brownish yellow (10 YR 6/6), soft, wet.		
			--	--			
30		210-003-30 ft			SAND, fine, brownish yellow (10 YR 6/8), loose consistency, wet.		
			--	--			
35		210-003-35 ft			Silty, fine SAND, brownish yellow (10 YR 6/8), loose consistency, wet.		
			--	--			
40		210-003-40 ft			Silty fine SAND, as above.		
			--	--			
45		210-003–45 ft			Very fine SAND, yellowish brown (10 YR 5/4), loose consistency, wet.		
			--	--			
50		210-003-50 ft			Fine SAND, brownish yellow (10 YR 6/8), loose consistency, wet.		
			--	--			
55		210-003-55 ft			Fine SAND, as above.		
			--	--			
60		210-003-60 ft			Fine SAND, as above.		
			--	--			
65		210-003-65 ft			SAND; 60% coarse, subangular, chert, 40% fine; yellowish brown (10 YR 5/6), loose consistency, wet.		
			--	--			
70		210-003-70 ft			SAND; 50% medium to very coarse, subangular; 50% fine; yellowish brown (10 YR 5/6), loose consistency, wet.		
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: 210-003	PAGE 2 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Southwest Plume
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: David Gentry
Drill Start (time/date): 09:20 on 06-18-04	Drill End (time/date): 18:00 on 06-21-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 104 ft
Logged By: K. Davis	Coordinates: E -7202, N -1020	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
75		210-003– 75 ft	--	--	SAND, coarse to very coarse, subangular, chert, yellowish brown (10 YR 5/6), loose, wet.		
80		210-003 –80 ft	--	--	SAND, well sorted, bimodal; 60% fine; 40% coarse to very coarse, well rounded; yellowish brown (10 YR 5/6), loose consistency, wet.		
85		210-003 –85 ft	--	--	SAND, bimodal; 60%coarse sand to small gravel (up to 0.5-in diameter), poorly sorted, subrounded chert; 40% fine sand well sorted; brownish yellow (10 YR 6/6), loose consistency, wet.		GRAVEL—as large as 1-in diameter
90		210-003 –90 ft	--	--	Coarse SAND (60%) subangular, chert; with gravel (20%), rounded chert; fine sand (20%); brownish yellow (10 YR 6/8), loose consistency, wet.		
95		210-003-95 ft	--	--	SAND and GRAVEL, as above but 20% coarse sand, 60% gravel, and 20% fine sand.		
100		210-003-100 ft	--	--	Fine GRAVEL (60%), rounded chert; sand (40%), fine-to-medium; brownish yellow (10 YR 6/8), loose consistency, wet. TD 104’.		GRAVEL—up to 0.3-in diameter RGA/McNairy contact @ 101’
105			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: 210-004	PAGE 1 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Southwest Plume
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: David Gentry
Drill Start (time/date): 14:55 on 06-22-04	Drill End (time/date): 14:14 on 06-23-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 108.5 ft
Logged By: K. Davis	Coordinates: E -7200, N -1305	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
			--	--			
5		210-004– 5 ft			Clayey SILT with traces of medium-to-coarse sand and gravel, yellowish brown (10YR 5/6), very soft, wet.		
			--	--			
10		210-004 –10 ft			SILT, yellowish brown (10YR 5/6), with 10% fine sand, black (10YR 2/1), loose consistency, wet.		
			--	--			
15		210-004 –15 ft			SILT, light yellowish brown (10YR 6/4), very soft, wet.		
			--	--			
20		210-004 –20 ft			Silty, fine SAND, brownish yellow (10YR 6/6), loose consistency, wet.		
			--	--			
25		210-004-25 ft			Silty, fine SAND, brownish yellow (10YR 6/6), loose consistency, wet.		
			--	--			
30		210-004-30 ft			Slightly clayey, silty, fine SAND, brownish yellow (10YR 6/6), soft, wet.		
			--	--			
35		210-004-35 ft			Silty, fine SAND, brownish yellow (10YR 6/6), loose consistency, wet.		
			--	--			
40		210-004-40 ft			Silty, fine SAND, yellow (10YR 7/8), loose consistency, wet.		
			--	--			
45		210-004-45 ft					
			--	--			
50		210-004-50 ft					
			--	--	Silty, fine SAND, as above.		
55		210-004-55 ft					
			--	--			
60		210-004-60 ft			SAND; 70% coarse, rounded chert; 30% fine sand; brownish yellow (10YR 6/6), loose consistency, wet.		
			--	--			
65		210-004-65 ft			SAND; 80% coarse, rounded, chert: 20% fine; yellowish brown (10YR 5/6), loose consistency, wet.		
			--	--			
70		210-004-70 ft			SAND; 85% medium-to-coase, subangular-to-rounded chert; 15% fine, yellowish brown (10YR 5/6), loose consistency, wet.		
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: 210-004	PAGE 2 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Southwest Plume
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: David Gentry
Drill Start (time/date): 14:55 on 06-22-04	Drill End (time/date): 14:14 on 06-23-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 108.5 ft
Logged By: K. Davis	Coordinates: E -7200, N -1305	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
			--	--			
75		210-004– 75 ft			SAND, as above.		
			--	--	SAND: 85% medium-to-very-coarse, subangular-to-rounded, chert; 15% fine; yellowish brown (10YR 5/6). Loose consistency, wet.		
80		210-004 –80 ft					
			--	--	SAND, as above.		
85		210-004 –85 ft					
			--	--	SAND, as above.		
90		210-004 –90 ft			SAND; 40% medium-to-coarse, subangular-to-rounded, chert; 30% fine; with 30% gravel (up to 1-in diameter), rounded, chert; yellowish brown (10YR 5/6), loose consistency, wet.		
			--	--			
95		210-004-95 ft					
			--	--	SAND; 85% medium-to-very coarse, subangular-to-rounded chert; 15% fine; yellowish brown (10YR 5/6), loose consistency, wet		
100		210-004-100 ft					
			--	--			
105		210-004-105 ft			SAND, as above. TD 108.5’		
			--	--			RGA/McNairy contact at 107.5’.
110							
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: 210-005	PAGE 1 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Southwest Plume
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: David Gentry
Drill Start (time/date): 09:18 on 06-02-04	Drill End (time/date): 17:30 on 06-08-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 100 ft
Logged By: K. Davis	Coordinates: E -7225, N -1401	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
			--	--			
5	/////	210-005– 5 ft			SILT, brownish yellow (10 YR 6/6), loose consistency, wet.		
			--	--			
10	/////	210-005 –10 ft			SILT, as above.		
			--	--			
15	/////	210-005 –15 ft			SILT, yellowish brown (10 YR 5/4), very soft, wet.		
			--	--			
20	/////	210-005 –20 ft					
			--	--	SAND, fine, very well-sorted, approx. 10% opaque grains, silty reddish yellow (7.5 YR 6/6), loose consistency, wet.		
25	/////	210-005-25 ft					
			--	--			
30	/////	210-005-30 ft					
			--	--			
35	/////	210-005-35 ft			dark yellowish brown (10 YR 4/6);		Coarse sand is rounded.
			--	--			
40	/////	210-005-40 ft			SAND, fine, well-sorted, as at 30 ft, but without very coarse sand.		
			--	--			
45	/////	210-005–45 ft			SAND, as above.		Poor sample.
			--	--			
50	/////	210-005-50 ft					
			--	--			
55	/////	210-005-55 ft					
			--	--			
60	/////	210-005-60 ft			SAND, as at 40 ft.		
			--	--			
65	/////	210-005-65 ft			SAND, as at 30 ft.		
			--	--			
70	/////	210-005-70 ft			No lithologic sample available for description.		
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: 210-005	PAGE 2 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Southwest Plume
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: David Gentry
Drill Start (time/date): 09:18 on 06-02-04	Drill End (time/date): 17:30 on 06-08-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 75 ft
Logged By: K. Davis	Coordinates: E -7225, N -1401	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
			--	--			
75		210-005– 75 ft	--	--	No lithologic sample available for description.		
80		210-005 –80 ft	--	--	No lithologic sample available for description.		
85		210-005 –85 ft	--	--	No lithologic sample available for description.		
90		210-005 –90 ft	--	--	No lithologic sample available for description.		
95		210-005-95 ft	--	--	No lithologic sample available for description.		
100		210-005-100 ft	--	--	No lithologic sample available for description. TD 100'.		
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: 210-006	PAGE 1 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Southwest Plume
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: David Gentry
Drill Start (time/date): 05-27-04	Drill End (time/date): 06-01-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram/ Geoprobe		Total Depth: 100 ft
Logged By: K. Davis	Coordinates: E -7146, N -1751	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
5		210-006– 5 ft	--	--	SILT, yellowish brown (10 YR 5/4), loose consistency, wet.		
10		210-006 –10 ft	--	--	SILT, as above.		
15		210-006 –15 ft	--	--	SILT, as above but with 15% fine sand.		
20		210-006 –20 ft	--	--	Silty (30%-40%), very coarse SAND with some (10%) gravel; sand and gravel are rounded; yellowish brown (10 YR 5/4), loose consistency		
25		210-006-25 ft	--	--	No lithologic sample available.		
30		210-006-30 ft	--	--	SILT, with coarse sand (20%), brownish yellow (10 YR 6/6), loose consistency, wet.		
35		210-006-35 ft	--	--			
40		210-006-40 ft	--	--	SILT, brownish yellow (10 YR 6/6), loose consistency, wet; poor sample.		Poor sample.
45		210-006–45 ft	--	--	SILT with fine sand (20%), brownish yellow, very soft, wet.		
50		210-006-50 ft	--	--	SILT, as above.		
55		210-006-55 ft	--	--	SILT, as above.		Poor sample.
60		210-006-60 ft	--	--	Silty, fine SAND, brownish yellow (10 YR 6/8); loose consistency, wet.		
65		210-006-65 ft	--	--	Medium SAND with some gravel (10%) (pebbles), subangular, brownish yellow (10 YR 6/8); loose consistency, wet.		
70		210-006-70 ft	--	--	Fine SAND, silty, yellowish brown (10 YR 5/6), loose consistency, wet.		
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: 210-006	PAGE 2 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Southwest Plume
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: David Gentry
Drill Start (time/date): 05-27-04	Drill End (time/date): 06-01-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram/ Geoprobe		Total Depth: 100 ft
Logged By: K. Davis	Coordinates: E -7146, N -1751	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
			--	--			
75		210-006– 75 ft	--	--	Poorly sorted SAND, medium to very coarse, rounded, quartzo-feldspathic, dark yellowish brown (10 YR 4/4), loose consistency, wet.		
80		210-006 –80 ft	--	--	No lithologic sample available for description.		
85		210-006 –85 ft	--	--	No lithologic sample available for description.		
90		210-006 –90 ft	--	--	No lithologic sample available for description.		
95		210-006-95 ft	--	--	No lithologic sample available for description.		
100		210-006-100 ft	--	--	No lithologic sample available for description. TD 100’.		
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: 210-007	PAGE 1 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Southwest Plume
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: David Gentry
Drill Start (time/date): 05-14-04	Drill End (time/date): 05-26-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 100 ft
Logged By: K. Davis	Coordinates: E -7180, N -2051	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
5		210-007- 5 ft	--	--	No sample available for description.		
10		210-007-10 ft	--	--	No sample available for description.		
15		210-007-15 ft	--	--	SILT, brownish yellow (10 YR 6/8), loose consistency, wet.		
20		210-007-20 ft	--	--	SILT, as above.		
25		210-007-25 ft	--	--	SILT with 10% coarse sand, brownish yellow (10 YR 6/6), loose consistency, wet.		
30		210-007-30 ft	--	--	SILT, yellowish brown (10 YR 5/8), soft, damp.		
35		210-007-35 ft	--	--	SILT, as above.		
40		210-007-40 ft	--	--	SILT, as above.		
45		210-007-45 ft	--	--	SILT, as above.		
50		210-007-50 ft	--	--	SILT with 20% fine sand, yellowish brown (10 YR 5/8), soft, damp.		
55		210-007-55 ft	--	--	SILT with fine sand, as above.		
60		210-007-60 ft	--	--	GRAVEL, rounded, light yellowish brown (10 YR 6/4), loose consistency, wet.		Gravel up to 1.2-in diameter
65		210-007-65 ft	--	--	Sandy coarse GRAVEL, subangular, brownish yellow (10 YR 6/6), loose consistency, damp.		Gravel up to 0.5-in diameter
70		210-007-70 ft	--	--	Silty (20%), Gravelly (20%) SAND, poorly-sorted, subangular, brownish yellow (10 YR 6/6), loose consistency, damp.		
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: 210-007	PAGE 2 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Southwest Plume
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: David Gentry
Drill Start (time/date): 05-14-04	Drill End (time/date): 05-26-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 100 ft
Logged By: K. Davis	Coordinates: E -7180, N -2051	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
			--	--			
75		210-007– 75 ft	--	--	Silty (20%) SAND with Gravel (10%), brownish yellow (10 YR 6/6), loose consistency, damp		
80		210-007 –80 ft	--	--	SAND, fine, dark yellowish brown (10 YR 4/6), loose consistency, wet.		
85		210-007 –85 ft	--	--	No lithologic sample available for description.		
90		210-007 –90 ft	--	--	No lithologic sample available for description.		
95		210-007-95 ft	--	--	No lithologic sample available for description.		
100		210-007-100 ft	--	--	No lithologic sample available for description. TD 100’.		
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: 210-008	PAGE 1 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Southwest Plume
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: David Gentry
Drill Start (time/date): 08:48 on 06-30-04	Drill End (time/date): 16:00 on 06-30-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 85 ft
Logged By: K. Davis	Coordinates: E -5663, N -1189	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
			--	--			
5		210-008– 5 ft	--	--	Fine SAND, brownish yellow (10YR 6/6), loose, wet.		
10		210-008 –10 ft	--	--	SILT, light yellowish brown (10YR 6/4), wet. Sample at 10 ft is loose.		
15		210-008 –15 ft	--	--			
20		210-008 –20 ft	--	--			
25		210-008-25 ft	--	--	Fine SAND, reddish yellow (7.5YR 6/6), loose, wet.		
30		210-008-30 ft	--	--	Fine SAND, reddish yellow (7.5YR 6/6), loose, wet.		
35		210-008-35 ft	--	--	Fine SAND as above but yellow (10YR 7/6).		
40		210-008-40 ft	--	--	SILT, brownish yellow (10YR 6/6), loose, wet.		
45		210-008–45 ft	--	--	SILT, as above but hard.		
50		210-008-50 ft	--	--			
55		210-008-55 ft	--	--			
60		210-008-60 ft	--	--	Fine SAND, brownish yellow (10YR 6/6), loose, wet.		
65		210-008-65 ft	--	--	Fine SAND, brownish yellow (10YR 6/6), loose, wet.		
70		210-008-70 ft	--	--	Coarse SAND-TO-PEBBLE (70%), up to 1/2-in diameter, subangular to angular, chert; silt (30%); yellowish brown (10YR 5/6), loose, wet.		

LITHOLOGIC LOG	BORING/WELL NO: 210-008	PAGE 2 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Southwest Plume
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: David Gentry
Drill Start (time/date): 08:48 on 06-30-04	Drill End (time/date): 16:00 on 06-30-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 85 ft
Logged By: K. Davis	Coordinates: E -5663, N -1189	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
			--	--	Coarse SAND-TO-PEBBLE (70%), up to 1/2-in diameter, subangular to angular, chert; silt (30%); yellowish brown (10YR 5/6), loose, wet.		
75		210-008– 75 ft	--	--			
80		210-008 –80 ft	--	--	SAND, fine (60%), coarse-sand-to-pebble as above (40%), yellowish brown (10YR 5/8), loose, wet.		
85		210-008 –85 ft	--	--	Very fine SAND, brownish yellow (10YR 6/8), loose, wet. TD 85'.		McNairy contact at 85'.
90			--	--			
95			--	--			
100			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: 210-009	PAGE 1 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Southwest Plume
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: David Gentry
Drill Start (time/date): 09:00 on 07-01-04	Drill End (time/date): 16:33 on 07-01-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 85 ft
Logged By: K. Davis	Coordinates: E -5415, N -1249	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
			--	--			
5	▨	210-009– 5 ft	--	--	No lithologic description available. Cuttings disposed.		
10	▨	210-009 –10 ft	--	--			
15	▨	210-009 –15 ft	--	--			
20	▨	210-009 –20 ft	--	--			
25	▨	210-009-25 ft	--	--			
30	▨	210-009-30 ft	--	--			
35	▨	210-009-35 ft	--	--			
40	▨	210-009-40 ft	--	--			
45	▨	210-009–45 ft	--	--			
50	▨	210-009-50 ft	--	--			
55	▨	210-009-55 ft	--	--			
60	▨	210-009-60 ft	--	--	RGA contact @ 64.5’		
65	▨	210-009-65 ft	--	--			DTW 56’
70	▨	210-009-70 ft	--	--			DTW 49’

LITHOLOGIC LOG	BORING/WELL NO: 210-009	PAGE 2 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Southwest Plume
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: David Gentry
Drill Start (time/date): 09:00 on 07-01-04	Drill End (time/date): 16:33 on 07-01-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 85 ft
Logged By: K. Davis	Coordinates: E -5415, N -1249	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
			--	--			
75		210-009– 75 ft	--	--			
80		210-009 –80 ft	--	--			DTW 50'
85		210-009 –85 ft	--	--	McNairy contact @ 85'. TD 85'.		DTW 74'
90			--	--			
95			--	--			
100			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: 210-010	PAGE 1 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Southwest Plume
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: David Gentry
Drill Start (time/date): 09:45 on 07-07-04	Drill End (time/date): 15:21 on 07-08-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 96 ft
Logged By: B. Joyce	Coordinates: E -5570, N -1568	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/ SAFETY VOC	HEALTH/ SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
			--	--			
5		210-010– 5 ft			SILT pale yellowish brown (10YR 6/2), includes some clay loose, wet.		
			--	--			
10		210-010 –10 ft			SILT with clay, pale yellowish brown (10YR 6/2), loose, wet.		
			--	--			
15		210-010 –15 ft			SILT (no clay), pale yellowish brown (10YR 6/2), loose, wet.		
			--	--			
20		210-010 –20 ft			SAND (with some silt), fine grained, grayish orange (10YR 7/4) some consolidated pieces, mostly loose, wet.		
			--	--			
25		210-010-25 ft			Silty SAND fine grained, grayish orange (10YR 7/4), loose wet.		
			--	--			
30		210-010-30 ft			SAND (with some clay) fine grained, grayish orange (10YR 7/4), loose, wet.		
			--	--			
35		210-010-35 ft			SAND (with some clay) fine grained, grayish orange (10YR 7/4), loose, wet.		
			--	--			
40		210-010-40 ft			SAND (with some clay) fine grained, grayish orange (10YR 7/4), loose, wet.		
			--	--			
45		210-010–45 ft			SAND (with some clay) fine grained, dark yellowish orange (10YR 6/6), loose, wet.		
			--	--			
50		210-010-50 ft			Silty SAND fine grained, dark yellowish orange (10YR 6/6), loose, wet.		
			--	--			
55		210-010-55 ft			Silty SAND (with some clay) fine grained, dark yellowish orange (10YR 6/6), loose, wet.		
			--	--			
60		210-010-60 ft			SAND medium grained, dark yellowish orange (10YR 6/6), loose, wet.		Drilling response indicated gravel at 61.5'.
			--	--			
65		210-010-65 ft			SAND medium grained with some gravel, dark yellowish orange (10YR 6/6), loose, wet.		
			--	--			
70		210-010-70 ft			Gravelly SAND poorly sorted grain size, moderate brown (5YR 4/4), with chert, loose, wet.		
			--	--			

LITHOLOGIC LOG	BORING/WELL NO: 210-010	PAGE 2 of 2
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Southwest Plume
Project No: DO 186	Client/Project: USDOE/PGDP Site Investigation of SW Plume	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: David Gentry
Drill Start (time/date): 09:45 on 07-07-04	Drill End (time/date): 15:21 on 07-08-04	Borehole Dia: 6 inch
Drill Method/Rig Type: Dual Wall Reverse Circulation with Schram		Total Depth: 96 ft
Logged By: B. Joyce	Coordinates: E -5570, N -1568	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
75		210-010– 75 ft	--	--	Gravelly SAND, as above.		
80		210-010 –80 ft	--	--	Gravel SAND, poorly sorted grain size, moderate brown (5YR 3/4), loose, wet.		
85		210-010 –85 ft	--	--	Gravel SAND, poorly sorted grain size, some very large moderate brown (5YR 4/4), loose, wet.		
90		210-010 –90 ft	--	--	Gravel SAND poorly sorted grain size, some very large, light brown (5YR 5/6), loose, wet.		
95		210-010 –95 ft	--	--	SAND with some silt and clay fine grained, dark yellowish orange (10YR 6/6), loose, wet. TD 96'.		McNairy contact at 96'. McNairy lithology is CLAY brownish gray (5YR 4/1) good plasticity, soft, malleable, clean.
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			
			--	--			

GROUNDWATER SAMPLE STABILIZATION LOGS

THIS PAGE INTENTIONALLY LEFT BLANK.

Boring 004-101

Boring: 004-101			Sample Depth: 76.5 ft bgs		
Sample Collection Date: 5/04/2004			Sample Collection Time: 14:10		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
13:44	20.2	1.94	0.210	7.17	-344
13:47	20.1	5.32	0.191	6.60	-45
13:50	19.7	6.11	0.179	6.29	-24
13:53	19.6	6.44	0.176	6.27	-15
13:56	19.6	6.66	0.175	6.27	-8
13:59	19.7	7.00	0.175	6.26	-4
14:02	19.6	7.29	0.175	6.26	1
14:05	19.5	7.35	0.175	6.25	5
14:08	19.5	7.40	0.175	6.24	8
14:12	19.5	9.06	0.174	6.26	8

Boring 004-101A

Boring: 004-101A			Sample Depth: 68.5 ft bgs		
Sample Collection Date: 6/25/2004			Sample Collection Time: 10:46		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
09:50	20.5	10.58 – 10.91	0.142	6.29	139
09:55	20.4	10.27 – 10.57	0.143	6.25	143
10:00	20.4	10.81 – 11.09	0.145	6.21	130
10:05	20.9	10.66 – 10.87	0.147	6.18	115
10:10	20.2	11.19 – 11.33	0.147	6.14	124
10:15	20.6	10.46 – 10.67	0.149	6.16	115
10:20	20.8	10.71 – 11.02	0.151	6.15	109
10:25	21.2	10.30 – 10.41	0.151	6.16	109
10:30	20.4	10.87 – 11.04	0.153	6.15	110
10:33	20.0	11.12 – 11.18	0.153	6.14	116
10:36	19.4	11.05 – 11.36	0.152	6.16	121-124
10:39	19.0	10.66 – 10.90	0.153	6.14	130
10:42	19.0	11.08 – 11.32	0.152	6.13	132
10:45	19.1	10.74 – 10.91	0.152	6.13	129
10:48	18.6	10.91 – 11.02	0.152	6.13	140

Boring: 004-101A			Sample Depth: 78.5 ft bgs		
Sample Collection Date: 6/25/2004			Sample Collection Time: 12:57		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
12:05	21.3	11.38 – 11.45	0.202	6.10	128
12:10	20.3	11.62 – 11.75	0.201	6.12	132
12:16	19.9	10.96 – 11.30	0.200	6.09	139
12:20	20.1	10.63 – 10.94	0.199	6.09	143
12:25	20.3	10.43 – 10.58	0.199	6.09	133
12:35	20.4	10.72 – 10.84	0.202	6.08	121
12:40	19.8	10.07 – 10.51	0.200	6.09	125
12:45	19.8	10.41 – 10.50	0.199	6.09	127
12:48	20.2	9.97 – 10.17	0.196	6.08	128
12:51	21.6	9.75 – 9.81	0.198	6.05	125
12:53	21.5	9.81 – 9.92	0.200	6.04	122

Boring 004-101A

Boring: 004-101A			Sample Depth: 88.5 ft bgs		
Sample Collection Date: 6/25/2004			Sample Collection Time: 14:04		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
13:25	19.5	9.56 – 9.66	0.248	6.07	156
13:30	19.8	9.31 – 9.52	0.249	6.06	149
13:35	19.1	9.65 – 9.80	0.249	6.06	149
13:40	18.9	9.68 – 9.82	0.248	6.06	148
13:45	18.8	9.60 – 9.70	0.249	6.03	147
13:50	18.7	9.64 – 9.69	0.249	5.99	145
13:55	19.0	9.26 – 9.50	0.248	5.96	146
13:58	19.1	9.33 – 9.45	0.249	5.95	147
14:01	19.0	9.33 – 9.44	0.248	5.94	148
14:06	19.3	8.99 – 9.13	0.248	5.91	148

Boring 004-102

Boring: 004-102			Sample Depth: 68.5 ft bgs		
Sample Collection Date: 6/29/2004			Sample Collection Time: 10:15		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
09:30	20.7	9.03	0.144	6.24	131
09:33	20.2	8.64	0.145	6.25	131
09:36	20.1	8.65	0.144	6.23	136
09:39	20.1	8.55	0.144	6.19	137
09:42	20.2	8.53	0.145	6.17	137
09:45	20.2	8.54	0.145	6.19	137
09:48	20.2	8.48	0.145	6.21	136
09:51	20.2	8.46	0.145	6.21	136
09:54	20.2	8.22	0.145	6.21	136
09:57	20.1	8.23	0.145	6.20	135
10:00	20.1	8.22	0.145	6.18	136
10:03	20.1	8.23	0.146	6.14	134
10:06	20.4	8.05	0.146	6.13	129
10:09	20.3	7.76	0.146	6.12	125
10:12	20.5	7.88	0.146	6.11	122
10:15	20.5	7.88	0.146	6.10	123

Boring: 004-102			Sample Depth: 80 ft bgs		
Sample Collection Date: 6/29/2004			Sample Collection Time: 11:30		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
11:05	21.1	0.78	0.180	6.25	128
11:10	20.4	0.72	0.181	6.31	NA
11:15	20.4	0.68	0.181	6.31	114
11:20	19.9	0.70	0.181	6.32	110
11:23	20.2	0.69	0.181	6.30	105
11:26	20.0	0.68 – 0.70	0.182	6.30	103
11:29	19.9	0.68 – 0.70	0.182	6.31	102
11:30	19.8	0.68 – 0.70	0.182	6.31	102

Boring 004-102

Boring: 004-102			Sample Depth: 90 ft bgs		
Sample Collection Date: 6/29/2004			Sample Collection Time: 13:37		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
13:05	25.4	1.68 – 1.98	0.265	6.30	114
13:10	26.3	1.46 – 1.50	0.268	6.29	119
13:15	26.5	1.21	0.269	6.29	125
13:20	27.0	1.20	0.270	6.30	129
13:25	27.5	1.19	0.270	6.30	136
13:30	28.0	1.25	0.271	6.31	143
13:33	28.3	1.29	0.271	6.31	145
13:36	28.7	1.29	0.271	6.32	146
13:37	28.9	1.20	0.271	6.32	146

Boring 004-103

Boring: 004-103			Sample Depth: 68.5 ft bgs		
Sample Collection Date: 7/28/2004			Sample Collection Time: 12:50		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
12:20	20.6	11.14	0.134	6.11	161
12:25	20.3	11.08	0.134	6.10	146
12:30	20.4	11.02	0.135	6.04	141
12:35	20.4	11.00	0.135	6.04	142
12:38	20.4	11.13	0.135	6.03	142
12:41	20.3	10.98	0.135	6.02	142
12:44	20.4	10.78	0.135	5.99	142
12:47	20.2	11.33	0.135	5.94	142
12:50	20.2	10.93	0.135	5.93	142

Boring: 004-103			Sample Depth: 78.5 ft bgs		
Sample Collection Date: 7/28/2004			Sample Collection Time: 14:15		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
13:45	20.9	11.09	0.138	6.16	176
13:50	20.5	10.79	0.138	6.14	166
13:55	20.0	10.91	0.138	6.14	164
14:00	20.5	11.33	0.139	6.13	159
14:03	20.1	11.04	0.138	6.12	160
14:06	20.2	11.38	0.138	6.12	162
14:09	20.5	11.05	0.138	6.10	158
14:12	20.6	11.16	0.138	6.08	158
14:15	20.2	11.22	0.139	6.07	159

Boring: 004-103			Sample Depth: 88.5 ft bgs		
Sample Collection Date: 7/28/2004			Sample Collection Time: 15:30		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
15:00	20.1	12.88	0.226	6.12	178
15:05	19.6	12.42	0.225	6.09	165
15:10	19.3	12.48	0.224	6.11	155
15:13	19.5	12.42	0.224	6.10	154
15:16	19.9	12.28	0.224	6.09	152
15:19	19.4	12.57	0.224	6.09	153
15:22	19.4	12.49	0.223	6.09	153
15:25	19.4	12.47	0.223	6.08	153
15:28	19.2	12.66	0.223	6.07	154
15:30	19.2	12.52	0.223	6.07	154

Boring 004-103

Boring: 004-103			Sample Depth: 98.5 ft bgs		
Sample Collection Date: 7/28/2004			Sample Collection Time: 17:10		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
16:40	18.8	7.00	0.250	5.98	138
16:45	18.5	7.06	0.249	6.01	138
16:50	18.5	7.11	0.250	6.05	134
16:55	18.3	7.14	0.248	6.05	133
16:58	18.3	7.18	0.248	6.04	132
17:01	18.1	7.25	0.248	6.03	132
17:04	18.1	6.92	0.247	6.03	132
17:07	18.0	7.24	0.249	6.02	131
17:10	18.0	6.98	0.248	6.01	131

Boring 004-104

Boring: 004-104			Sample Depth: 65 ft bgs		
Sample Collection Date: 5/10/2004			Sample Collection Time: 15:20		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
15:00	27.8	4.87	0.174	6.78	-15
15:03	28.2	8.48	0.160	6.74	19
15:06	29.0	5.53	0.157	6.74	34
15:09	29.7	5.38	0.155	6.72	39
15:12	30.9	6.16	0.145	7.00	48
15:15	31.9	5.04	0.144	6.99	54
15:18	31.9	5.36	0.143	6.99	60
15:20	31.9	6.00	0.144	6.97	58

Boring: 004-104			Sample Depth: 70 ft bgs		
Sample Collection Date: 5/10/2004			Sample Collection Time: 17:04		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
16:55	24.6	9.50	0.157	6.09	70
16:58	24.5	9.53	0.158	6.10	71
17:01	24.3	9.76	0.158	6.12	72
17:04	24.2	9.64	0.159	6.12	70

Boring: 004-104			Sample Depth: 80 ft bgs		
Sample Collection Date: 5/11/2004			Sample Collection Time: 10:40		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
10:31	25.0	5.59	0.170	6.19	35
10:34	25.0	5.28	0.172	6.18	34
10:37	25.1	5.12	0.172	6.13	34
10:40	25.2	5.19	0.172	6.19	34

Boring: 004-104			Sample Depth: 90 ft bgs		
Sample Collection Date: 5/12/2004			Sample Collection Time: 15:11		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
15:00	22.1	10.80	0.217	6.37	58
15:05	21.7	10.50	0.217	6.37	60
15:10	21.8	10.20	0.217	6.40	56
15:11	21.8	10.20	0.217	6.40	56

Boring 004-104

Boring: 004-104			Sample Depth: 95 ft bgs		
Sample Collection Date: 5/12/2004			Sample Collection Time: 17:55		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
17:42	23.6	2.63	0.189	7.22	74
17:45	23.5	3.02	0.193	7.12	77
17:48	23.4	3.01	0.196	7.03	79
17:51	23.4	3.01	0.197	7.01	79
17:54	23.4	3.06	0.204	6.85	80
17:55	23.4	3.06	0.204	6.88	80

Boring 004-105

Boring: 004-105			Sample Depth: 63.5 ft bgs		
Sample Collection Date: 7/10/2004			Sample Collection Time: 11:50		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
09:40	31.0	4.21	0.202	6.10	62
10:10	31.1	3.83	0.202	5.57	54
10:15	24.9	10.02	0.190	5.74	112
10:20	24.0	11.31	0.189	5.77	128
10:27	25.3	10.25	0.191	5.74	128
10:38	23.0	12.37	0.188	5.93	138
10:41	23.4	12.11	0.188	5.97	141
11:10	23.5	9.47	0.195	5.78	130
11:15	22.9	9.77	0.191	5.82	133
11:20	23.9	9.76	0.191	5.80	136
11:25	23.9	9.63	0.191	5.77	138
11:30	22.6	10.47	0.191	5.76	142
11:35	23.4	9.82	0.192	5.74	142
11:38	23.7	9.96	0.190	5.74	142
11:41	24.0	9.79	0.191	5.75	141
11:44	23.9	10.03	0.191	5.75	142
11:47	23.8	9.56	0.191	5.75	141
11:50	23.7	9.89	0.191	5.75	144

Boring: 004-105			Sample Depth: 73.5 ft bgs		
Sample Collection Date: 7/10/2004			Sample Collection Time: 15:25		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
13:55	24.7	7.90	0.240	5.82	90
14:12	22.2	8.22	0.237	6.24	97
14:15	22.5	7.73	0.237	6.23	89
14:18	22.5	7.58	0.233	6.19	92
14:55	21.9	10.10	0.229	5.88	110
14:58	22.1	9.76	0.230	5.95	94
15:01	22.2	7.62	0.226	6.05	114
15:04	24.4	7.03	0.221	6.02	115
15:07	20.8	11.39	0.228	6.13	120
15:10	20.6	10.00	0.232	6.15	100
15:13	20.3	10.57	0.225	6.09	116
15:16	20.4	10.91	0.225	6.07	119
15:19	20.3	11.28	0.224	6.05	125
15:22	20.2	11.80	0.221	6.03	139
15:25	20.2	12.08	0.221	6.02	147

Boring 004-105

Boring: 004-105			Sample Depth: 78.5 ft bgs		
Sample Collection Date: 7/10/2004			Sample Collection Time: 17:00		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
16:30	21.3	12.53	0.212	6.19	132
16:35	20.9	12.93	0.212	6.16	141
16:40	20.2	13.05	0.212	6.13	141
16:45	20.1	13.09	0.212	6.13	140
16:48	20.2	13.14	0.212	6.12	142
16:51	20.4	13.13	0.212	6.10	142
16:54	20.3	13.01	0.213	6.08	141
16:57	20.3	12.97	0.212	6.07	140
17:00	20.4	13.01	0.213	6.04	140

Boring: 004-105			Sample Depth: 88.5 ft bgs		
Sample Collection Date: 7/11/2004			Sample Collection Time: 10:15		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
09:30	19.6	9.52	0.205	5.83	117
09:35	19.5	10.11	0.205	5.78	113
09:40	19.6	10.09	0.206	5.69	111
09:55	19.8	11.10	0.208	5.86	105
10:00	19.7	11.23	0.208	5.91	106
10:03	19.8	11.02	0.208	5.89	107
10:06	19.7	10.86	0.208	5.84	107
10:09	19.9	11.21	0.207	5.82	108
10:12	19.9	10.96	0.207	5.79	108
10:15	19.9	11.00	0.207	5.79	108

Boring: 004-105			Sample Depth: 98.5 ft bgs		
Sample Collection Date: 7/11/2004			Sample Collection Time: 12:10		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
11:30	19.2	2.20	0.169	5.79	108
11:35	19.7	2.27	0.170	5.79	104
11:40	19.4	2.20	0.169	5.75	103
11:45	19.6	2.16	0.170	5.69	102
11:50	19.7	2.13	0.170	5.66	101
11:53	19.8	2.11	0.171	5.63	101
11:56	19.6	1.99	0.170	5.61	100
11:59	19.5	2.06	0.170	5.60	100
12:02	19.5	2.03	0.170	5.59	100
12:05	19.7	1.96	0.170	5.57	100
12:10	19.5	1.93	0.170	5.57	99

Boring 004-106

Boring: 004-106			Sample Depth: 68.5 ft bgs		
Sample Collection Date: 7/12/2004			Sample Collection Time: 11:30		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
10:40	24.0	10.11	0.211	5.46	99
10:50	23.6	10.56	0.209	5.56	158
10:55	25.0	9.98	0.208	5.79	143
11:00	24.9	9.86	0.211	5.80	154
11:03	24.7	9.82	0.210	5.85	155
11:07	24.5	9.62	0.210	5.92	154
11:09	24.6	9.60	0.210	5.87	155
11:12	24.8	9.62	0.210	5.92	156
11:15	24.8	9.64	0.210	5.83	156
11:18	24.6	9.68	0.211	5.86	156
11:21	24.7	9.54	0.209	5.89	155
11:24	24.8	9.50	0.210	5.89	155
11:27	24.2	9.32	0.210	5.90	156
11:30	23.8	9.56	0.210	5.90	157

Boring: 004-106			Sample Depth: 78.5 ft bgs		
Sample Collection Date: 7/12/2004			Sample Collection Time: 14:10		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
13:30	22.3	12.67	0.220	5.77	225
13:35	22.9	12.37	0.221	5.85	231
13:40	22.9	12.48	0.220	5.86	233
13:45	22.8	12.44	0.221	5.87	236
13:50	22.6	12.30	0.221	5.86	239
13:53	22.5	12.39	0.220	5.84	241
13:56	22.5	12.51	0.220	5.82	243
13:59	22.5	12.25	0.220	5.80	243
14:02	22.2	12.45	0.221	5.79	245
14:05	22.2	12.70	0.220	5.77	247
14:10	22.5	12.50	0.219	5.75	247

Boring 004-106

Boring: 004-106			Sample Depth: 88.5 ft bgs		
Sample Collection Date: 7/12/2004			Sample Collection Time: 16:45		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
15:45	22.6	8.50	0.221	6.02	106
15:50	23.5	7.71	0.221	6.29	97
15:55	23.9	6.73	0.220	6.38	94
16:35	25.3	6.25	0.226	6.23	97
16:37	23.0	8.14	0.221	6.19	111
16:39	22.0	8.24	0.219	6.24	117
16:41	22.0	7.92	0.219	6.26	126
16:43	23.2	6.97	0.214	6.27	111
16:45	21.1	6.69	0.223	6.25	92

Boring: 004-106			Sample Depth: 98.5 ft bgs		
Sample Collection Date: 7/13/2004			Sample Collection Time: 09:45		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
08:59	20.7	10.09	0.211	6.18	114
09:05	20.6	10.11	0.209	6.15	122
09:10	20.6	9.93	0.209	6.13	124
09:18	20.8	9.96	0.212	6.06	128
09:25	20.0	9.86	0.207	5.99	133
09:30	19.9	10.04	0.206	6.01	136
09:33	20.1	10.11	0.208	6.01	135
09:36	20.0	9.96	0.207	6.01	136
09:39	20.0	10.14	0.207	6.00	136
09:42	20.0	9.91	0.208	6.00	136
09:45	19.8	9.93	0.208	6.00	136

Boring 004-107

Boring: 004-107			Sample Depth: 63.5 ft bgs		
Sample Collection Date: 7/14/2004			Sample Collection Time: 10:30		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
09:55	22.3	9.26	0.146	6.03	216
10:00	22.0	10.02	0.147	6.01	210
10:05	21.6	8.57	0.146	6.05	212
10:10	21.6	8.87	0.147	6.06	211
10:13	21.4	9.34	0.147	6.06	211
10:16	21.4	9.44	0.147	6.06	209
10:19	21.7	8.90	0.148	6.06	202
10:22	23.0	7.93	0.147	6.05	198
10:25	21.9	9.79	0.150	6.03	185
10:28	21.2	9.97	0.151	6.04	173
10:30	20.6	10.12	0.151	6.04	168

Boring: 004-107			Sample Depth: 73.5 ft bgs		
Sample Collection Date: 7/14/2004			Sample Collection Time: 12:45*		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
12:48	23.4	7.02	0.228	6.42	80
12:50	24.5	5.78	0.226	6.45	64
12:52	25.3	4.92	0.228	6.49	51
12:53	Pumped dry				

* Due to sample volume concerns, the sample was collected prior to measurements being taken.

Boring: 004-107			Sample Depth: 78.5 ft bgs		
Sample Collection Date: 7/14/2004			Sample Collection Time: 14:30		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
13:30	24.7	9.02	0.213	6.39	146
13:40	20.0	11.19	0.213	6.35	145
13:45	20.4	11.55	0.210	6.33	164
13:50	20.4	11.66	0.212	6.30	170
13:55	20.2	9.62	0.212	6.32	169
14:00	19.6	9.78	0.216	6.29	165
14:08	20.0	9.94	0.219	6.28	160
14:11	19.5	9.98	0.219	6.26	150
14:19	20.5	10.26	0.220	6.25	157
14:25	20.7	11.28	0.221	6.25	150
14:30	20.8	11.42	0.221	6.24	150

Boring 004-107

Boring: 004-107			Sample Depth: 88.5 ft bgs		
Sample Collection Date: 7/14/2004			Sample Collection Time: 16:40		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
16:02	21.7	8.40	0.226	6.43	123
16:04	23.0	8.52	0.224	6.41	106
16:06	22.6	7.92	0.225	6.42	108
16:08	23.1	8.87	0.223	6.42	105
16:10	23.8	7.89	0.224	6.43	102
16:35	20.4	10.30	0.234	6.45	100
16:38	20.3	9.63	0.227	6.47	97
16:40	20.7	8.99	0.228	6.49	86

Boring: 004-107			Sample Depth: 98.5 ft bgs		
Sample Collection Date: 7/14/2004			Sample Collection Time: 18:00		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
17:30	18.8	6.25	0.198	6.36	145
17:35	18.6	6.07	0.198	6.35	140
17:40	18.5	6.62	0.198	6.33	140
17:43	18.4	6.72	0.197	6.33	141
17:46	18.4	6.25	0.197	6.32	142
17:49	18.3	6.00	0.197	6.31	141
17:52	18.4	6.09	0.197	6.31	142
17:55	18.3	6.32	0.197	6.31	141
17:58	18.3	6.01	0.196	6.31	141
18:00	18.2	6.18	0.196	6.31	141

Boring 004-108

Boring: 004-108			Sample Depth: 63.5 ft bgs		
Sample Collection Date: 7/19/2004			Sample Collection Time: 16:00		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
15:08	26.1	8.23	0.230	6.05	113
15:11	25.3	6.16	0.227	6.09	100
15:14	25.5	5.30	0.225	6.12	91
15:17	26.6	5.16	0.224	6.12	89
15:20	24.7	6.39	0.228	6.00	92
15:58	23.4	6.59	0.237	6.07	98
16:00	22.6	6.04	0.232	6.10	84

Boring: 004-108			Sample Depth: 73.5 ft bgs		
Sample Collection Date: 7/19/2004			Sample Collection Time: 17:45		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
17:15	20.2	8.90	0.284	6.09	179
17:20	19.8	8.89	0.284	5.94	170
17:25	19.7	8.66	0.284	5.73	166
17:30	19.5	9.20	0.286	5.66	163
17:33	19.4	9.60	0.286	5.63	161
17:36	19.4	9.00	0.286	5.58	159
17:39	19.4	9.03	0.286	5.56	159
17:42	19.3	9.04	0.286	5.54	159
17:45	19.3	8.62	0.286	5.55	158

Boring: 004-108			Sample Depth: 78.5 ft bgs		
Sample Collection Date: 7/20/2004			Sample Collection Time: 11:40		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
11:05	21.0	8.44	0.211	6.30	151
11:10	20.8	8.66	0.210	6.26	143
11:15	20.7	8.77	0.211	6.22	143
11:20	20.6	8.50	0.212	6.14	144
11:23	20.5	8.53	0.213	6.03	144
11:26	20.6	8.47	0.213	5.98	144
11:29	20.5	8.95	0.214	5.90	145
11:32	20.5	8.75	0.215	5.83	145
11:35	20.6	9.35	0.214	5.79	145
11:38	20.7	9.65	0.215	5.77	145
11:40	20.7	9.14	0.216	5.76	145

Boring 004-108

Boring: 004-108			Sample Depth: 88.5 ft bgs		
Sample Collection Date: 7/20/2004			Sample Collection Time: 13:30		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
12:55	19.5	7.67	0.217	6.12	175
13:00	19.4	7.11	0.217	6.10	167
13:05	19.3	7.33	0.217	6.05	163
13:10	19.2	7.81	0.217	5.99	163
13:13	19.2	7.21	0.217	5.93	164
13:16	19.2	7.23	0.217	5.88	163
13:19	19.2	7.26	0.217	5.81	162
13:22	19.2	7.14	0.217	5.74	163
13:25	19.0	7.83	0.218	5.72	163
13:28	19.0	8.14	0.217	5.70	163
13:30	18.8	7.78	0.217	5.71	163

Boring: 004-108			Sample Depth: 98.5 ft bgs		
Sample Collection Date: 7/20/2004			Sample Collection Time: 16:00		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
14:50	20.4	10.23	0.163	6.21	169
14:55	20.3	9.83	0.164	6.24	142
15:35	21.0	11.02	0.171	6.31	150
15:40	21.2	10.36	0.171	6.26	118
15:43	21.9	9.41	0.170	6.26	115
15:46	20.8	11.87	0.170	6.18	119
15:49	20.1	10.45	0.172	6.27	109
15:52	20.6	10.10	0.171	6.27	109
15:55	21.3	9.73	0.169	6.29	108
15:58	21.6	12.56	0.167	6.35	114
16:00	20.8	10.22	0.174	6.39	107

Boring 004-109

Boring: 004-109			Sample Depth: 68.5 ft bgs		
Sample Collection Date: 7/22/2004			Sample Collection Time: 09:50		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
09:15	21.1	9.54	0.187	6.15	142
09:20	20.8	10.22	0.187	6.15	140
09:25	20.6	10.08	0.187	6.14	138
09:30	20.4	9.73	0.187	6.11	143
09:33	20.3	10.82	0.187	6.10	144
09:36	20.3	10.49	0.187	6.11	145
09:39	20.2	10.51	0.188	6.09	146
09:42	20.2	9.78	0.187	6.09	147
09:45	20.3	11.02	0.187	6.08	147
09:48	20.3	10.82	0.188	6.08	148
09:50	20.2	11.05	0.188	6.07	149

Boring: 004-109			Sample Depth: 78.5 ft bgs		
Sample Collection Date: 7/22/2004			Sample Collection Time: 13:10		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
11:48	23.8	10.21	0.172	6.44	99
11:51	24.5	9.25	0.173	6.49	108
11:54	25.8	7.07	0.170	6.51	93
12:05	22.8	12.24	0.168	6.34	99
12:10	23.0	9.54	0.171	6.37	95
12:13	23.5	9.14	0.171	6.34	92
12:16	23.6	9.41	0.170	6.32	92
12:20	22.1	12.80	0.168	6.26	97
12:23	22.2	9.25	0.172	6.34	85
12:26	22.6	9.22	0.172	6.33	83
12:55	22.0	12.17	0.169	6.29	104
12:58	23.2	11.15	0.170	6.31	120
13:01	25.0	10.21	0.171	6.29	136
13:04	22.7	11.73	0.171	6.29	114
13:07	22.7	10.58	0.172	6.33	105
13:10	22.7	11.61	0.172	6.31	103

Boring 004-109

Boring: 004-109			Sample Depth: 88.5 ft bgs		
Sample Collection Date: 7/22/2004			Sample Collection Time: 14:45		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
14:10	26.6	7.64	0.158	6.35	139
14:15	24.1	11.68	0.159	6.30	136
14:20	23.4	11.84	0.159	6.29	142
14:25	22.6	11.66	0.159	6.28	157
14:28	22.8	11.33	0.159	6.26	154
14:31	23.6	11.37	0.159	6.25	156
14:34	23.5	12.34	0.160	6.23	150
14:37	22.0	12.16	0.159	6.25	136
14:40	21.9	11.72	0.159	6.24	126
14:43	21.8	12.05	0.159	6.23	121
14:45	22.3	12.12	0.159	6.22	122

Boring: 004-109			Sample Depth: 98.5 ft bgs		
Sample Collection Date: 7/22/2004			Sample Collection Time: 16:40		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
16:05	21.7	7.98	0.152	6.33	131
16:10	21.8	8.66	0.150	6.26	124
16:20	21.8	10.05	0.154	6.25	121
16:25	22.2	9.97	0.150	6.22	132
16:28	22.4	9.50	0.150	6.21	135
16:31	22.4	9.94	0.150	6.19	136
16:34	22.1	9.30	0.150	6.19	132
16:40	21.5	9.67	0.151	6.18	129

Boring 004-110

Boring: 004-110			Sample Depth: 63.5 ft bgs		
Sample Collection Date: 7/26/2004			Sample Collection Time: 16:10		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
15:40	20.6	5.25	0.578	5.86	175
15:45	19.7	5.40	0.581	5.85	160
15:50	19.6	5.86	0.581	5.83	150
15:55	19.6	5.87	0.577	5.82	141
15:58	19.7	5.76	0.576	5.80	141
16:01	19.9	5.93	0.577	5.79	140
16:04	19.9	5.98	0.578	5.78	138
16:07	19.0	5.84	0.577	5.79	136
16:10	18.8	5.59	0.578	5.80	134

Boring: 004-110			Sample Depth: 68.5 ft bgs		
Sample Collection Date: 7/26/2004			Sample Collection Time: 17:40		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
17:10	19.0	8.57	5.03	5.97	155
17:15	19.5	7.12	5.04	5.96	159
17:20	18.2	7.48	4.95	5.97	149
17:25	17.9	7.56	5.05	5.94	150
17:28	18.1	8.96	5.07	5.92	155
17:31	18.1	7.99	5.11	5.91	157
17:34	18.2	8.03	5.12	5.90	159
17:37	18.1	8.30	5.13	5.89	161
17:40	18.1	8.62	5.17	5.89	164

Boring: 004-110			Sample Depth: 78.5 ft bgs		
Sample Collection Date: 7/27/2004			Sample Collection Time: 08:45		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
08:15	18.7	10.81	0.203	6.18	163
08:20	18.9	11.11	0.203	6.18	190
08:25	18.9	10.99	0.204	6.17	151
08:30	19.0	10.83	0.205	6.17	119
08:33	19.1	10.80	0.205	6.17	122
08:36	19.1	10.80	0.206	6.17	202
08:39	19.2	10.63	0.206	6.16	204
08:42	19.2	10.81	0.206	6.16	186
08:45	19.2	10.66	0.206	6.16	135

Boring 004-110

Boring: 004-110			Sample Depth: 88.5 ft bgs		
Sample Collection Date: 7/27/2004			Sample Collection Time: 10:10		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
09:35	18.9	7.68	0.182	6.26	132
09:40	18.6	10.86	0.181	6.25	139
09:45	18.7	10.52	0.180	6.23	136
09:50	18.6	10.40	0.180	6.22	136
09:55	18.7	9.33	0.180	6.22	135
09:58	18.6	10.53	0.180	6.21	136
10:01	18.5	10.65	0.179	6.20	139
10:04	18.5	10.60	0.179	6.20	137
10:07	18.5	10.00	0.179	6.20	135
10:10	18.6	9.60	0.180	6.20	138

Boring: 004-110			Sample Depth: 98.5 ft bgs		
Sample Collection Date: 7/27/2004			Sample Collection Time: 14:45		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
12:45	20.1	7.56	0.171	6.09	150
12:50	20.4	7.38	0.170	6.12	146
12:55	19.2	4.74	0.172	6.18	140
13:00	20.2	4.53	0.169	6.14	155
13:05	20.9	6.27	0.171	6.06	169
13:08	20.8	6.00	0.171	6.04	168
13:11	20.3	6.43	0.171	5.97	164
13:47	20.1	6.61	0.179	5.93	151
13:50	21.1	5.47	0.181	5.95	122
13:53	20.6	5.66	0.182	5.94	107
13:56	20.5	4.58	0.183	5.97	95
14:40	22.2	6.74	0.184	6.10	139
14:43	21.8	5.97	0.180	6.03	123
14:45	20.3	6.09	0.182	6.10	107

Boring 210-001

Boring: 210-001			Sample Depth: 58.5 ft bgs		
Sample Collection Date: 6/15/2004			Sample Collection Time: NA		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
12:08	23.1	1.11	0.261	6.08	-54
12:11	23.1	1.24	0.259	6.08	-61
12:14	Pumped dry – abandoned effort to sample at 58.5 ft bgs.				

Boring: 210-001			Sample Depth: 63.5 ft bgs		
Sample Collection Date: 6/15/2004			Sample Collection Time: 14:06		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
12:52	21.1	9.20	0.197	5.95	NA
13:00	21.1	8.87	0.198	5.80	NA
13:10	22.5	8.11	0.200	5.85	NA
13:20	22.6	7.35	0.198	5.88	101
13:30	23.1	7.89	0.198	5.79	108
14:00	22.1	4.45	0.213	6.02	74
14:06	21.6	8.05	0.200	5.74	120

Boring: 210-001			Sample Depth: 68.5 ft bgs		
Date: 6/16/2004			Sample Collection Time: NA		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
08:30	21.5	10.90 (Variable)	0.167	5.68	88
08:40	21.0	10.99 (Variable)	0.167	6.00	95
08:50	20.8	10.92 (Variable)	0.170	5.93	97
09:05	20.6	9.35 (Variable)	0.171	5.94	108
Pump developed problems – no further purging/sampling.					

Boring: 210-001			Sample Depth: 68.5 ft bgs		
Sample Collection Date: 6/17/2004			Sample Collection Time: 09:03		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
08:25	20.2	6.02	0.184	6.04	-10
08:30	19.6	7.40 (Variable)	0.180	6.02	13
08:35	19.2	8.40 (Variable)	0.177	5.98	44
08:40	19.0	8.61 (Variable)	0.175	5.97	53
08:45	18.8	9.0 (Variable)	0.175	5.96	67
08:50	19.4	9.0 (Variable)	0.175	5.95	70
08:55	18.9	9.1 (Variable)	0.175	5.95	75
08:58	19.0	9.1 (Variable)	0.174	5.93	84
09:01	19.0	9.4 (Variable)	0.174	5.92	87
09:05	19.0	9.4 (Variable)	0.175	5.93	85

Boring 210-001

Boring: 210-001			Sample Depth: 78.5 ft bgs		
Sample Collection Date: 6/17/2004			Sample Collection Time: 10:14		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
09:40	20.7	7.8 (Variable)	0.191	6.17	86
09:45	20.3	8.2 (Variable)	0.192	6.18	87
09:50	20.6	7.52	0.192	6.17	82
09:55	20.3	7.9 (Variable)	0.191	6.18	80
10:00	20.4	7.6 (Variable)	0.192	6.18	77
10:05	19.6	8.0 (Variable)	0.191	6.19	79
10:08	20.2	7.7 (Variable)	0.192	6.18	77
10:11	20.2	7.6 (Variable)	0.194	6.17	78
10:16	20.0	7.9 (Variable)	0.194	6.17	82

Boring: 210-001			Sample Depth: 88.5 ft bgs		
Sample Collection Date: 6/17/2004			Sample Collection Time: 12:40		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
12:05	20.0	7.3 – 7.9	0.236	6.17	70
12:10	19.9	8.8 – 9.1	0.234	6.18	79
12:15	19.5	8.6 – 8.7	0.233	6.15	80
12:20	19.9	8.6 – 8.7	0.234	6.13	80
12:26	19.8	8.64	0.234	6.12	80
12:29	20.6	8.3 – 8.4	0.233	6.11	77
12:32	20.2	7.8 – 7.9	0.236	6.10	76
12:35	19.8	8.5 – 8.6	0.236	6.10	76
12:40	19.6	8.3 – 8.4	0.236	6.11	78

Boring 210-001

Boring: 210-001			Sample Depth: 93.5 ft bgs		
Sample Collection Date: 6/17/2004			Sample Collection Time: 14:49		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
13:30	19.3	9.4 – 10.4	0.232	6.20	92
13:35	18.7	8.9 – 9.2	0.100	6.18	96
13:40	18.9	10.7 – 10.8	0.098	6.17	96
13:45	18.8	10.73 – 10.79	0.098	6.16	101
13:50	18.9	10.77 – 10.83	0.097	6.16	106
13:55	19.5	10.42 – 10.54	0.096	6.15	105
14:00	19.9	9.6 – 9.8	0.238	6.15	93
14:03	19.8	9.2 – 9.3	0.236	6.16	94
14:06	19.8	8.9 – 9.1	0.236	6.16	94
14:25	20.2	8.82 – 8.89	0.233	6.16	89
14:30	19.7	8.76 – 8.82	0.234	6.18	83
14:40	19.4	8.68 – 8.80	0.234	6.18	89
14:43	19.0	9.35 – 9.40	0.235	6.18	93
14:46	19.4	8.67 – 8.83	0.233	6.19	88
14:51	19.8	8.55 – 8.62	0.233	6.18	86

Boring 210-002

Boring: 210-002			Sample Depth: 58.5 ft bgs		
Sample Collection Date: 6/10/2004			Sample Collection Time: 16:43		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
16:19	23.3	3.86 (Variable)	0.108	5.92	102
16:22	22.6	4.35 (Variable)	0.104	5.87	120
16:25	22.4	4.60 (Variable)	0.102	5.77	122
16:28	22.0	4.65 (Variable)	0.101	5.85	124
16:31	21.8	4.86 (Variable)	0.100	5.82	128
16:34	21.8	4.78 (Variable)	0.099	5.65	134
16:37	22.0	4.90 (Variable)	0.098	5.62	139
16:40	22.1	4.90 (Variable)	0.096	5.62	157
16:43	22.1	4.80 (Variable)	0.096	5.60	161

Boring: 210-002			Sample Depth: 68.5 ft bgs		
Sample Collection Date: 6/11/2004			Sample Collection Time: 09:17		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
08:15	21.3	9.02	0.128	6.36	124
08:18	22.0	8.23	0.126	6.32	137
08:21	23.5	7.62	0.125	6.30	130
08:24	24.5	7.94	0.126	6.29	128
08:30	22.4	8.85	0.132	6.31	109
08:33	20.7	9.92	0.128	6.26	133
08:45	20.5	10.31	0.126	6.19	122
09:00	20.7	9.92	0.127	6.07	121
09:12	21.0	10.09	0.127	6.07	119
09:17	21.0	9.74	0.128	6.09	118

Boring: 210-002			Sample Depth: 78.5 ft bgs		
Sample Collection Date: 6/11/2004			Sample Collection Time: 11:00		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
10:00	26.0	9.16	0.186	6.26	111
10:03	22.1	10.02	0.192	6.25	108
10:15	21.6	9.96	0.188	6.19	114
10:30	21.1	9.82	0.187	6.16	117
10:46	21.4	9.83	0.186	6.16	113
10:50	21.5	9.88	0.186	6.16	113
10:54	21.5	9.87	0.185	6.16	111
11:00	21.5	10.06	0.187	6.17	112

Boring 210-002

Boring: 210-002			Sample Depth: 88.5 ft bgs		
Sample Collection Date: 6/11/2004			Sample Collection Time: 13:15		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
12:35	21.8	10.38	0.224	6.12	126
12:45	21.2	9.64	0.223	5.95	114
12:55	21.0	9.24	0.222	5.80	118
13:00	21.2	8.96	0.223	5.72	120
13:05	21.1	8.74	0.223	5.71	126
13:10	21.0	8.63	0.223	5.71	122
13:15	20.7	8.25	0.225	5.74	121

Boring: 210-002			Sample Depth: 98.5 ft bgs		
Sample Collection Date: 6/11/2004			Sample Collection Time: 14:14		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
13:45	23.7	5.98	0.221	6.17	141
13:50	23.7	5.54	0.218	6.13	125
13:55	23.8	5.60	0.219	6.16	123
14:00	23.6	5.65	0.219	6.14	163
14:03	23.3	5.51	0.220	6.13	122
14:06	23.2	5.56	0.220	6.13	119
14:09	23.3	5.49	0.219	6.11	117
14:14	23.1	5.70	0.223	6.14	114

Boring 210-003

Boring: 210-003			Sample Depth: 73.5 ft bgs		
Sample Collection Date: 6/18/2004			Sample Collection Time: 14:31		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
13:50	24.0	8.50 – 8.73	0.227	5.85	142
13:55	23.8	8.63 – 8.87	0.227	5.97	140
14:00	22.0	9.29 – 9.40	0.227	5.76	136
14:05	21.9	9.25 – 9.46	0.227	5.61	135
14:10	21.6	9.22 – 9.36	0.227	5.51	136
14:15	21.5	9.35 – 9.51	0.227	5.46	137
14:19	21.3	9.53 – 9.68	0.226	5.44	136
14:22	21.5	9.40 – 9.45	0.226	5.44	136
14:25	21.4	9.55 – 9.65	0.226	5.44	137
14:28	21.1	9.69 – 9.76	0.227	5.43	137
14:36	21.2	9.31 – 9.42	0.225	5.47	137

Boring: 210-003			Sample Depth: 78.5 ft bgs		
Sample Collection Date: 6/21/2004			Sample Collection Time: 13:35		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
12:45	21.3	6.80 – 6.92	0.330	6.01	131
12:50	21.2	7.73 – 7.87	0.325	6.01	132
12:55	20.9	8.77 – 8.87	0.327	5.97	131
13:00	21.6	7.41 – 7.50	0.322	5.95	131
13:05	22.3	6.27 – 6.30	0.326	5.93	125
13:10	21.7	7.96 – 8.06	0.327	5.90	125
13:15	20.7	8.23 – 8.27	0.328	5.90	124
13:20	20.9	7.69 – 7.72	0.327	5.89	122
13:23	21.3	7.46 – 7.48	0.326	5.88	121
13:26	21.3	7.39 – 7.45	0.329	5.87	114
13:29	21.1	7.37 – 7.42	0.329	5.86	112
13:32	21.2	7.12 – 7.16	0.330	5.85	111
13:35	21.2	7.10 – 7.16	0.330	5.83	114
13:42	21.2	7.15 – 7.22	0.334	5.82	114

Boring 210-003

Boring: 210-003			Sample Depth: 88.5 ft bgs		
Sample Collection Date: 6/21/2004			Sample Collection Time: 14:59		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
14:15	19.7	9.60 – 9.66	0.300	5.95	133
14:20	19.3	9.71 – 9.77	0.301	5.93	136
14:25	19.5	9.51 – 9.54	0.298	5.91	139
14:30	19.4	9.35 – 9.44	0.299	5.85	134
14:35	19.4	9.27 – 9.33	0.298	5.82	128
14:40	19.1	9.55 – 9.67	0.298	5.78	137
14:45	19.0	9.33 – 9.37	0.298	5.78	139
14:50	19.1	9.45 – 9.51	0.298	5.78	137
14:53	19.5	9.32 – 9.36	0.296	5.79	131
14:56	19.0	9.49 – 9.53	0.296	5.80	132
14:59	19.0	9.31 – 9.37	0.295	5.81	131
15:04	18.8	9.27 – 9.37	0.297	5.82	135

Boring: 210-003			Sample Depth: 98.5 ft bgs		
Sample Collection Date: 6/21/2004			Sample Collection Time: 16:46		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
16:15	20.7	5.99 – 6.10	0.205	6.10	97
16:20	20.6	6.18 – 6.24	0.202	6.10	97
16:25	20.1	6.24 – 6.27	0.202	6.08	97
16:30	20.0	6.16 – 6.22	0.201	6.07	99
16:35	20.4	6.12 – 6.16	0.202	6.06	98
16:40	20.1	6.09 – 6.12	0.201	6.05	99
16:43	20.1	6.06 – 6.10	0.202	6.04	99
16:46	20.1	6.03 – 6.06	0.201	6.04	100
16:51	19.8	6.03 – 6.05	0.202	6.03	102

Boring 210-004

Boring: 210-004			Sample Depth: 63.5 ft bgs		
Sample Collection Date: 6/22/2004			Sample Collection Time: 17:07		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
16:10	19.1	8.78 – 9.00	0.238	6.51	103
16:15	18.9	8.87 – 9.02	0.241	6.51	90
16:20	18.7	8.99 – 9.19	0.241	6.36	88
16:25	18.5	8.76 – 9.04	0.241	6.33	83
16:30	18.5	8.95 – 9.16	0.242	6.33	82
16:35	18.4	8.83 – 9.19	0.243	6.29	78
16:45	18.4	8.84 – 8.96	0.242	6.17	78
16:50	18.4	8.90 – 9.14	0.242	6.13	80
16:55	18.3	9.12 – 9.22	0.243	6.11	89
16:58	18.4	8.65 – 9.15	0.244	6.09	84
17:01	18.4	8.23 – 8.91	0.245	6.09	84
17:04	18.4	8.53 – 8.59	0.244	6.09	81
17:09	18.7	7.33 – 7.41	0.243	6.10	83

Boring: 210-004			Sample Depth: 68.5 ft bgs		
Sample Collection Date: 6/23/2004			Sample Collection Time: 09:41		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
09:00	18.5	6.88 – 7.92	0.120	6.21	220
09:05	18.2	7.00 – 7.10	0.120	6.20	208
09:10	18.0	6.91 – 7.04	0.120	6.11	195
09:15	18.0	6.71 – 6.80	0.120	6.06	190
09:20	18.0	6.71 – 6.90	0.120	5.99	178 – 185
09:25	18.0	6.67 – 6.81	0.120	5.98	169 – 172
09:30	18.1	6.67 – 6.75	0.120	6.00	168 – 173
09:33	18.0	6.58 – 6.69	0.120	6.01	162 – 165
09:36	18.0	6.41 – 6.66	0.120	6.01	156 – 159
09:39	18.0	6.63 – 6.71	0.121	5.97	152
09:43	18.0	6.74 – 6.79	0.121	5.95	143

Boring 210-004

Boring: 210-004			Sample Depth: 78.5 ft bgs		
Sample Collection Date: 6/23/2004			Sample Collection Time: 10:47		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
10:15	18.8	6.38 – 6.47	0.113	5.98	181
10:20	18.5	6.39 – 6.53	0.112	5.95	183
10:25	18.4	6.40 – 6.47	0.112	5.91	180
10:30	18.2	6.32 – 6.40	0.112	5.87	180
10:36	18.1	6.32 – 6.38	0.112	5.87	178
10:39	18.1	6.20 – 6.43	0.112	5.87	177
10:42	18.0	6.33 – 6.41	0.112	5.88	177
10:45	18.1	6.22 – 6.29	0.112	5.91	179
10:49	18.0	6.19 – 6.25	0.112	5.91	179

Boring: 210-004			Sample Depth: 88.5 ft bgs		
Sample Collection Date: 6/23/2004			Sample Collection Time: 12:59		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
12:30	18.9	6.52 – 6.56	0.235	6.05	174
12:35	18.4	6.58 – 6.62	0.235	5.96	158
12:40	18.0	6.51 – 6.58	0.236	5.81	150
12:50	17.9	6.46 – 6.51	0.235	5.83	145
12:53	18.0	6.37 – 6.47	0.235	5.81	144
12:56	18.0	6.17 – 6.33	0.234	5.84	143
13:00	17.8	6.20 – 6.27	0.235	5.83	143

Boring: 210-004			Sample Depth: 98.5 ft bgs		
Sample Collection Date: 6/23/2004			Sample Collection Time: 13:59		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
13:30	18.4	3.31 – 3.32	0.189	6.04	130
13:35	18.2	3.22 – 3.26	0.189	6.02	128
13:40	18.1	3.12 – 3.16	0.189	5.99	126
13:45	18.0	3.05 – 3.10	0.188	6.01	126
13:50	18.0	2.98 – 3.01	0.189	6.02	124
12:53	18.0	2.92 – 2.98	0.189	6.01	123
12:56	18.0	2.85 – 2.93	0.188	6.02	123
14:02	18.0	2.75 – 2.82	0.187	6.02	123

Boring 210-004

Boring: 210-004			Sample Depth: 106.5 ft bgs		
Sample Collection Date: 6/23/2004			Sample Collection Time: 15:48		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
14:55	20.0	3.19 – 3.77	0.185	6.10	101
15:00	20.2	2.78 – 2.93	0.186	6.13	95
15:05	20.3	2.74 – 2.79	0.186	6.10	92
15:10	20.3	2.80 – 2.86	0.186	6.05	89
15:15	20.2	2.85 – 2.90	0.189	6.09	89
15:20	19.9	2.82 – 2.85	0.180	6.09	88
15:25	20.0	2.80 – 2.86	0.167	6.10	87
15:30	19.8	2.68 – 2.76	0.155	6.11	85
15:35	19.9	2.69 – 2.72	0.152	6.12	85
15:40	20.0	2.61 – 2.68	0.150	6.12	84
15:43	19.9	2.60 – 2.65	0.150	6.12	83
15:46	19.8	2.63 – 2.69	0.149	6.12	83
15:51	20.3	2.41 – 2.61	0.147	6.13	80

Boring 210-005

Boring: 210-005			Sample Depth: 68.5 ft bgs		
Sample Collection Date: 6/03/2004			Sample Collection Time: 12:45		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
12:17	20.6	6.65	0.384	6.16	70
12:20	20.2	7.90	0.385	6.18	88
12:23	20.0	7.95	0.386	6.20	93
12:26	19.9	8.00	0.386	6.20	102
12:29	19.9	8.57	0.387	6.18	107
12:32	19.5	8.25	0.388	6.20	110
12:35	19.0	8.5 (Variable)	0.389	6.19	110
12:38	19.5	8.1 (Variable)	0.390	6.18	114
12:41	19.5	8.6 (Variable)	0.391	6.19	108
12:45	19.6	7.8	0.392	6.21	113

Boring: 210-005	Sample Depth: 84 ft bgs
Sample Collection Date: 6/08/2004	Sample Collection Time: 09:20
Unable to purge sufficient volume to support collection of water quality parameters.	

Boring: 210-005			Sample Depth: 90 ft bgs		
Sample Collection Date: 6/08/2004			Sample Collection Time: 14:44		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
13:57	26.7	2.26	0.383	6.33	-52
14:00	24.1	2.42	0.254	6.37	-56
14:03	23.9	2.02	0.253	6.30	-62
14:07	23.6	2.04	0.253	6.34	-63
14:09	21.8	2.69	0.242	6.29	-75
14:13	21.3	2.50	0.248	6.29	-75
14:17	21.5	2.41	0.251	6.27	-70
14:21	20.6	2.45	0.249	6.25	-66
14:24	21.0	2.56	0.247	6.23	-69
14:29	21.9	2.90	0.244	6.21	-55
14:31	21.0	2.84	0.244	6.19	-62
14:34	21.2	2.96	0.240	6.19	-54
14:37	21.8	2.90	0.240	6.20	-38
14:41	22.0	2.90	0.240	6.20	-27
14:44	21.0	3.00	0.240	6.20	-12

Boring 210-005

Boring: 210-005			Sample Depth: 100 ft bgs		
Sample Collection Date: 6/08/2004			Sample Collection Time: 16:52		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
16:07	24.0	1.40	0.240	6.40	-20
16:10	23.5	0.85	0.236	6.37	-42
16:13	22.8	1.05	0.235	6.34	-53
16:16	22.4	1.06	0.243	6.39	-67
16:20	21.7	1.43	0.237	6.38	-61
16:23	21.1	2.03	0.217	6.30	-13
16:26	21.7	1.74	0.219	6.28	-8
16:29	21.5	2.08	0.221	6.34	-10
16:35	21.8	0.73	0.271	6.46	-146
16:38	21.4	1.84	0.233	6.38	-45
16:41	20.9	1.59	0.226	6.33	-47
16:44	20.5	1.49	0.224	6.33	-43
16:49	20.4	1.51	0.227	6.34	-49
16:52	20.6	1.49	0.229	6.33	-48

Boring 210-006

Boring: 210-006			Sample Depth: 60 ft bgs		
Sample Collection Date: 5/27/2004			Sample Collection Time: 13:00		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
12:47	26.1	7.80	0.363	6.7	NA
12:50	26.1	8.03	0.366	6.5	NA
12:53	23.8	8.41	0.377	6.6	NA
12:56	22.8	8.69	0.382	6.6	NA
12:59	23.1	8.60	0.385	6.6	NA
13:00	23.1	8.71	0.393	6.5	NA

Boring: 210-006			Sample Depth: 70 ft bgs		
Sample Collection Date: 5/27/2004			Sample Collection Time: 16:02		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
14:03	24.0	12.40	0.211	6.50	68
14:06	23.0	12.40	0.208	6.46	70
14:09	22.9	12.43	0.210	6.44	71
14:12	22.6	12.53	0.211	6.43	71
14:15	22.7	12.57	0.212	6.43	74
14:25	22.9	11.81	0.213	6.37	74
14:30	21.3	--	0.213	6.37	68
15:30	20.6	12.40	0.211	6.50	71
15:33	21.7	12.14	0.209	6.52	73
15:36	20.9	13.64	0.218	6.44	80
15:39	19.6	13.61	0.216	6.44	80
15:42	19.5	13.35	0.216	6.45	80
15:43	19.5	13.35	0.216	6.45	80
15:52	18.8	13.75	0.218	6.51	81
15:55	19.1	13.35	0.217	6.51	77
15:58	19.3	13.20	0.218	6.50	76
16:01	19.4	13.12	0.217	6.48	77
16:02	19.3	13.03	0.218	6.47	77

Boring: 210-006			Sample Depth: 80 ft bgs		
Sample Collection Date: 5/28/2004			Sample Collection Time: 08:03		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
07:56	18.9	2.09	0.208	6.64	22
07:59	19.1	1.99	0.197	6.65	16
08:02	19.3	1.90	0.191	6.68	14
08:03	19.4	1.86	0.188	6.69	14

Boring 210-006

Boring: 210-006			Sample Depth: 90 ft bgs		
Sample Collection Date: 6/01/2004			Sample Collection Time: 10:50		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
10:15	22.7	NA	0.225	6.55	43
10:20	21.6	1.69	0.225	6.65	31
10:25	21.5	2.39	0.224	6.55	27
10:30	21.3	1.86	0.220	6.55	32
10:35	21.3	2.05	0.218	6.55	51
10:40	21.0	1.56	0.220	6.55	19
10:43	21.6	1.85	0.218	6.55	52
10:46	21.3	1.75	0.220	6.55	48
10:49	20.6	1.75	0.215	6.55	57

Boring: 210-006			Sample Depth: 100 ft bgs		
Sample Collection Date: 6/01/2004			Sample Collection Time: 14:06		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
13:25	29.2	0.05	0.300	7.49	-214
13:39	27.2	0.66	0.254	6.80	-214
13:47	27.1	0.84	0.280	6.87	-387
13:51	24.6	0.97	0.259	6.81	-350
13:54	24.6	1.18	0.255	6.78	-130
13:57	24.5	1.23	0.247	6.75	-50
14:00	24.5	1.24	0.244	6.73	-21
14:04	25.5	1.23	0.244	6.71	-13

Boring 210-007

Boring: 210-007			Sample Depth: 65 ft bgs		
Sample Collection Date: 5/14/2004			Sample Collection Time: 14:31		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
14:14	19.5	4.50	0.207	6.05	79
14:21	19.3	4.46	0.206	6.04	74
14:24	19.2	4.04	0.208	6.04	68
14:27	19.1	4.07	0.208	6.03	70
14:30	19.1	4.07	0.208	6.05	69
14:31	19.1	4.07	0.208	6.03	69

Boring: 210-007			Sample Depth: 70 ft bgs		
Sample Collection Date: 5/17/2004			Sample Collection Time: 15:56		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
15:46	21.5	NA	NA	5.98	88
15:49	21.6	NA	NA	6.02	87
15:52	21.4	NA	NA	6.02	86
15:55	21.5	NA	NA	6.03	86
15:56	21.6	NA	NA	6.03	86

Boring: 210-007			Sample Depth: 80 ft bgs		
Sample Collection Date: 5/19/2004			Sample Collection Time: 09:42		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
09:11	22.0	8.20	0.130	6.00	55
09:14	22.6	8.17	0.126	5.96	55
09:17	23.6	7.97	0.103	5.70	55
09:20	23.8	8.16	0.124	5.90	60
09:23	23.6	8.01	0.073	5.52	60
09:26	23.8	8.00	0.140	5.94	60
09:29	22.3	7.88	0.138	5.99	55
09:32	22.0	7.90	0.130	6.03	60
09:35	23.7	7.36	0.119	6.07	65
09:37	24.7	7.43	0.125	5.90	65
09:40	23.1	7.58	0.128	5.90	70
09:42	23.9	7.46	0.128	5.90	70

Boring 210-007

Boring: 210-007			Sample Depth: 90 ft bgs		
Sample Collection Date: 5/25/2004			Sample Collection Time: 10:55		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
10:25	21.4	NA	0.291	6.11	-7
10:31	20.5	NA	0.193	6.05	-15
10:34	20.3	NA	0.210	6.14	-102
10:38	20.0	NA	0.219	6.17	-132
10:41	20.5	NA	0.201	6.09	-67
10:44	20.5	NA	0.213	6.10	-105
10:47	20.3	NA	0.217	6.11	-127
10:58	20.4	NA	0.218	6.11	-134

Boring: 210-007			Sample Depth: 100 ft bgs		
Sample Collection Date: 5/25/2004			Sample Collection Time: 14:30		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
13:49	21.1	NA	0.220	6.23	-40
13:52	21.8	NA	0.221	6.23	-20
13:55	22.0	NA	0.227	6.29	-55
13:58	20.5	NA	0.218	6.26	-77
14:01	20.3	NA	0.218	6.28	-122
14:04	20.8	NA	0.214	6.29	-69
14:07	21.4	NA	0.207	6.28	-42
14:11	21.5	NA	0.230	6.34	-102
14:15	20.8	NA	0.219	6.30	-98
14:18	20.4	NA	0.201	6.24	-47
14:21	20.0	NA	0.205	6.28	-66
14:24	20.0	NA	0.208	6.27	-81
14:27	20.0	NA	0.205	6.27	-92
14:36	20.4	NA	0.205	6.23	-114

Boring 210-008

Boring: 210-008			Sample Depth: 68.5 ft bgs		
Sample Collection Date: 6/30/2004			Sample Collection Time: 10:42		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
10:18	21.1	9.30 – 10.20	0.154	6.30	184
10:23	20.8	9.50 – 9.75	0.156	6.27	163
10:28	21.1	9.60 – 9.75	0.156	6.25	156
10:33	21.0	9.65 – 9.75	0.156	6.23	149
10:36	20.9	9.55 – 9.69	0.157	6.23	143
10:39	20.7	9.62 – 9.69	0.158	6.22	142
10:42	20.6	9.63 – 9.70	0.158	6.22	138

Boring: 210-008			Sample Depth: 78.5 ft bgs		
Sample Collection Date: 6/30/2004			Sample Collection Time: 12:51		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
12:25	21.1	4.08 – 4.20	0.259	6.12	104
12:30	20.0	5.00 – 5.08	0.254	6.05	96
12:35	19.8	5.14 – 5.19	0.253	6.06	96
12:40	20.1	5.20 – 5.32	0.250	6.03	97
12:45	20.0	5.23 – 5.31	0.250	6.01	97
12:48	20.3	5.23 – 5.27	0.250	6.00	97
12:51	20.0	5.23 – 5.28	0.249	5.99	98

Boring: 210-008			Sample Depth: 85 ft bgs		
Sample Collection Date: 6/30/2004			Sample Collection Time: 14:47		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
14:05	19.5	11.30 – 11.40	0.265	6.17	114
14:10	19.4	11.11 – 11.25	0.265	6.11	115
14:15	19.3	10.70 – 10.84	0.264	6.07	115
14:20	19.3	10.95 – 11.07	0.264	6.02	115
14:25	19.3	10.84 – 10.95	0.264	5.94	116
14:28	19.2	10.85 – 10.90	0.264	5.92	115
14:31	19.3	10.78 – 10.80	0.263	5.87	115
14:34	19.6	10.68 – 10.71	0.262	5.85	116
14:37	19.7	10.50 – 10.61	0.264	5.81	116
14:40	19.7	10.54 – 10.60	0.264	5.78	116
14:43	19.5	10.52 – 10.60	0.265	5.76	117
14:46	19.4	10.45 – 10.53	0.264	5.74	117
14:47	19.1	10.49 – 10.55	0.265	5.73	117

Boring 210-009

Boring: 210-009			Sample Depth: 64.5 ft bgs		
Sample Collection Date: 7/01/2004			Sample Collection Time: 10:50		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
10:20	20.2	9.50 – 9.60	0.209	6.26	116
10:25	20.1	9.60 – 9.72	0.209	6.20	113
10:30	19.9	9.61 – 9.72	0.208	6.20	111
10:35	19.9	9.58 – 9.64	0.208	6.19	113
10:40	19.9	9.41 – 9.52	0.208	6.15	111
10:43	19.9	9.43 – 9.50	0.207	6.14	111
10:46	19.7	9.31 – 9.40	0.207	6.13	112
10:49	19.8	9.34 – 9.40	0.207	6.12	109
10:50	19.8	9.34 – 9.40	0.207	6.12	110

Boring: 210-009			Sample Depth: 70 ft bgs		
Sample Collection Date: 7/01/2004			Sample Collection Time: 12:52		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
12:20	19.5	10.50 – 10.60	0.229	6.17	116
12:25	19.2	9.76 – 9.85	0.228	6.17	117
12:30	18.9	10.00 – 10.20	0.227	6.08	122
12:35	18.8	10.15 – 10.19	0.226	6.08	118
12:40	18.7	10:08 – 10:15	0.225	6.06	118
12:45	18.6	10:14 – 10:23	0.224	6.03	119
12:48	18.7	10:16 – 10:27	0.224	6.01	118
12:51	18.7	10:14 – 10:20	0.223	6.00	122
12:52	18.7	10:16 – 10:23	0.223	6.00	123

Boring: 210-009			Sample Depth: 80 ft bgs		
Sample Collection Date: 7/01/2004			Sample Collection Time: 14:02		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
13:45	18.7	5.73 – 5.76	0.271	5.99	185
13:50	18.4	5.73 – 5.75	0.269	5.99	190
13:55	18.5	5.51 – 5.56	0.267	5.98	185
13:58	18.3	5.52 – 5.56	0.267	5.97	174
14:01	18.4	5.50 – 5.52	0.267	5.97	176
14:02	18.3	5.50 – 5.52	0.267	5.97	173

Boring 210-009

Boring: 210-009			Sample Depth: 85 ft bgs		
Sample Collection Date: 7/01/2004			Sample Collection Time: 15:26		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
14:40	17.8	11.16 – 11.34	0.264	5.99	137
14:45	17.9	11.03 – 11.16	0.265	5.98	127
14:50	18.4	8.47 – 8.58	0.266	6.00	112
14:55	17.6	11.15 – 11.22	0.260	5.94	134
15:00	17.6	11.15 – 11.22	0.259	5.92	137
15:03	17.6	11.13 – 11.16	0.259	5.91	136
15:06	17.6	11.09 – 11.16	0.259	5.90	136
15:09	17.6	10.80 – 10.90	0.258	5.90	136
15:12	17.6	10.80 – 10.90	0.258	5.88	135
15:15	17.7	10.48 – 10.55	0.256	5.86	135
15:20	17.7	10.44 – 10.55	0.255	5.86	137
15:23	17.7	10.42	0.257	5.86	136
15:26	17.7	10.44	0.257	5.85	134

Boring 210-010

Boring: 210-010			Sample Depth: 63.5 ft bgs		
Sample Collection Date: 7/07/2004			Sample Collection Time: 12:10		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
11:26	22.0	6.48	0.163	5.96	108
11:32	22.3	6.34	0.162	5.77	110
11:37	21.8	6.48	0.162	5.57	112
11:42	21.3	6.46	0.160	5.47	112
11:48	22.1	6.29	0.161	5.36	111
11:55	21.8	6.22	0.161	5.32	111
12:00	22.1	6.23	0.161	5.31	112
12:03	21.8	6.40	0.162	5.31	113
12:06	21.9	6.19	0.161	5.32	111
12:09	21.1	6.27	0.162	5.32	112
12:10	21.1	6.19	0.162	5.33	111

Boring: 210-010			Sample Depth: 73.5 ft bgs		
Sample Collection Date: 7/07/2004			Sample Collection Time: 15:20		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
13:25	24.1	11.63	0.167	6.12	128
13:55	23.0	10.38	0.171	6.13	84
14:01	20.7	10.73	0.171	6.21	85
14:07	19.8	12.35	0.162	6.11	124
14:13	19.5	12.36	0.160	6.05	131
14:18	20.0	12.27	0.159	6.05	133
14:24	23.1	9.55	0.160	6.15	131
14:57	21.2	8.92	0.176	6.23	71
15:00	20.5	10.41	0.167	6.04	102
15:03	20.5	11.01	0.164	5.77	113
15:06	20.2	11.05	0.163	5.68	116
15:09	20.2	11.15	0.162	5.68	118
15:12	20.1	11.19	0.162	5.71	119
15:16	20.1	11.22	0.162	5.79	120
15:20	20.2	11.19	0.161	5.82	121

Boring 210-010

Boring: 210-010			Sample Depth: 78.5 ft bgs		
Sample Collection Date: 7/07/2004			Sample Collection Time: 17:20		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
16:00	20.2	11.70	0.180	5.94	133
16:10	19.1	11.50	0.178	5.79	126
16:20	19.6	11.09	0.179	5.72	129
16:54	19.1	9.54	0.191	6.10	87
16:59	19.2	11.30	0.179	5.85	127
17:02	19.1	11.33	0.179	5.84	129
17:06	19.2	11.23	0.178	5.80	129
17:09	19.1	11.14	0.179	5.79	128
17:12	19.1	11.19	0.179	5.77	126
17:15	19.1	11.15	0.179	5.75	126
17:20	19.0	11.22	0.179	5.74	126

Boring: 210-010			Sample Depth: 88.5 ft bgs		
Sample Collection Date: 7/08/2004			Sample Collection Time: 11:30		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
08:50	18.1	2.54	0.429	5.88	120
08:55	17.8	2.59	0.426	5.79	126
09:02	17.8	2.58	0.424	5.78	121
09:30	17.6	2.75	0.424	5.58	123
09:48	17.6	2.93	0.425	5.54	120
10:00*	18.3	0.69	0.316	6.02	122
10:17	17.9	0.60	0.307	5.93	120
10:25	17.8	0.51	0.307	5.91	118
10:35	18.1	0.52	0.306	5.91	116
10:40	18.2	0.45	0.307	5.98	113
10:47	18.3	0.44	0.307	6.10	111
10:55	18.3	0.46	0.309	6.12	110
10:58	18.0	0.48	0.308	6.11	109
11:01	18.3	0.47	0.308	6.13	108
11:04	18.4	0.45	0.308	6.16	107
11:16	18.0	0.50	0.309	5.92	109
11:20	18.5	0.42	0.311	6.01	98
11:23	18.5	0.38	0.311	6.06	97
11:26	18.6	0.40	0.309	6.12	98
11:29	18.8	0.40	0.309	6.17	99
11:30	19.0	0.37	0.308	6.17	100

*Water quality meter replaced at 10:00.

Boring 210-010

Boring: 210-010			Sample Depth: 94 ft bgs		
Sample Collection Date: 7/08/2004			Sample Collection Time: 14:20		
Time	**Temperature**	**Dissolved Oxygen**	**Conductivity**	**pH**	**Eh**
	(°C)	(mg/L)	(mS/cm)	(SU)	(mV)
12:45	19.8	0.75	0.140	6.06	140
12:50	20.5	0.90	0.141	6.02	125
12:55	19.4	0.47	0.136	5.95	128
13:00	19.1	0.44	0.137	5.98	125
13:05	19.5	0.54	0.140	5.98	119
13:10	19.1	0.37	0.137	5.97	121
13:15	19.2	0.24	0.136	5.93	107
13:22	19.3	0.39	0.139	6.13	105
13:55	19.9	0.40	0.137	6.26	109
13:58	20.2	0.31	0.140	6.20	110
14:01	19.9	0.22	0.140	6.16	107
14:04	19.9	0.24	0.139	6.11	107
14:07	19.9	0.18	0.140	6.09	104
14:10	19.9	0.18	0.140	6.08	103
14:13	20.0	0.16	0.140	6.10	102
14:16	19.9	0.12	0.140	6.11	101
14:19	20.0	0.13	0.139	6.12	100
14:20	20.0	0.16	0.139	6.13	100

THIS PAGE INTENTIONALLY LEFT BLANK.

WELL DEVELOPMENT LOGS

THIS PAGE INTENTIONALLY LEFT BLANK.

MW414 Well Development Log

Time	Volume Removed (gal)	Water Level (ft BTOC*)	Turbidity (TU)	Temp (°C)	pH (SU)	Conductivity (mS/cm)	Remarks
9/14/04							
16:03	0	45.90	--	--	--	--	Began pumping (~2 gal/min), pump set @ 4 ft above base of screen
16:10	--	--	--	--	--	--	Lowered pump to base of screen
17:28	200	--	--	--	--	--	Ceased pumping
9/15/04							
14:15	--	--	--	--	--	--	Resumed pumping (~2 gal/min)
14:29	--	47.82	--	--	--	--	--
14:34	210	47.78	78	17.3	6.79	0.214	--
14:37	216	47.78	250	17.2	6.97	0.214	--
14:40	--	47.76	340	17.2	6.88	0.212	--
14:43	--	47.78	286	17.1	6.87	0.212	--
14:46	--	47.78	200	17.1	6.87	0.211	--
14:49	--	47.78	143	17.1	6.80	0.211	--
14:52	--	47.78	96	17.1	6.77	0.210	--
14:55	--	47.79	63	17.1	6.75	0.210	--
14:58	--	47.79	50	17.1	6.72	0.209	--
15:01	--	47.79	39	17.0	6.77	0.209	--
15:04	--	47.80	33	17.0	6.79	0.208	--
15:07	--	47.80	33	17.0	6.88	0.208	--
15:10	--	47.81	28	17.0	6.84	0.207	--
15:13	--	47.81	30	17.0	6.84	0.207	--
15:16	--	47.81	30	17.0	6.98	0.207	--
15:19	--	47.81	28	17.0	6.99	0.207	--
15:22	310	47.81	28	17.0	6.98	0.207	Parameters stabilized – ceased pumping
15:25	--	45.97	--	--	--	--	--
15:28	--	45.89	--	--	--	--	--
15:31	--	45.89	--	--	--	--	--

MW415 Well Development Log

Time	Volume Removed (gal)	Water Level (ft BTOC*)	Turbidity (TU)	Temp (°C)	pH (SU)	Conductivity (mS/cm)	Remarks
9/15/04							
15:52	0	--	--	--	--	--	Began pumping (~2 gal/min)
16:59	140	--	--	--	--	--	Ceased pumping
9/16/04							
07:42	--	--	--	--	--	--	Resumed pumping (~2 gal/min)
09:57	655	47.98	--	--	--	--	--
10:00	660	47.98	36	17.0	6.11	0.191	--
10:03	--	--	--	--	--	--	Pumping ceased (generator problem)
10:07	--	46.38	--	--	--	--	--
10:10	--	46.38	--	--	--	--	--
10:15	--	46.38	--	--	--	--	--
10:17	--	--	--	--	--	--	Resumed pumping
10:18	--	47.48	160	18.7	5.76	0.198	--
10:20	--	--	--	--	--	--	Pumping ceased (generator problem)
10:39	--	--	--	--	--	--	Resumed pumping (~2 gal/min)
10:42	685	47.99	88	17.3	5.63	0.194	--
10:45	--	47.99	68	17.2	5.69	0.193	--
10:48	710	48.00	34	17.1	5.72	0.193	--
10:51	--	48.00	39	17.1	5.76	0.192	--
10:54	790	48.00	35	17.1	5.76	0.192	Parameters stabilized – ceased pumping
11:50	--	46.38	--	--	--	--	--

MW416 Well Development Log

Time	Volume Removed (gal)	Water Level (ft BTOC*)	Turbidity (TU)	Temp (°C)	pH (SU)	Conductivity (mS/cm)	Remarks
10/06/04							
13:55	--	49.01	--	--	--	--	--
14:05	0	--	--	--	--	--	Began pumping (~2 gal/min)
14:20	--	49.99	--	--	--	--	--
14:40	--	49.91	--	--	--	--	--
14:50	--	49.84	--	--	--	--	--
15:00	--	49.83	--	--	--	--	--
16:34	300	49.83	--	--	--	--	--
16:40	--	--	--	--	--	--	Ceased pumping (generator out of gas)
16:45	--	49.00	--	--	--	--	--
16:48	--	--	--	--	--	--	Resumed pumping
16:55	--	49.80	--	--	--	--	--
16:58	350	--	--	--	--	--	--
17:00	--	49.80	53	17.5	5.89	0.234	--
17:10	~390	49.82	98	17.4	6.00	0.234	--
17:20	~430	49.83	97	17.3	6.04	0.234	--
17:30	~450	49.83	76	17.3	6.13	0.234	--
17:40	~480	49.83	75	17.3	6.14	0.233	--
17:50	500	49.83	75	17.3	6.11	0.234	Parameters stabilized – ceased pumping
17:52	--	49.00	--	--	--	--	--

MW417 Well Development Log

Time	Volume Removed (gal)	Water Level (ft BTOC*)	Turbidity (TU)	Temp (°C)	pH (SU)	Conductivity (mS/cm)	Remarks
10/05/04							
14:44	--	51.74	--	--	--	--	--
14:46	0	--	--	--	--	--	Began pumping
15:22	--	54.58	--	--	--	--	--
15:28	~30	--	--	--	--	--	Increased pumping rate
15:39	~40	55.30	--	--	--	--	--
15:50	~50	55.32	181	17.5	6.11	0.220	--
16:15	100	55.15	173	17.2	6.26	0.225	--
16:58	--	54.98	--	--	--	--	Increased pumping rate
17:10	~240	55.40	151	17.1	6.17	0.225	--
17:23	--	--	--	--	--	--	Ceased pumping
17:30	--	51.73	--	--	--	--	--
10/6/04							
08:15	--	--	--	--	--	--	Resumed pumping
08:30	~280	55.78	23	17.1	5.92	0.239	--
08:37	300	55.75	--	--	--	--	--
09:14	400	55.37	--	--	--	--	--
09:30	450	55.39	95	17.2	6.17	0.226	--
09:46	500	55.33	--	--	--	--	
10:06	560	55.25	60	17.2	6.18	0.224	--
10:20	600	55.14	54	17.2	6.17	0.226	--
12:10	640	54.48	62	17.5	6.02	0.233	--
12:30	690	54.48	67	17.3	6.11	0.230	--
13:12	800	54.38	114	17.4	6.20	0.227	--
13:20	~830	54.37	71	17.3	6.20	0.228	--
13:30	~850	54.36	70	17.4	6.20	0.228	--
13:40	~875	54.35	72	17.4	6.18	0.228	--
13:50	~890	54.34	74	17.4	6.19	0.228	Parameters stabilized – ceased pumping
13:56	--	51.82	--	--	--	--	--

APPENDIX F

CONTAMINANT FATE AND TRANSPORT MODELING RESULTS FOR SWMU 1 AND THE C-720 BUILDING AREA

Deleted: , SWMU 4,

THIS PAGE INTENTIONALLY LEFT BLANK

CONTENTS

Deleted: MODELING APPEARING IN THE WAG 3 RI REPORT F-14¶ F2.3

Deleted:

Deleted:

Deleted: 23

Deleted: F3.1.2 Preliminary Modeling for SWMU 4 F-62¶

Deleted: ,

Deleted: SWMU 4,

Deleted: , SWMU 4,

THIS PAGE INTENTIONALLY LEFT BLANK

TABLES

FIGURES

ACRONYMS AND ABBREVIATIONS

AT123D	Analytical Transient 1-, 2-, 3-Dimensional Model
BHHRA	baseline human health risk assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cis-1, 2-DCE	*cis*-1, 2-dichloroethene
COC	contaminant of concern
COPC	chemical of potential concern
CSM	conceptual site model
DAF	dilution-attenuation factor
DOE	U.S. Department of Energy
DQO	data quality objective
EPA	U. S. Environmental Protection Agency
f_{oc}	organic carbon content
FS	Feasibility Study
GWOU	Groundwater Operable Unit
HQ	hazard quotient
K_d	soil-water distribution coefficient
K_{oc}	organic carbon partition coefficient
LCL	lower confidence limit
MCL	maximum contaminant level
MCS	Monte Carlo Sampling
MEPAS	Multimedia Environmental Pollutant Assessment System
MODFLOW	modular three-dimensional groundwater flow model
MODPATH	three-dimensional particle-tracking model
^{237}Np	neptunium-237
OREIS	Oak Ridge Environmental Information System
PGDP	Paducah Gaseous Diffusion Plant
POE	point of exposure
PRG	preliminary remediation goal
^{239}Pu	plutonium-239
^{226}Ra	radium-226
RESRAD	Residual Radiation model
RGA	Regional Gravel Aquifer
RI	Remedial Investigation
SADA	Spatial Analysis and Decision Assistance
SESOIL	Seasonal Soil Compartment Model
SI	Site Investigation
SQL	sample quantitation limit
SSL	soil screening level
SWMU	Solid Waste Management Unit
^{99}Tc	technetium-99
TCE	trichloroethene
trans-1,2-DCE	*trans*-1,2-dichloroethene
^{234}U	uranium-234
^{235}U	uranium-235
^{238}U	uranium-238
UCL	upper confidence limit
UCRS	Upper Continental Recharge System
VC	vinyl chloride

VOC	volatile organic compound
WAG	waste area grouping

CONTAMINANT MIGRATION FROM SWMU 1 AND THE C-720 BUILDING AREA

Deleted: , SWMU 4,

F.1. INTRODUCTION

This appendix presents the methods and results of the fate and transport modeling performed for the source areas identified in the Site Investigation (SI) Report at Solid Waste Management Unit (SWMU) 1 (C-747-C Oil Landfarm) and the C-720 Building area. The results presented include those for SWMU 1 and the C-720 Building area appearing in the Waste Area Grouping (WAG) 27 Remedial Investigation (RI) Report (DOE 1999a), those for SWMU 1 and the C-720 Building area appearing in a report completed to support strategic discussions between the regulatory agencies and the U.S. Department of Energy (DOE) concerning response actions for the Paducah Gaseous Diffusion Plant (PGDP) (BJC 2003), and those for SWMU 1 and the C-720 Building area from fate and transport modeling completed for the SI Report.

Deleted: , SWMU 4 (C-747 Contaminated Burial Yard),

Deleted: those for SWMU 4 appearing in the WAG 3 RI Report (DOE 2000a),

Deleted:

Deleted: 1, SWMU 4,

Deleted: a

The results presented are consistent with modeling performed following Tiers 1, 2, and 3 of the modeling matrix presented in the PGDP Risk Methods Document (DOE 2000b). As indicated by this matrix (Table F.1), Tier 1 consists of simple screens using soil screening levels (SSLs) to identify those contaminants that may migrate from source areas to undefined downgradient points of exposure (POEs); Tier 2 consists of source delimitation and transport modeling using input parameters that are unlikely to underestimate the potential for contaminant transport to undefined downgradient POEs (i.e., are conservative estimates of contaminant transport), and Tier 3 consists of source delimitation and transport modeling using input parameters that result in more accurate estimates of future contaminant concentrations at POEs at the PGDP plant boundary, PGDP property boundary, and near the Ohio River.

The modeling results presented in this appendix are used in Chapter 7 of the SI Report to address the data quality objectives (DQOs) used to develop the SI and to complete the risk assessment of source areas presented in Appendix G of the SI Report. In addition, the modeling results will be used in forthcoming decision documents to determine if a response action is needed at sources at SWMU 1 and the C-720 Building area and, if necessary, to select among response action alternatives.

Deleted: , SWMU 4,

F.2. RESULTS OF PREVIOUS MODELING EFFORTS

This section presents the results of previous modeling efforts appearing in earlier reports. In addition, the methods used to complete the modeling are summarized.

F2.1 MODELING APPEARING IN THE WAG 27 RI REPORT

The conservative modeling in Appendix C of Volume 4 the WAG 27 RI Report was completed to determine if any contaminants could migrate from source areas at SWMU 1 and the C-720 Building to POEs at the plant boundary and property boundary at a rate that could result in maximum concentrations

Table F.1. PGDP modeling matrix from risk methods document (DOE 2000b)[a]

	Values for Soil to Protect Groundwater	Model	Point of Exposure	Notes
INVESTIGATION DOCUMENTS	Tier 1 (Used for scoping)	SSLs and/or RESRAD	At source unit	Value to be used for initial scoping. Use DAF of 1 for SSLs until site-specific values are available. Groundwater Protection value based on residential use and targets of 1E-6, 0.1, and 1 for risk, hazard, and dose, respectively. If site-specific DAF values are used, then need to justify these values. The depth of water needs to be considered in the calculation.
INVESTIGATION DOCUMENTS	Tier 2 (Used for scoping)	SESOIL and/or RESRAD	At source unit	Includes source delimitation. Value to be used during follow-up activities. Recognize SESOIL limitations when modeling inorganic COPCs-refine K_ds.
DECISION DOCUMENTS	Tier 3 (Enhanced modeling used in Decision Documents if needed)	SESOIL and RESRAD with AT123D (Use "RESRAD TRANS" when available)	At source unit and at Down-gradient points (Fence, property boundary, creek, river)	Uses source delimitation and refined K_ds from above. Use values from this effort to set initial clean-up goals. On the Terrace (southern portion of PGDP) different points of exposure will apply.
DECISION DOCUMENTS	Tier 4 (Enhanced modeling used in Decision and Design Documents if needed)	Source modeling and MODFLOW T	Down-gradient points	To be used to refine clean-up goals (if needed). May be especially important to set monitoring goals. On the Terrace (southern portion of PGDP) different points of exposure will apply.

PGDP = Paducah Gaseous Diffusion Plant
SSL = soil screening level
RESRAD = Residual Radiation model (DOE 2005a)
DAF = dilution-attenuation factor
SESOIL = Seasonal Soil Compartment model (Bonazountas and Wagner 1984; GSC 1996)
COPCs = contaminants of potential concern
AT123D = Analytical Transient 1-, 2-, 3- Dimensional model (Yeh 1981; GSC 1998)
MODFLOW T = MODFLOW T model (USGS 2005)
[a] The modeling matrix in the Risk Methods Document considers groundwater, surface water, and biota modeling. Only the groundwater matrix is presented here.

greater than risk-based screening levels. This modeling was completed using the Multimedia Environmental Pollutant Assessment System (MEPAS, PNL 1995 and 2005b) and conservative source term estimates developed using comparisons of sampling results to background concentrations and risk-based preliminary remediation goals (PRGs).

MEPAS is a physics-based environmental analysis code that integrates source-term, transport, and exposure models for endpoints such as concentration, dose, or risk. Developed by Pacific Northwest National Laboratory, MEPAS is designed for site-specific assessments using readily available information. Endpoints are computed for chemical and radioactive pollutants. This system has wide applicability to a range of environmental problems using air, groundwater, surface-water, overland, and exposure models. With this system, a user can simulate release from the source, transport through air, groundwater, surface water, or overland, and transfer through food chains and exposure pathways to the exposed individual or population

Whenever available and appropriate, U.S. Environmental Protection Agency (EPA) guidance and models were used to facilitate compatibility and acceptance of MEPAS. Although based on relatively standard transport and exposure computation approaches, the unique feature of MEPAS is that these approaches are integrated into a single system. The use of a single system provides a consistent basis for evaluating health impacts for a large number of problems and sites.

Sampling results used in source term development were from sampling completed as part of the WAG 27 RI and from earlier sampling completed in support of the PGDP Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) SI performed in the early 1990s (CH2M Hill 1991 and 1992). Source terms developed for SWMU 1 and the C-720 Building area are presented in Tables F.2 and F.3. As noted in the modeling report, "In all cases, modelers applied conservatism (worst case) in the definition of the extent of the source zones. In most cases, the maximum concentrations were used to develop each contaminant source-term inventory."

Input parameters used in the MEPAS modeling were based on site-specific data when available. When relevant on-site data were not available, data collected at nearby SWMUs having similar hydrogeologic conditions were used to define the input parameter. If no site-specific data were available, then default values provided by MEPAS were used. In the analysis, all sources were modeled as depleting over time and degrading in the environment. The modeled period was 10,000 years. Modeling inputs for SWMU 1 and the C-720 Building area modeling are presented in Tables F.4 and F.5. The distribution coefficients (K_d) used were default values taken from MEPAS. (These values were not presented in the WAG 27 RI Report.)

The results of the MEPAS modeling for SWMU 1 and the C-720 Building area taken from Appendix C of Volume 4 of the WAG 27 RI Report are in Tables F.6 and F.7. Interpretations of these results following the presentation in the WAG 27 RI Report Baseline Human Health Risk Assessment (BHHRA) are in Tables F.8 and F.9.

The contaminants predicted by the conservative MEPAS model to be contaminants of concern (COCs) for SWMU 1 because they could attain concentrations at both POEs that result in greater than *de minimis* risk levels [i.e., a cancer risk and/or hazard to a resident using groundwater in the home greater than 1×10^{-6} and 1, respectively] are antimony, trichloroethene (TCE), and vinyl chloride (VC). Using the same benchmarks, the COCs for the C-720 Building area at both POEs are antimony; *trans*-1,2-dichloroethene (*trans*-1,2-DCE); TCE; and VC.

Deleted: ,(a)

Deleted: ¶

Deleted: <#>MODELING APPEARING IN THE WAG 3 RI REPORT¶
The conservative modeling in Appendix B of Volume 4 the WAG 3 RI Report was completed to determine if any contaminants could migrate from source areas at SWMU 4 to POEs at the plant boundary and property boundary at a rate that could result in maximum concentrations greater than risk-based screening levels. This modeling was completed using MEPAS and conservative source term estimates developed using comparisons of sampling results to background concentrations and SSLs for protection of groundwater taken from U. S. Environmental Protection Agency (EPA) sources. ¶
Sampling results used in source term development were from sampling completed as part of the WAG 3 RI, the Data Gaps Investigation Report (DOE 2000c), and from earlier sampling completed in support of the PGDP CERCLA SI performed in the early 1990s. Source terms developed for SWMU 4 are presented in Table F.10. As noted in the modeling report, "In all cases, modelers applied conservatism (worst case) in the definition of the extent of the source zones. In all cases, the maximum concentrations were used to develop each contaminant source-term inventory."¶

Table F.2. Source term for SWMU 1 developed in the WAG 27 RI Report MEPAS modeling[a]

Contaminant[b]	Level[c] (mg/kg)	East-West Axis (feet)	North-South Axis (feet)	Thickness (feet)	Volume (ft^3)	Inventory[d] (g)	Note[e]
			Inorganic Chemicals (Metals)				
Antimony	5	290	200	28	1,624,000	336,000	Layer 1
		100	75	10	75,000	15,500	Layer 2
		50	50	3	7,500	1,770	RGA
Beryllium	10	50	50	5	7,500	5,170	Layer 1
		175	75	10	131,250	54,300	Layer 2
Cadmium	6	525	210	3	330,750	82,000	Layer 1
Manganese	2,160	85	80	3	20,400	1,820,000	Layer 1
			Organic Compounds				
Bis(2-ethylhexyl)phthalate	2.40	50	75	31	116,250	11,500	Layer 1
Trichloroethene	439	175	115	40	805,000	14,600,000	Layer 1
	66	175	115	10	201,250	549,000	Layer 2
Vinyl chloride	4.80	150	80	9	108,000	21,400	Layer 1
Xylene	0.012	50	50	4	10,000	91.0	Layer 1
		100	75	5	37,500	340	Layer 2

[a] Information taken from Tables C-5 and C-6 in Appendix C of Volume 4 of the WAG 27 RI Report.
[b] The following were not modeled because they were detected only once above screening levels in subsurface soil:

2-hexanone	benzene 1,2,4-trimethyl	decane, 6-ethyl-2-methyl	lead	octadecene
4,4'-DDT	butyl benzyl phthalate	di-n-butylphthalate	nonane, 2,3-dimethyl	phenanthrene
arsenic	*cis*-1,2-dichloroethene	hexadecane	octacosane	phthalate
				tetrachloro 1,1-biphenyl iso

[c] The maximum concentration was used to estimate the contaminant inventory for all contaminants.
[d] Calculated using a bulk density of 1.46 g/cm^3 for Layers 1 and 2 and 1.67 g/cm^3 for the RGA.
[e] Layer 1 assumed to extend from 1 to 40 ft bgs. Layer 2 assumed to extend from 40 to 55 ft bgs. Regional Gravel Aquifer (RGA) assumed to extend from 55 to 105 ft bgs.

Table F.3. Source term for C-720 Building area developed in the WAG 27 RI Report MEPAS modeling[a]

Contaminant[b]	Level[c] (mg/kg)	East-West Axis (feet)	North-South Axis (feet)	Thickness (feet)	Volume (ft^3)	Inventory[d] (g)	Note[e]
			Inorganic Chemicals (Metals)				
Antimony	87.2	200	120	7	168,000	705,000	Layer 2
	1.59	300	275	8	660,000	50,500	Layer 2
	87.2	200	120	13	312,000	1,120,000	Layer 3
Beryllium	107	200	120	7	168,000	865,000	Layer 2
	1.99	300	275	8	660,000	63,200	Layer 2
	107	200	120	13	312,000	1,380,000	Layer 3
Cadmium	102	200	120	7	168,000	825,000	Layer 2
		200	120	13	312,000	1,320,000	Layer 3
Cobalt	103	200	120	7	168,000	833,000	Layer 2
		200	120	13	312,000	1,330,000	Layer 3
Copper	106	200	120	7	168,000	857,000	Layer 2
		200	120	13	312,000	1,370,000	Layer 3
Silver	94.8	200	120	7	168,000	767,000	Layer 2
		200	120	13	312,000	1,220,000	Layer 3
Thallium	94.4	200	120	7	168,000	763,000	Layer 2
		200	120	13	312,000	1,220,000	Layer 3
Vanadium	128	200	120	7	168,000	1,040,000	Layer 2
		200	120	13	312,000	1,650,000	Layer 3
Lead	139	200	140	4	112,000	644,000	Layer 1
			Organic Compounds				
Bis(2-ethylhexyl)phthalate	1.10	200	120	2	48,000	2,180	Layer 1
		200	120	25	600,000	31,800	Layer 2
		200	120	13	312,000	14,200	Layer 3
trans-1,2-Dichloroethene	450	200	150	4	120,000	2,230,000	Layer 1
Trichloroethene	13.1	825	150	7	866,250	468,000	Layer 1
	2.64	1,050	225	20	4,725,000	601,000	Layer 2
	13.1	825	150	13	1,608,750	1,010,000	Layer 2
	0.686	1000	200	40	8,000,000	260,000	RGA
Vinyl chloride	0.4	200	150	5	150,000	2,480	Layer 1
		200	150	2	60,000	1,160	Layer 2

[a] Information taken from Tables C-14 and C-15 in Appendix C of Volume 4 of the WAG 27 RI Report.
[b] The following were not modeled because they were detected only once above screening levels in subsurface soil:

mercury 1,1-dichloroethene 4-chloro-3-methylphenol

[c] The maximum concentration was used to estimate the contaminant inventory for all contaminants except TCE. For TCE, the average concentration within each source area was used to develop the source term inventories.
[d] Calculated using a bulk density of 1.46 g/cm^3 for Layers 1 and 3. 1.70 g/cm^3 for Layer 2, and 1.67 g/cm^3 for the RGA.
[e] Layer 1 assumed to extend from 1 to 17 ft bgs. Layer 2 assumed to extend from 17 to 42 ft bgs. Layer 3 assumed to extend from 42 to 60 ft bgs. RGA assumed to extend from 60 to 100 ft bgs.

Table F.4. Modeling inputs for SWMU 1 MEPAS modeling in the WAG 27 RI Report[a]

Description	Name	Value	Reference
		Top Soil Parameters (WT)	
Textural Classification	WT-CLASS	silt	Soil Survey
Sand (%)	WT-SAND	15	Soil Survey
Silt (%)	WT-SILT	80	Maximum for soil type
Clay (%)	WT-CLAY	5	By difference
Organic Matter (%)	WT-OMC	0.05	CH2M Hill 1992
Iron and Aluminum (%)	WT-IRON	4	DOE 1995a
pH of Topsoil	WT-pH	5.0	Soil Survey
Vegetative Cover (%)	WT-VEGCOV	95	Description
Topsoil water capacity	WT-AVAILW	4.4	Soil Survey
SCS Curve Number	WT-SCSN	71	MEPAS
		Partially Saturated Zone Parameters (WP)	
Thickness	WP-THICK	WP1: 39 WP2: 15	HU1 and HU2; RI HU3; RI
Textural classification	WP-CLASS	WP1: Loam WP2: Silty clay	RI
Sand (%)	WP-SAND	WP1: 35.9 WP2: 2.8	RI SWMU 2
Silt (%)	WP-SILT	WP1: 50 WP2: 38	MEPAS SWMU 2
Clay (%)	WP-CLAY	WP1: 14 WP2: 54	By difference
Organic Matter (%)	WP-OMC	WP1: 0.08 WP2: 0.06	RI
Iron and Aluminum (%)	WP-IRON	4	DOE 1995a
pH of Pore Water	WP-pH	6.0	DOE 1995b
Bulk Density (g/cm^3)	WP-BULKD	WP1: 1.46 WP2: 1.46	MEPAS
Total porosity (%)	WP-TOTPOR	WP1: 45 WP2: 45	MEPAS
Field capacity (%)	WP-FIELDC	WP1: 27.8 WP2: 27.8	MEPAS
Longitudinal dispersivity (ft)	WP-LDISP	WP1: 0.39 WP2: 0.15	MEPAS
Saturated hydraulic conductivity	WP-CONDUC	WP1: 8E-02 ft/day 3E-05 cm/sec WP2: 2E-03 ft/day 7.2E-07 cm/sec	CH2M Hill 1991a Slug test
Soil Moisture Content (%)	WS-MOISTC	WP1: 40 WP2: 45	MEPAS
		Saturated Zone Parameters (WZ)	
Textural classification	WZ-CLASS	sand (gravelly)	RI
Sand (%)	WZ-SAND	96	RI
Silt (%)	WZ-SILT	3	RI
Clay (%)	WZ-CLAY	1	RI
Organic Matter (%)	WZ-OMC	0.02	WAG 6
Iron and Aluminum (%)	WZ-IRON	3	WAG 6
pH of Pore Water	WZ-pH	6.2	RI
Total porosity (%)	WZ-TOTPOR	37	WAG 6
Effective porosity (%)	WZ-EFFPOR	30	MEPAS

Table F.4. Modeling inputs for SWMU 1 MEPAS modeling in the WAG 27 RI Report[a] (continued)

Description	Name	Value	Reference
Darcy velocity (ft/day)	WZ-PVELOC	0.6	Conductivity = 1500 ft/d Gradient = 0.0004
Thickness	WZ-THICK	50	RI
Bulk Density (g/cm^3)	WZ-BULKD	1.67	Calculated
Travel Distance (ft)	WZ-DIST	Plant boundary: 500 Property boundary: 3,300	RI
Longitudinal dispersivity (ft)	WZ-LDISP	50	Bioscreen Model
Transverse dispersivity (ft)	WZ-TDISP	5.0	Bioscreen Model
Vertical dispersivity (ft)	WZ-VDISP	0.1	near zero
Total flux to aquifer (%)	WZ-FRACT	100	estimate
Perpendicular to receptor	WZ-YDIST	0	on plume centerline
Vertical to receptor	WZ-AQDEPTH	0	minimum

[a] Information taken from Table C-1 in Appendix C of Volume 4 of the WAG 27 RI Report.

Table F.5. Modeling inputs for C-720 Building area MEPAS modeling in the WAG 27 RI Report[a]

Description	Name	Value	Reference
		Top Soil Parameters (WT)	
Textural Classification	WT-CLASS	silt	Soil Survey
Sand (%)	WT-SAND	15	Soil Survey
Silt (%)	WT-SILT	80	Maximum for soil type
Clay (%)	WT-CLAY	5	By difference
Organic Matter (%)	WT-OMC	0.05	CH2M Hill 1992
Iron and Aluminum (%)	WT-IRON	4	DOE 1995a
pH of Topsoil	WT-pH	5.0	Soil Survey
Vegetative Cover (%)	WT-VEGCOV	10	Description
Topsoil water capacity	WT-AVAILW	0.46	Soil Survey
SCS Curve Number	WT-SCSN	86	MEPAS
		Partially Saturated Zone Parameters (WP)	
Thickness	WP-THICK	WP1: 16 WP2: 25 WP3: 18	HU1; RI HU2; RI HU3: RI
Textural classification	WP-CLASS	WP1: Silty clay WP2: Sandy loam WP3: Silty clay	RI
Sand (%)	WP-SAND	WP1: 8 WP2: 67 WP3: 20	RI and MEPAS
Silt (%)	WP-SILT	WP1: 52 WP2: 19 WP3: 40	RI and MEPAS
Clay (%)	WP-CLAY	WP1: 40 WP2: 14 WP3: 40	RI and MEPAS
Organic Matter (%)	WP-OMC	WP1: 0.09 WP2: 0.07 WP3: 0.06	RI

Table F.5. Modeling inputs for C-720 Building area MEPAS modeling in the WAG 27 RI Report[a] (continued)

Description	Name	Value	Reference
Iron and Aluminum (%)	WP-IRON	4	DOE 1995a
pH of Pore Water	WP-pH	6.5	OHM 1992
Bulk Density (g/cm^3)	WP-BULKD	WP1: 1.46 WP2: 1.8 WP3: 1.46	MEPAS
Total porosity (%)	WP-TOTPOR	WP1: 45 WP2: 36 WP3: 45	WAG 6
Field capacity (%)	WP-FIELDC	WP1: 27.8 WP2: 9 WP3: 27.8	MEPAS
Longitudinal dispersivity (ft)	WP-LDISP	WP1: 0.16 WP2: 0.25 WP3: 0.18	MEPAS
Saturated hydraulic conductivity	WP-CONDUC	WP1: 7.4E-02 ft/day 2.6E-05 cm/sec WP2: 8.8 ft/day 3.1E-03 cm/sec WP3: 7.4E-02 ft/day 2.6E-05 cm/sec	MEPAS Slug test
Soil Moisture Content (%)	WS-MOISTC	WP1: 36 WP2: 36 WP3: 45	MEPAS
		Saturated Zone Parameters (WZ)	
Textural classification	WZ-CLASS	sand (gravelly)	RI
Sand (%)	WZ-SAND	74	RI
Silt (%)	WZ-SILT	17	RI
Clay (%)	WZ-CLAY	9	RI
Organic Matter (%)	WZ-OMC	0.02	WAG 6
Iron and Aluminum (%)	WZ-IRON	3	WAG 6
pH of Pore Water	WZ-pH	6.2	RI
Total porosity (%)	WZ-TOTPOR	37	WAG 6
Effective porosity (%)	WZ-EFFPOR	30	MEPAS
Darcy velocity (ft/day)	WZ-PVELOC	0.6	Conductivity = 1500 ft/d Gradient = 0.0004
Thickness	WZ-THICK	40	RI
Bulk Density (g/cm^3)	WZ-BULKD	1.67	Calculated
Travel Distance (ft)	WZ-DIST	Plant boundary: 1,800 Property boundary: 4,600	RI
Longitudinal dispersivity (ft)	WZ-LDISP	50	Bioscreen Model
Transverse dispersivity (ft)	WZ-TDISP	5.0	Bioscreen Model
Vertical dispersivity (ft)	WZ-VDISP	0.1	near zero
Total flux to aquifer (%)	WZ-FRACT	100	estimate
Perpendicular to receptor	WZ-YDIST	0	on plume centerline
Vertical to receptor	WZ-AQDEPTH	0	minimum

[a] Information taken from Table C-4 in Appendix C of Volume 4 of the WAG 27 RI Report.

Table F.6. MEPAS results for SWMU 1[a]

Source	Contaminant	PGDP Plant Boundary Maximum Concentration (mg/L)	PGDP Plant Boundary Time of Maximum (Years)	PGDP Property Boundary Maximum Concentration (mg/L)	PGDP Property Boundary Time of Maximum (Years)	MCL[b]
UCRS	Antimony	6.43E-02	794	1.31E-02	862	6E-03
	Beryllium[c]	0	10,000	0	10,000	4E-03
	Bis(2-ethylhexyl) phthalate[c]	0	10,000	0	10,000	6E-03
	Cadmium[d]	6.456E-33	9,946	1.543E-34	9,974	5E-03
	Manganese	1.73E-01	2,334	2.63E-02	2,643	5E-02
	Trichloroethene	2.044E+01	120	3.4E+00	122	5E-03
	Vinyl chloride	8.19E-02	57	1.29E-02	63	2E-03
	Xylenes	1.193E-04	159	1.86E-05	171	1E+01
RGA	Antimony	1.67E-02	7	8.22E-04	54	6E-03

[a] Information taken from Table C-7 of Appendix C in Volume 4 of the WAG 27 RI Report.
[b] Maximum contaminant levels (MCLs) taken from PGDP Risk Methods Document. All values in mg/L.
[c] Concentrations at POEs are zero over 10,000 year period modeled.
[d] Contaminant reaches steady state concentration. Time of maximum is first time maximum concentration is attained.

Table F.7. MEPAS results for C-720 Building area[a]

Source	Contaminant	PGDP Plant Boundary Maximum Concentration (mg/L)	PGDP Plant Boundary Time of Maximum (Years)	PGDP Property Boundary Maximum Concentration (mg/L)	PGDP Property Boundary Time of Maximum (Years)	MCL[b]
UCRS	Antimony	2.55E-01	229	8.73E-02	361	6E-03
	Beryllium[c]	0	10,000	0	10,000	4E-03
	Bis(2-ethylhexyl) phthalate[d]	3.67E-12	9,930	5.41E-21	9,996	6E-03
	Cadmium[d]	4.075E-06	9,973	1.13E-19	9,959	5E-03
	Cobalt	1.3E-02	4,252	5.6E-03	4,301	None
	Copper	7.88E-03	7,931	3.24E-03	9,974	1.3E+00
	Lead[c]	0	10,000	0	10,000	1.5E-02
	Silver	6.3E-02	847	3.0E-02	976	1E-01
	Thallium	1.935E+00	31	8.026E-01	38	2E-03
	trans-1,2-Dichloroethene	7.22E+00	25	2.83E+00	30	1E-01
	Trichloroethene	1.27E+00	72	5.33E-01	82	5E-03
	Vanadium	2.39E-02	3,797	7.7E-03	6,039	None
	Vinyl chloride	3.63E-03	54	1.50E-03	60	2E-03
RGA	Trichloroethene	7.66E-01	9	2.56E-01	21	5E-03

[a] Information taken from Table C-17 of Appendix C in Volume 4 of the WAG 27 RI Report.
[b] Maximum contaminant levels (MCLs) taken from PGDP Risk Methods Document. All values in mg/L.
[c] Concentrations at POEs are zero over 10,000 year period modeled.
[d] Contaminant reaches steady state concentration. Time of maximum is first time maximum concentration is attained.

Table F.8. Estimated hazard quotients (HQs) for a resident from exposure to maximum modeled concentrations from sources at SWMU 1 and the C-720 Building area

		PGDP Plant Boundary		PGDP Property Boundary		
Source	Contaminant	Maximum Concentration (mg/L)	Hazard Quotient[a]	Maximum Concentration (mg/L)	Hazard Quotient[a]	Risk-based Concentration[b]
		SWMU 1				
UCRS	Antimony	6.43E-02	11.4	1.31E-02	2.3	5.64E-04
	Cadmium	6.456E-33	<0.1	1.543E-34	<0.1	6.61E-04
	Manganese	1.73E-01	0.5	2.63E-02	<0.1	3.50E-02
	Trichloroethene	2.044E+01	1,280	3.4E+00	213	1.60E-03
	Vinyl chloride	8.19E-02	2.7	1.29E-02	0.4	3.06E-03
	Xylenes	1.193E-04	<0.1	1.86E-05	<0.1	6.53E-02
RGA	Antimony	1.67E-02	3.0	8.22E-04	0.1	5.64E-04
		C-720 Building area				
UCRS	Antimony	2.55E-01	45.2	8.73E-02	15.5	5.64E-04
	Bis(2-ethylhexyl) phthalate	3.67E-12	<0.1	5.41E-21	<0.1	2.58E-02
	Cadmium	4.075E-06	<0.1	1.13E-19	<0.1	6.61E-04
	Cobalt	1.3E-02	<0.1	5.6E-03	<0.1	9.06E-02
	Copper	7.88E-03	<0.1	3.24E-03	<0.1	5.57E-02
	Silver	6.3E-02	0.8	3.0E-02	0.4	7.50E-03
	Thallium	1.935E+00	No value	8.026E-01	No value	No value
	trans-1,2-Dichloroethene	7.22E+00	132	2.83E+00	51.6	5.48E-03
	Trichloroethene	1.27E+00	79.4	5.33E-01	33.3	1.60E-03
	Vanadium	2.39E-02	0.3	7.7E-03	0.1	9.25E-03
	Vinyl chloride	3.63E-03	0.1	1.50E-03	<0.1	3.06E-03
RGA	Trichloroethene	7.66E-01	47.9	2.56E-01	16.0	1.60E-03

[a] Calculated using comparison to risk-based concentration. Contaminants with a hazard quotient (HQ) greater than 1 are considered contaminants of concern (COCs).

[b] Risk-based no action screening value from Appendix A of the Risk Methods Document. In some cases, these updated values differ from those used in calculation in the WAG 27 RI Report. All values in mg/L.

Table F.9. Estimated cancer risks for a resident from exposure to maximum modeled concentrations from sources at SWMU 1 and the C-720 Building area

		PGDP Plant Boundary		PGDP Property Boundary		
Source	Contaminant	Maximum Concentration (mg/L)	Cancer Risk[a]	Maximum Concentration (mg/L)	Cancer Risk[a]	Risk-based Concentration[b]
		SWMU 1				
UCRS	Antimony	6.43E-02	No value	1.31E-02	No value	No value
	Cadmium	6.456E-33	No value	1.543E-34	No value	No value
	Manganese	1.73E-01	No value	2.63E-02	No value	No value
	Trichloroethene	2.044E+01	1.18E-02	3.4E+00	1.97E-03	1.73E-03
	Vinyl chloride	8.19E-02	2.34E-03	1.29E-02	3.69E-04	3.50E-05
	Xylenes	1.193E-04	No value	1.86E-05	No value	No value
RGA	Antimony	1.67E-02	No value	8.22E-04	No value	No value
		C-720 Building area				
UCRS	Antimony	2.55E-01	No value	8.73E-02	No value	No value
	Bis(2-ethylhexyl) phthalate	3.67E-12	<1.00E-06	5.41E-21	<1.00E-06	3.12E-03
	Cadmium	4.075E-06	No value	1.13E-19	No value	No value
	Cobalt	1.3E-02	No value	5.6E-03	No value	No value
	Copper	7.88E-03	No value	3.24E-03	No value	No value
	Silver	6.3E-02	No value	3.0E-02	No value	No value
	Thallium	1.935E+00	No value	8.026E-01	No value	No value
	trans-1,2-Dichloroethene	7.22E+00	No value	2.83E+00	No value	No value
	Trichloroethene	1.27E+00	7.34E-04	5.33E-01	3.08E-04	1.73E-03
	Vanadium	2.39E-02	No value	7.7E-03	No value	No value
	Vinyl chloride	3.63E-03	1.04E-04	1.50E-03	4.29E-05	3.50E-05
RGA	Trichloroethene	7.66E-01	4.43E-04	2.56E-01	1.48E-04	1.73E-03

[a] Calculated using comparison to risk-based concentration. Contaminants with a cancer risk greater than 1.00E-06 are considered contaminants of concern (COCs).

[b] Risk-based no action screening value from Appendix A of the Risk Methods Document. In some cases, these updated values differ from those used in calculations in the WAG 27 RI Report. All values in mg/L.

Deleted: Table F.10. Source term for SWMU 4 developed in the WAG 3 RI Report MEPAS modeling[a]¶
Contaminant ... [1]

F2.2 MODELING FOR SWMU 1 AND THE C-720 BUILDING AREA APPEARING IN BJC 2003

The modeling for SWMU 1 and the C-720 Building area in BJC 2003 was performed to support strategic discussions between DOE and the regulatory agencies. Unlike the modeling completed as part of the WAG 27 RI, which was completed using MEPAS, and consistent with the Risk Methods Document, the modeling in BJC 2003 was completed using the Seasonal Soil Compartment (SESOIL; Bonazountas and Wagner 1984; GSC 1996) and the Analytical Transient 1-, 2-, 3- Dimensional (AT123D; Yeh 1981; GSC 1998) models. Additionally, this modeling only considered the transport of TCE from sources at SWMU 1 and the C-720 Building because TCE was determined in the WAG 27 BHHRA to be the COC presenting the greatest risk to downgradient receptors. The POEs considered were the plant boundary, property boundary, and near the Ohio River (i.e., at Little Bayou Creek).

In this modeling, source terms for TCE in soil at SWMU 1 and the C-720 Building were developed using all data collected previously. To refine the source areas and identify source zones within each area, plots were made of the distribution of TCE within the subsurface. As a first step to this process, the data were compiled and summary statistics derived for each source area. (See Tables F.10 and F.11.) This was followed by the evaluation of the dimensions of the source areas used in the earlier MEPAS modeling and the refinement of the areas consistent with the modeling matrix contained in the PGDP Risk Methods Document.

Deleted: 6

Deleted: 7

At SWMU 1, TCE contamination was found to be limited to five areas (Fig. F.1). Source zones were defined within each of these areas by examining scatter plots that included all sampling locations, distinguished by detect versus nondetect, and by vertical depths at 0–1 ft, 1–10 ft, 11–20 ft, 21–30 ft, 31–40 ft, 41–50 ft, and 51–60 ft bgs. These areas included Area 1, with an approximate area of 6,243 ft^2, and Areas 2 through 5, with an approximate area of 258 ft^2 each. (Note that only Source Area 1 was modeled because it was determined that its contaminant contribution to the Regional Gravel Aquifer (RGA) would dominate the amount of TCE transported from SWMU 1, due to its much larger size). An average thickness of the contamination within Source Area 1 was defined, the data were examined, and the average of the results within the source area–depth classification was used as the source term in the SESOIL modeling. (The geometric mean was used to represent the average TCE contamination throughout each source zone because data were determined to be log normally distributed.) The source term of TCE for SWMU 1, including the thickness of each source zone used in the SESOIL modeling, is presented in Table F.12.

Deleted: -

Deleted: -

Deleted: -

Deleted: -

Deleted: -

Deleted: -

Deleted: -

Deleted: 8

Deleted: Table F.11. Modeling inputs for SWMU 4 MEPAS modeling in the WAG 3 RI Report[a]¶
Description ... [2]

Table F.10. Summary statistics for trichloroethene (mg/kg) in Source Area 1 at SWMU 1 (from BJC 2003)

Deleted: 6

Depth	Number of Results	Minimum Result	Maximum Result	Arithmetic Mean	Geometric Mean[a]	Median
			All Results			
1 to 10 ft bgs	41	0.003	87	6.9	0.380	0.250
11 to 20 ft bgs	12	0.003	439	39.2	0.668	0.675
21 to 30 ft bgs	19	0.003	50	9.3	0.547	0.600
31 to 40 ft bgs	16	0.003	74	8.4	1.204	1.000
41 to 50 ft bgs	20	0.003	66	9.6	1.006	0.550
			Detects Only			
1 to 10 ft bgs	26	0.026	87	10.8	0.768	0.265
11 to 20 ft bgs	8	0.040	439	58.6	2.35	1.5
21 to 30 ft bgs	12	0.013	50	14.6	1.85	13.5
31 to 40 ft bgs	13	0.013	74	10.3	2.19	1.7
41 to 50 ft bgs	12	0.008	66	15.8	3.92	7.2

bgs = below ground surface.
[a] The geometric mean over all results was chosen as the source term concentration after it was determined that the Source Area 1 data were log normally distributed.

Table F.11. Summary statistics for trichloroethene (mg/kg) in all source areas at C-720 Building area (from BJC 2003)

Deleted: 7

Depth	Source Area	Number of Results	Minimum Result	Maximum Result	Arithmetic Mean[a]
1 to 10 ft bgs	1	2	0.037	17	8.5
	2	1	2.7	2.7	2.7
11 to 20 ft bgs	1	3	0.110	19	8.0
	2	2	7.8	17	12.4
21 to 30 ft bgs	1	4	1.8	68	29.5
	2	4	1.3	6.3	2.7
	3	1	2.2	2.2	2.2
	4	3	0.5	8.1	4.5
	5	2	0.05	0.4	0.225
31 to 40 ft bgs	1	3	1.5	1.6	1.6
	3	2	0.8	14	7.4
	4	3	0.3	1.8	1.3
	5	1	1.6	1.6	1.6
41 to 50 ft bgs	1	3	0.273	1.3	0.92

bgs = below ground surface.
Results for source area/depth combinations not containing any detected results are not presented.
[a] The arithmetic mean was used as the source term.

051706

Fig. F.1. TCE source areas identified at SWMU 1 in BJC/PAD-506.

Table F.12. Source term for trichloroethene used in SESOIL modeling of SWMU 1 (from BJC 2003)

Deleted: 8

Layer No.	Thickness of Layer (feet)	No. of Sublayers	Sublayer No.	Concentration (mg/kg)
1	30	3	1	0.38
			2	0.668
			3	0.547
2	20	2	1	1.204
			2	1.006
3	5	5	1	0
			2	0
			3	0
			4	0
			5	0
4	0.5	2	1	0
			2	0

At the C-720 Building, TCE contamination was also identified in five areas (Fig. F.2). As with SWMU 1, source zones were defined by depth within each of these areas by examining scatter plots. These areas included Areas 1, 2, 3, and 5, each with an approximate area of 2,497 ft^2, and Area 4, with an approximate area of 1,249 ft^2. The average of the concentrations within each source zone was used as the source term in the modeling. This concentration was assumed to be present throughout the contaminated mass within the source zone. The source terms for TCE for the five source areas at the C-720 Building, including the thickness of each source zone used in the SESOIL modeling, are presented in Table F.13.

Deleted: 9

For both SWMU 1 and the C-720 Building area, the input parameters used in the modeling were from results in the WAG 27 RI Report (DOE 1999a) and the Groundwater Operable Unit Feasibility Study Report (GWOU FS Report; DOE 2001a). Generally, the modeling parameters were selected so that they would represent site conditions, could account for expected variability in the hydraulic system, and would be unlikely to underestimate contaminant release and transport. Chemical-specific parameters used in the modeling included each COC's solubility in water, organic carbon partition coefficient (K_{oc}), Henry's Law constant, distribution coefficient (K_d), and diffusion coefficients in air and water, and, for TCE, degradation rate constant. The input parameters are presented in Tables F.14 through F.16. (Note that multiple degradation rates for TCE were used to investigate the effect degradation may have upon transport. The rates utilized in the model were no degradation; 0.00042 day^{-1} [a 4.5-yr half-life; Howard et al. 1991]; and 0.0000714 day^{-1} [a 26.6-yr half-life; LMES 1997].)

Deleted: 20

Deleted: 22

The maximum groundwater concentrations predicted at each of the POEs for Source Area 1 at SWMU 1 and for the five source areas at the C-720 Building are presented in Tables F.17, F.18, and F.19. Table F.17 shows maximum groundwater concentrations if TCE is assumed not to degrade. Table F.18 shows maximum groundwater concentrations if TCE is assumed to degrade with a half-life of 26.6 years. Table F.19 shows maximum groundwater concentrations if TCE is assumed to degrade with a half-life of 4.5-years. The results for the property boundary POE also are depicted by source area over the period modeled in Figs. F.3 through F.8 and for all Source Areas in Fig. F.9. (Note that Fig. F.9 presents concentrations at the property boundary POE assuming a TCE degradation half-life of 26.6 years.)

Deleted: 23

Deleted: 24

Deleted: 25

Deleted: 23

Deleted: 24

Deleted: 25

051706

Fig. F.2. TCE source areas identified at C-720 Building in BJC/PAD-506.

05102007

Table F.13. Source term for trichloroethene used in SESOIL modeling of C-720 Building area (from BJC 2003)

Deleted: 9

Source Area	No. of Layers	Layer No.	Thickness of Layer (feet)	No. of Sublayers	Sublayer No.	Concentration (mg/kg)
Source Area 1	4	1	5	1	1	0
		2	30	3	1	8.5
					2	8
					3	29.5
		3	25	5	1	1.6
					2	1.6
					3	0.92
					4	0.92
					5	0
		4	0.5	1	1	0
Source Area 2	4	1	5	1	1	0
		2	30	3	1	2.7
					2	12.4
					3	2.7
		3	25	5	1	0
					2	0
					3	0
					4	0
					5	0
		4	0.5	1	1	0
Source Area 3	4	1	5	1	1	0
		2	30	3	1	0
					2	0
					3	2.2
		3	25	5	1	7.4
					2	7.4
					3	0
					4	0
					5	0
		4	0.5	1	1	0
Source Area 4	4	1	5	1	1	0
		2	30	3	1	0
					2	0
					3	4.5
		3	25	5	1	1.3
					2	1.3
					3	0
					4	0
					5	0
		4	0.5	1	1	0

Table F.13. Source term for trichloroethene used in SESOIL modeling of C-720 Building area (from BJC 2003) (continued)

Deleted: 9

Source Area	No. of Layers	Layer No.	Thickness of Layer (feet)	No. of Sublayers	Sublayer No.	Concentration (mg/kg)
Source Area 5	4	1	5	1	1	0
		2	30	3	1	0
					2	0
					3	0.225
		3	25	5	1	1.6
					2	1.6
					3	0
					4	0
					5	0
		4	0.5	1	1	0

Table F.14. Soil parameters for SESOIL modeling of SWMU 1 and the C-720 Building area in BJC 2003

Deleted: 20

Parameter Type	Parameter Value		Source
	C-720	SWMU 1	
Soil type	Silty clay	Silty clay	PGDP site-specific
Bulk density (g/cm^3)	1.46	1.46	Laboratory analysis
Percolation rate (cm/year)	11	11	PGDP Calibrated Model
Intrinsic permeability (cm^2)	1.65E-10	1.65E-10	Calibrated
Disconnectedness index	10	10	Calibrated
Porosity	0.45	0.45	Laboratory analysis
Depth to water table	18.3 m 60 ft	18.3 m 60 ft	Site specific (to RGA) based on field observation
Organic carbon content (%)	0.09	0.08	Laboratory analysis
Frendlich equation exponent	1	1	SESOIL default value
Area of source – Area 1[a]	232 m^2 2,497 ft^2	580 m^2 6,243 ft^2	Estimated from soil contamination area
Area of source – Area 2	232 m^2 2,497 ft^2	24 m^2 258 ft^2	Estimated from soil contamination area
Area of source – Area 3	232 m^2 2,497 ft^2	24 m^2 258 ft^2	Estimated from soil contamination area
Area of source – Area 4	116 m^2 1,249 ft^2	24 m^2 258 ft^2	Estimated from soil contamination area
Area of source – Area 5	232 m^2 2,497 ft^2	24 m^2 258 ft^2	Estimated from soil contamination area

[a] Multiple source areas were identified as part of source refinement as discussed earlier. Source Areas 2, 3, 4, and 5 at SWMU 1 were not modeled, due to their small size relative to Area 1.

Table F.15. Hydrogeologic parameters used in AT123D modeling of SWMU 1 and the C-720 Building area in BJC 2003

Deleted: 21

Parameter Type	Parameter Values C-720	SWMU 1	Source
Bulk density (kg/m^3)	1670	1670	Laboratory analysis
Effective porosity	0.3	0.3	PGDP site-wide model calibrated value
Hydraulic conductivity (m/hour)	19.05	19.05	PGDP site-wide model calibrated value
Hydraulic gradient	0.0004	0.0004	PGDP site-wide model calibrated value
Aquifer thickness	12.2 m 40 ft	12.2 m 40 ft	Site average
Longitudinal dispersivity (m)	15	15	Approximate values used in the past
Density of water (kg/m^3)	1,000	1,000	Default
Fraction of organic carbon (unitless)	0.02	0.02	Laboratory analysis
Distance to Plant Boundary	549 m 1,800 ft	152 m 500 ft	Approximate downgradient distance in RGA
Distance to Property Boundary	1,402 m 4,600 ft	1,006 m 3,300 ft	Approximate downgradient distance in RGA
Source Area Length	34.6 m 114 ft	34.6 m 114 ft	These dimensions were used to represent the area over which contaminant loading to the aquifer occurs. These were selected by considering the areas of the sources in UCRS soil used in the SESOIL modeling and the distance from the sources to the aquifer (i.e., the RGA). As a simplifying assumption, the contaminant loading areas were kept constant for each of the C-720 Building source areas and for the SWMU 1 source area.
Source Area Width	34.6 m 114 ft	34.6 m 114 ft	These dimensions were used to represent the area over which contaminant loading to the aquifer occurs. These were selected by considering the areas of the sources in UCRS soil used in the SESOIL modeling and the distance from the sources to the aquifer (i.e., the RGA). As a simplifying assumption, the contaminant loading areas were kept constant for each of the C-720 Building source areas and for the SWMU 1 source area.

UCRS = Upper Continental Recharge System.

Table F.16. Literature-based chemical-specific parameters used in SESOIL and AT123D modeling of SWMU 1 and the C-720 Building area in BJC 2003

Deleted: 22

Contaminant	Mol. Wt. (g/gmol)	Solubility in water (mg/L)	Diffusion in air (cm^2/s)	Diffusion in water (cm^2/s)	Henry's Constant (atm.m^3/mol)	K_{oc} (L/kg)	K_d (L/kg)	MCL (mg/L)	SSL (mg/kg)	SSL×20 (mg/kg)
Trichloroethene	131	1100	0.08	9.10E-06	0.0103	94	0.0188	0.005	0.003	0.06
1,2-Dichloroethene[a]	97	800	0.11	1.14E-05	0.0066	78	0.0155	0.055	0.021	0.42
cis-1,2-Dichloroethene[a]	97	3500	0.07	1.13E-05	0.00408	36	0.0071	0.070	0.020	0.40
trans-1,2-Dichloroethene[a]	97	6300	0.07	1.19E-05	0.00938	38	0.0076	0.100	0.030	0.70
1,1-Dichloroethene[a]	97	2250	0.09	1.04E-05	0.0261	65	0.0130	0.007	0.003	0.06
Vinyl chloride[a]	63	2760	0.11	1.23E-06	0.0270	19	0.0037	0.002	0.001	0.01

Mol. Wt = molecular weight
Koc = organic carbon partition coefficient
Kd = distribution coefficient
MCL = maximum contaminant level
SSL = soil screening level
SSL× 20 = 20 times the SSL
[a] These constituents are degradation products of trichloroethene and were not modeled.

Table F.17. Trichloroethene groundwater concentrations assuming no degradation in BJC 2003

Deleted: 23

Source Area	Maximum Groundwater Concentration[a] at Plant Boundary (mg/L)	Property Boundary (mg/L)	Near Ohio River (mg/L)
C-720 Building area			
Area-1: TCE	2.05E-02	8.56E-03	3.26E-03
Area-2: TCE	8.08E-03	3.40E-03	1.26E-03
Area-3: TCE	5.01E-03	2.07E-03	7.84E-04
Area-4: TCE	1.54E-03	6.38E-04	2.42E-04
Area-5: TCE	9.59E-04	3.96E-04	1.50E-04
SWMU 1			
Area-1: TCE	1.70E-02	2.45E-03	7.26E-04

[a] The maximum contaminant level (MCL) for TCE is 5E-03 mg/L.

Table F.18. Trichloroethene groundwater concentrations assuming degradation half-life of 26.6 years in BJC 2003

Deleted: 24

Source Area	Maximum Groundwater Concentration[a] at Plant Boundary (mg/L)	Property Boundary (mg/L)	Near Ohio River (mg/L)
C-720 Building area			
Area-1: TCE	1.33E-02	4.89E-03	8.58E-04
Area-2: TCE	4.59E-03	1.70E-03	2.89E-04
Area-3: TCE	3.18E-03	1.16E-03	2.01E-04
Area-4: TCE	4.59E-04	1.62E-04	2.73E-05
Area-5: TCE	2.88E-04	1.01E-04	1.71E-05
SWMU 1			
Area-1: TCE	1.21E-02	1.56E-03	2.09E-04

[a] The maximum contaminant level (MCL) for TCE is 5E-03 mg/L.

Table F.19. Trichloroethene groundwater concentrations assuming degradation half-life of 4.5 years in BJC 2003

Deleted: 25

Source Area	Maximum Groundwater Concentration at Plant Boundary (mg/L)	Property Boundary (mg/L)	Near Ohio River (mg/L)
C-720 Building area			
Area-1: TCE	1.95E-03	4.26E-04	1.80E-06
Area-2: TCE	2.87E-04	5.72E-05	2.18E-07
Area-3: TCE	3.43E-04	8.53E-05	3.74E-07
Area-4: TCE	1.05E-04	2.53E-05	1.12E-07
Area-5: TCE	6.57E-05	1.64E-05	7.17E-08
SWMU 1			
Area-1: TCE	0.00321	2.77E-04	7.31E-07

[a] The maximum contaminant level (MCL) for TCE is 5E-03 mg/L.

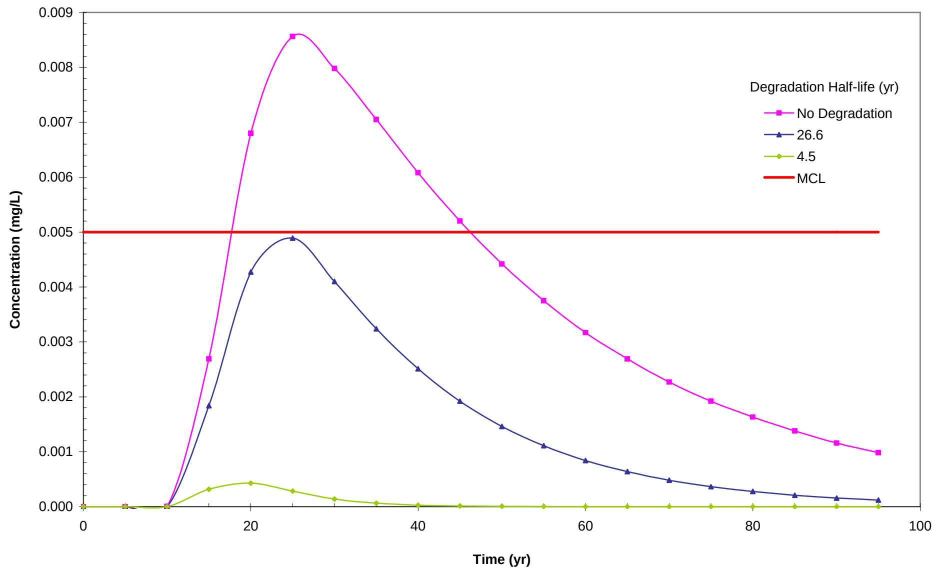


Fig. F.3. Concentrations of TCE in groundwater at the property boundary POE from migration from C-720 Building Source Area 1.

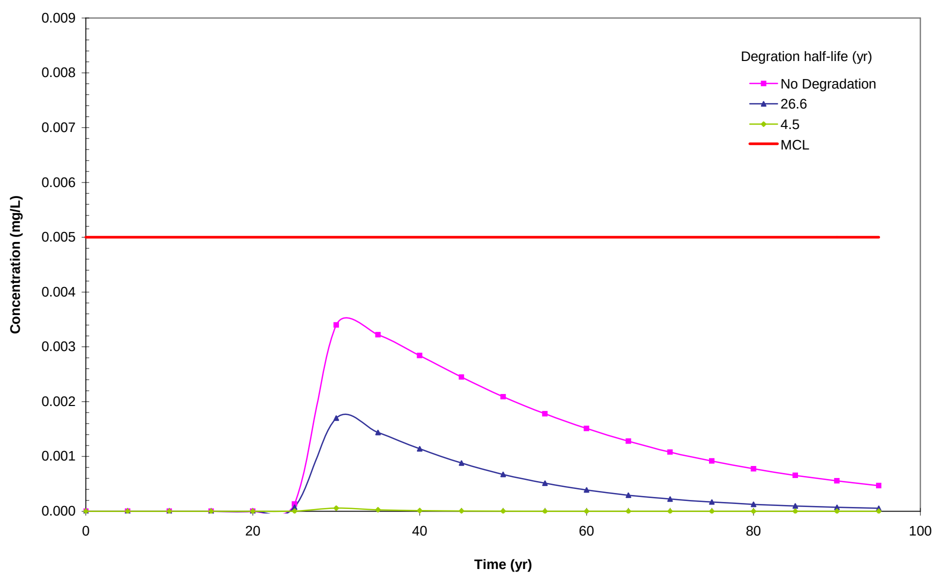


Fig. F.4. Concentrations of TCE in groundwater at the property boundary POE from migration from C-720 Building Source Area 2.

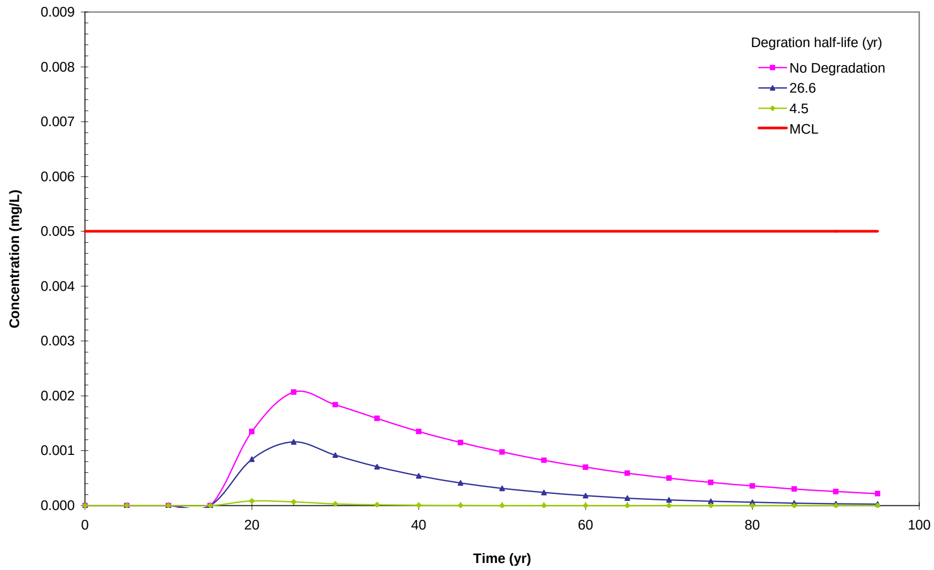


Fig. F.5. Concentrations of TCE in groundwater at the property boundary POE from migration from C-720 Building Source Area 3.

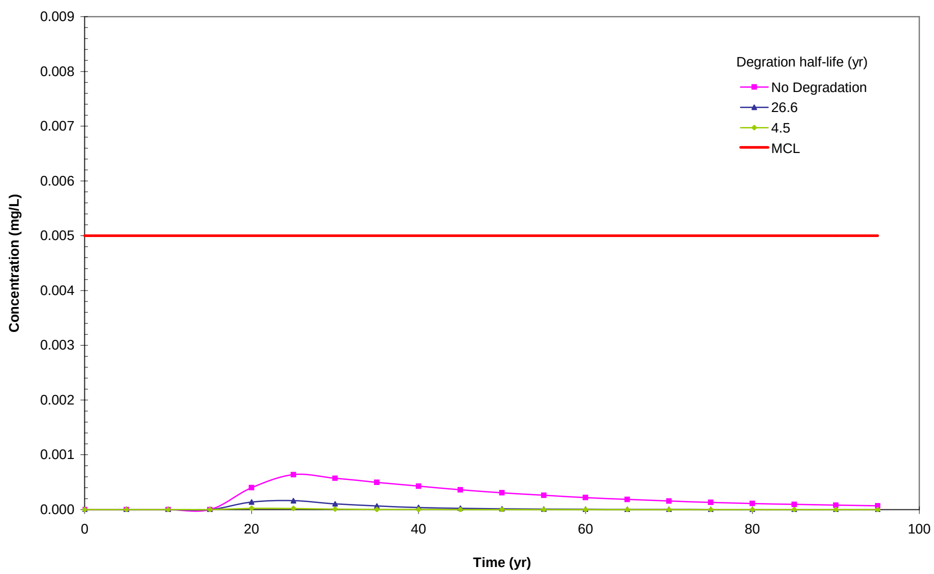


Fig. F.6. Concentrations of TCE in groundwater at the property boundary POE from migration from C-720 Building Source Area 4.

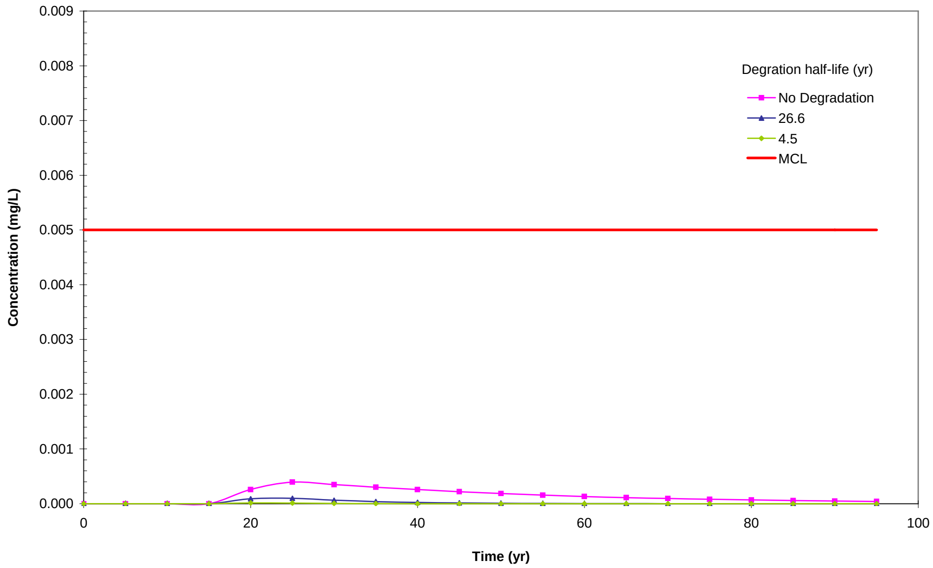


Fig. F.7. Concentrations of TCE in groundwater at the property boundary POE from migration from C-720 Building Source Area 5.

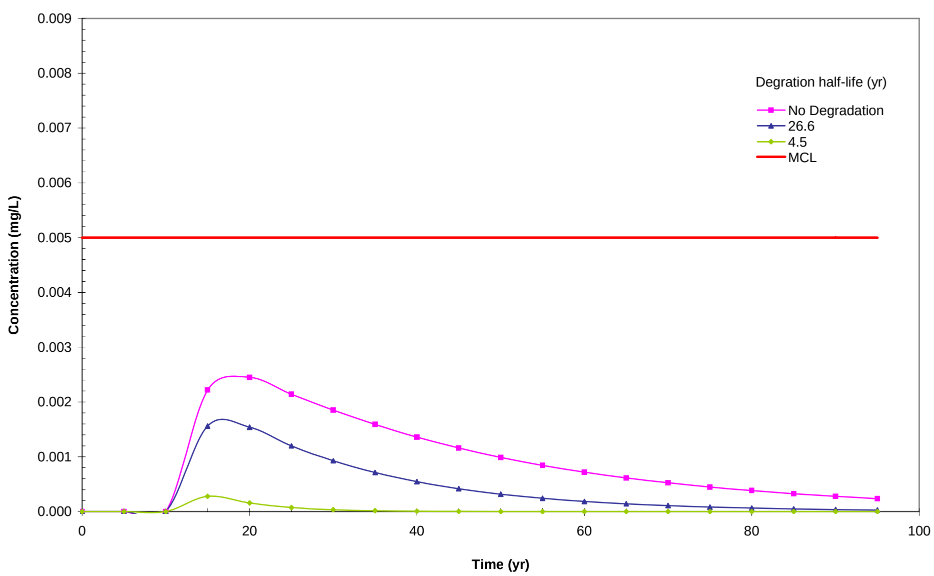


Fig. F.8. Concentrations of TCE in groundwater at the property boundary POE from migration from SWMU 1 Source Area 1.

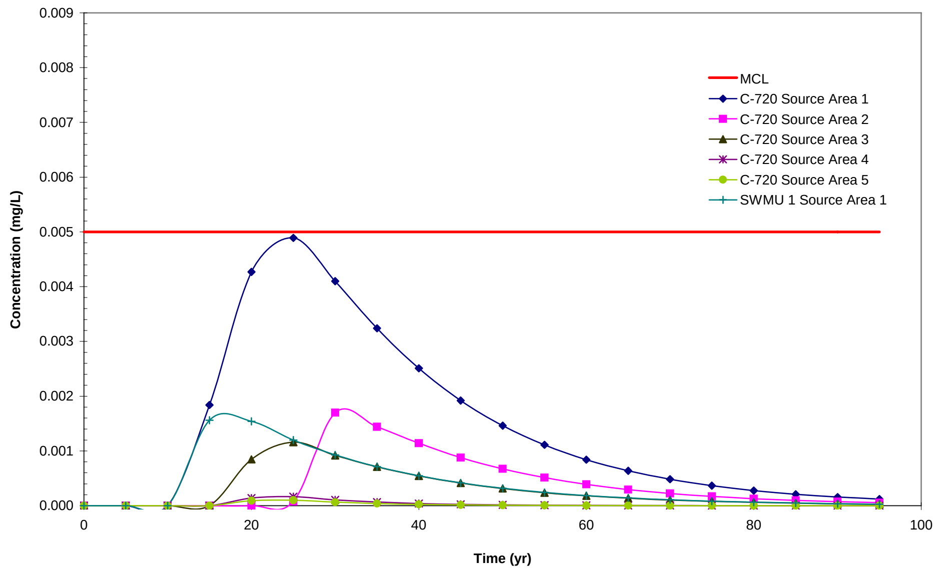


Fig. F.9. Concentrations of TCE in groundwater at the property boundary POE assuming 26.6 year degradation half-life – C-720 Building area and SWMU 1 sources.

As shown in the tables and figures, only Source Area 1 at the C-720 Building under the no degradation scenario is predicted to result in concentrations of TCE at the property boundary POE greater than the MCL. The maximum concentration at that POE from Source Area 1 at the C-720 Building is 8.56E-03 mg/L versus the TCE MCL of 5E-03 mg/L. Assuming a degradation half-life of 26.6 years, the maximum concentration at the POE from Source Area 1 at the C-720 Building falls to 4.89E-03 mg/L.

As shown in Figs. F.3 through F.7 the source area estimated to result in the greatest TCE concentration at the property boundary POE is Source Area 1 at the C-720 Building. The other source areas at C-720 Building ranked in order of estimated TCE concentration at the property boundary POE are 2, 3, 4, and 5. Source Area 1 at SWMU 1 is estimated to result in TCE concentrations at the property boundary POE similar to those from C-720 Building Source Areas 2 and 3.

Hazards and cancer risks estimated using the maximum concentrations at the three POEs under the no degradation scenario and under the scenario that assumes degradation with a half-life of 26.6 years are presented in Tables F.20 and F.21 respectively. As shown there, no sources areas are predicted to have a maximum hazard quotient (HQ) greater than 1 at the property boundary POE under either degradation scenario. Under the no degradation scenario, Source Areas 1, 2, and 3 at the C-720 Building and Source Area 1 at SWMU 1 have maximum cancer risks that are greater than but similar to 1.00E-06; however, under the scenario assuming a 26.6 year half-life, only Source Area 1 at the C-720 Building has a maximum cancer risk (2.83E-06) greater than 1.00E-06.

Deleted: 8

Deleted: ,

Deleted: ,

Deleted: 6

Deleted: 7

Table F.20. Hazard and cancer risk predicted from maximum groundwater concentrations derived in BJC 2003 under a scenario that assumes no trichloroethene degradation[a,b]

Deleted: 6

Source Area	Plant Boundary		Property Boundary		Near Ohio River	
	Hazard Quotient	Cancer Risk	Hazard Quotient	Cancer Risk	Hazard Quotient	Cancer Risk
C-720 Building area						
Area-1: TCE	1.3	1.18E-05	0.5	4.95E-06	0.2	1.88E-06
Area-2: TCE	0.5	4.67E-06	0.2	1.97E-06	<0.1	<1.00E-06
Area-3: TCE	0.3	2.90E-06	0.1	1.20E-06	<0.1	<1.00E-06
Area-4: TCE	0.1	<1.00E-06	<0.1	<1.00E-06	<0.1	<1.00E-06
Area-5: TCE	<0.1	<1.00E-06	<0.1	<1.00E-06	<0.1	<1.00E-06
SWMU 1						
Area-1: TCE	1.1	9.83E-06	0.2	1.42E-06	<0.1	<1.00E-06

[a] Hazard quotients and cancer risks calculated using no action screening values from Appendix A of the Risk Methods Document. The screening value for hazard at a target hazard of 0.1 is 1.60E-03 mg/L. The screening value for cancer risk at a target risk of 1.00E-06 is 1.73E-03 mg/L.
[b] Contaminants with a hazard quotient (HQ) greater than 1 or a cancer risk greater than 1.00E-06 are considered contaminants of concern (COCs).

Table F.21. Hazard and cancer risk predicted from maximum groundwater concentrations derived in BJC 2003 under a scenario that assumes a TCE degradation half-life of 26.6 years[a,b]

Deleted: 7

Source Area	Plant Boundary		Property Boundary		Near Ohio River	
	Hazard Quotient	Cancer Risk	Hazard Quotient	Cancer Risk	Hazard Quotient	Cancer Risk
C-720 Building area						
Area-1: TCE	0.8	7.69E-06	0.3	2.83E-06	<0.1	<1.00E-06
Area-2: TCE	0.3	2.65E-06	0.1	<1.00E-06	<0.1	<1.00E-06
Area-3: TCE	0.2	1.84E-06	<0.1	<1.00E-06	<0.1	<1.00E-06
Area-4: TCE	<0.1	<1.00E-06	<0.1	<1.00E-06	<0.1	<1.00E-06
Area-5: TCE	<0.1	<1.00E-06	<0.1	<1.00E-06	<0.1	<1.00E-06
SWMU 1						
Area-1: TCE	0.8	6.99E-06	0.1	<1.00E-06	<0.1	<1.00E-06

[a] Hazard quotients and cancer risks calculated using no action screening values from Appendix A of the Risk Methods Document. The screening value for hazard at a target hazard of 0.1 is 1.60E-03 mg/L. The screening value for cancer risk at a target risk of 1.00E-06 is 1.73E-03 mg/L.
[b] Contaminants with a hazard quotient (HQ) greater than 1 or a cancer risk greater than 1.00E-06 are considered contaminants of concern (COCs).

F.3. MODELING COMPLETED AS PART OF SOUTHWEST PLUME SITE INVESTIGATION

In order to minimize the uncertainty in understanding the fate and transport of contaminants from sources at SWMU 1 and the C-720 Building area, a preliminary modeling effort that used fixed input values and a probabilistic modeling effort that allowed selected input values to vary were completed. In both cases, in order to be consistent with the modeling matrix in the Risk Methods Document (see Table F.1), fate and transport modeling was completed using the SESOIL and AT123D models. In addition, the Spatial Analysis and Decision Assistance (SADA; UT 2002) model was used to refine the contaminant source areas, and MODFLOW/MODPATH (USGS 2005), along with the PGDP site-wide groundwater flow model (DOE 1998a), were used to better delineate the conceptual site models.

Deleted: , SWMU 4,

Deleted: The following material discusses these modeling efforts and their results.

SESOIL is a one-dimensional vertical transport model for the unsaturated soil zone. SESOIL can consider only one chemical at a time and the model is based on mass balance and equilibrium partitioning of the chemical between phases (dissolved, sorbed, vapor, and pure). The SESOIL model was designed to perform long-term simulations of chemical transport and transformation in the soil. The model uses theoretically derived equations to represent water transport, sediment transport on land surfaces, contaminant transformation, and migration of the contaminant to the atmosphere and groundwater. Climatic data, compartment geometry, and soil and chemical property data are the major components used in the equations. SESOIL was used to model the transport of soil contamination from SWMU 1 and the C-720 Building to the aquifer.

Deleted: b

The MODFLOW/MODPATH models were used to estimate hydraulic gradients, flow distances, and hydraulic conductivities along site-to-receptor flow paths. This information subsequently was used to support the AT123D modeling effort (discussed below). MODFLOW is a three-dimensional, finite difference model capable of simulating both steady-state and transient head distribution for a saturated groundwater flow field. In contrast, MODPATH is a three-dimensional, particle-tracking model capable of using the steady-state head distribution generated by MODFLOW to track flow paths of particles released in the groundwater flow field modeled by MODFLOW. As noted above, the MODPATH model was used to track flow paths of particles released from a location by using the steady-state head distribution generated by MODFLOW.

Deleted: was

Deleted: steady

Together, MODFLOW/MODPATH models were used to trace the fastest site-to-exposure point flow paths to each receptor. Thereafter, hydraulic gradients, flow distances, and hydraulic conductivities along the flow paths were estimated. A more detailed summary of the MODFLOW model development at PGDP is provided in Appendix F, Attachment 6.

The AT123D model was used to model the lateral transport of contaminants in the groundwater to the exposure points. This model is a well known and commonly used analytical groundwater pollutant fate and transport model that computes the spatial-temporal concentration distribution of chemicals in the aquifer system and predicts the transient spread of a chemical plume through a groundwater aquifer. The fate and transport processes accounted for in AT123D are advection, dispersion, adsorption/retardation, and degradation. This model estimates the dissolved concentration of a chemical in three dimensions in the groundwater resulting from a mass release (either continuous, instant or depleting source) over a source area (i.e., point, line, area, or volume source). Predicted contaminant concentrations in groundwater developed by AT123D subsequently are used as inputs for estimating risks and doses to receptors exposed to the contaminated groundwater at each of the exposure points.

Deleted: -

Deleted: decay

Deleted: are

The following material discusses these modeling efforts and their results.

F3.1 PRELIMINARY MODELING

The primary goal of the preliminary modeling was to determine which of the COCs identified in the MEPAS modeling completed as part of the WAG 27 and WAG 3 RI Reports needed to be considered in the probabilistic modeling. In order to meet this goal, the fate and transport of the COCs identified at SWMU 1 and the C-720 Building area were examined using the SESOIL and AT123D models and fixed inputs. For SWMU 1 and the C-720 Building area, the COCs examined were antimony; *cis*- and *trans*-1,2-DCE; TCE; and VC.

Deleted: , SWMU 4,

Deleted: For SWMU 4, the COCs examined were carbon tetrachloride; *cis*-1,2-DCE; TCE; and VC.

F3.1.1 Preliminary Modeling for SWMU 1 and the C-720 Building Area

Preliminary modeling for SWMU 1 and the C-720 Building area was performed using SADA, SESOIL, MODFLOW/MODPATH, and AT123D models. The selected POEs where groundwater concentration of the COCs was estimated were the plant boundary, the property boundary, and near the Ohio River (see Fig. F.10).

In summary, the following approach was used to evaluate the migration of the selected COCs from the source areas at SWMU 1 and the C-720 Building to groundwater and subsequently to the POEs.

1. Develop a conceptual model for each source area utilizing information developed during the Southwest Plume SI, WAG 27 RI Report, and the GWOU FS Report, including locating the POEs at the plant boundary, property boundary, and near the Ohio River using MODPATH and information from the PGDP site-wide groundwater flow model.

2. Refine the source zones for each COC found in the source areas at the SWMU 1 and the C-720 Building using the SADA model.

3. Perform leachate modeling using SESOIL to estimate the rate of contaminant loading over time from each source area to the RGA.

4. Complete saturated flow and contaminant transport modeling using contaminant loading information from SESOIL and AT123D.

Fig. F.10. Points of exposure used in SWMU 1 and C-720 area fate and transport modeling.

F3.1.1.1 Conceptual model for source areas at SWMU 1 and the C-720 Building area

As discussed in the main text of the SI Report, the conceptual models for SWMU 1 and the C-720 Building area are as follows.

SWMU 1: The source of contaminants at SWMU 1 was the past surface application of waste oils when this area was used as a landfarm. Subsequently, some waste oils directly impacted soils below or adjacent to the areas where waste oils were applied and, through vertical infiltration in soil, contaminated the groundwater underlying these sources. Contaminated groundwater migrates laterally and vertically, which could carry the contaminants to the three POEs.

C-720 Building area: The source of contaminants at the C-720 Building area is believed to be past releases through floor drains and surface spills. Subsequently, released contaminants impacted soils below or adjacent to the release locations and, through vertical infiltration in soil, contaminated the groundwater underlying these sources. Contaminated groundwater migrates laterally and vertically, which could carry the contaminants to the three POEs.

At both SWMU 1 and the C-720 Building area, three hydrogeologic units underlying the source areas could have been impacted as contaminants migrated. These units, which control the flow of groundwater and contaminant migration at these source areas, are, in descending order:

1. UCRS – approximately 60 ft of silt and clay with discontinuous lenses of sand and gravel beneath an overlying loess deposit;

2. RGA – approximately 40 ft of gravel, sand, and silt deposits that overlie the McNairy Formation; and

3. McNairy Formation – approximately 225 ft of a sandy, silty confining clay

Because previous work has shown that groundwater flow in the UCRS is primarily vertical and that lateral groundwater flow in the McNairy Formation is significantly slower than that in the RGA, the primary contaminant pathway considered in the fate and transport modeling is vertical migration through the UCRS followed by lateral migration in the RGA to the POEs.

F3.1.1.2 Source zone refinement at SWMU 1 and the C-720 Building area

Soil and groundwater results for antimony; TCE; *cis*- and *trans*-1,2-DCE; and VC were taken from the PGDP-Oak Ridge Environmental Information System (OREIS). Information for each result used in the analysis included the sample and station identifier, the date of sample collection, the COC analyzed for, the location and depth at which the sample was taken, whether the COC was detected or not detected at the sample quantitation limit (SQL), and the result in mg/kg. Results were subsequently used to characterize the source zones using geospatial interpolation techniques in SADA (please see the discussion on source term development in Attachment F.1).

The techniques in SADA that can be used for source term development are nearest neighbor, natural neighbor, inverse distance, ordinary kriging, and indicator kriging. The nearest neighbor technique was selected for source zone refinement because it yielded results that were most compatible with the conceptual site model of contaminant release summarized above. In addition, nearest neighbor interpolation provided greater contrast in contaminant concentrations and greater ease in source delineation through visual inspection.

Each potential TCE source area was discretized using rows and columns with a uniform spacing of 25 ft. Multiple domains with varying depths were used to characterize the TCE source area vertically in relation to the existing aquifers; therefore, the domain was further discretized into horizontal layers with uniform thickness of 10 ft. Subsequently, a source model was set-up for each domain.

Results for each domain were compiled, and TCE concentrations in each cell of the domain were predicted using geospatial interpolation. Sampling results were scattered throughout the domain, and the interpolation smoothed the predicted concentrations over the domain providing an average concentration for each cell. The complete characterization involved initial interpolation runs of the data within each domain, a visual inspection of the results of the interpolation runs, the selection of an acceptable interpolation, a final interpolation, and an analysis (post-processing) of the final interpolation. In this work, the average TCE concentration, planer area, and bulk mass of TCE within a lower and an upper concentration bound (limits) were estimated. The lower bound was set at 0 mg/kg, and the upper bound was set at the maximum TCE concentration. The following sections present additional site-specific information developed during TCE source term refinement.

SWMU 1

SWMU 1 occupies an area of approximately 96,300 ft^2 (2.2 acre); however, the area of TCE contamination was found to cover approximately 8,712 ft^2 (0.2 acre). The thickness of the contaminated mass within the UCRS was estimated to be 55 ft or to the top of the RGA.

To define the extent of contamination at varying depths, the contaminated mass was divided into six layers. Each of the six layers, beginning from the ground surface, is 10-ft thick; however, only the top 5-ft of layer 6 was used in the volume and mass calculations to correctly approximate the 55-ft thickness of the UCRS at SWMU 1.

Deleted: The first five
Deleted: layers
Deleted: are
Deleted: each
Deleted: were
Deleted: .
Deleted: H
Deleted: and the sixth layer was 5-ft thick.

Initially the TCE concentration defining the source zone (i.e., lower bound value) was set at 0 mg/kg [i.e., the cells with soil concentration (C_s) greater than or equal to 0 mg/kg were used to derive source zone parameters] for each layer and the average concentration, area, volume, and mass of TCE were estimated. In order to select the source area, the lower bound concentration was allowed to increase to larger values (e.g., 0.05 mg/kg, 0.1 mg/kg, 0.2 mg/kg, etc.), and the source zone associated with each concentration was estimated. The lower bound concentrations ultimately selected for each layer varied from the TCE detection limit to 0.1 mg/kg. Generally, the average TCE concentration within each layer increased as the area of the source zone decreased. The source zones and average concentrations were then inspected and values for use in SESOIL modeling were selected (see Attachment F.1). Once the size of the source zones and source concentrations were selected, the mass of TCE in each source zone was estimated using an average bulk density (ρ_b) of 1.46 g/cm^3 (DOE 1999a).

Figure F.11 shows a block diagram of the extent of the TCE source area developed using soil concentration data for SWMU 1. As noted earlier, these results were derived using nearest neighbor interpolation. The source terms for TCE within each source zone at SWMU 1 are presented in Table F.22. As shown in the table, the size of sources varied between the layers.[1]

Deleted: 8

[1] Because SESOIL cannot account for different areas in different layers, the input area for SESOIL modeling was set to the SADA estimated area for Layer 2 (3,125 ft^2), which was the layer found to contain the greatest contaminant mass. The average concentrations derived by SADA were assumed to be present throughout the layer.

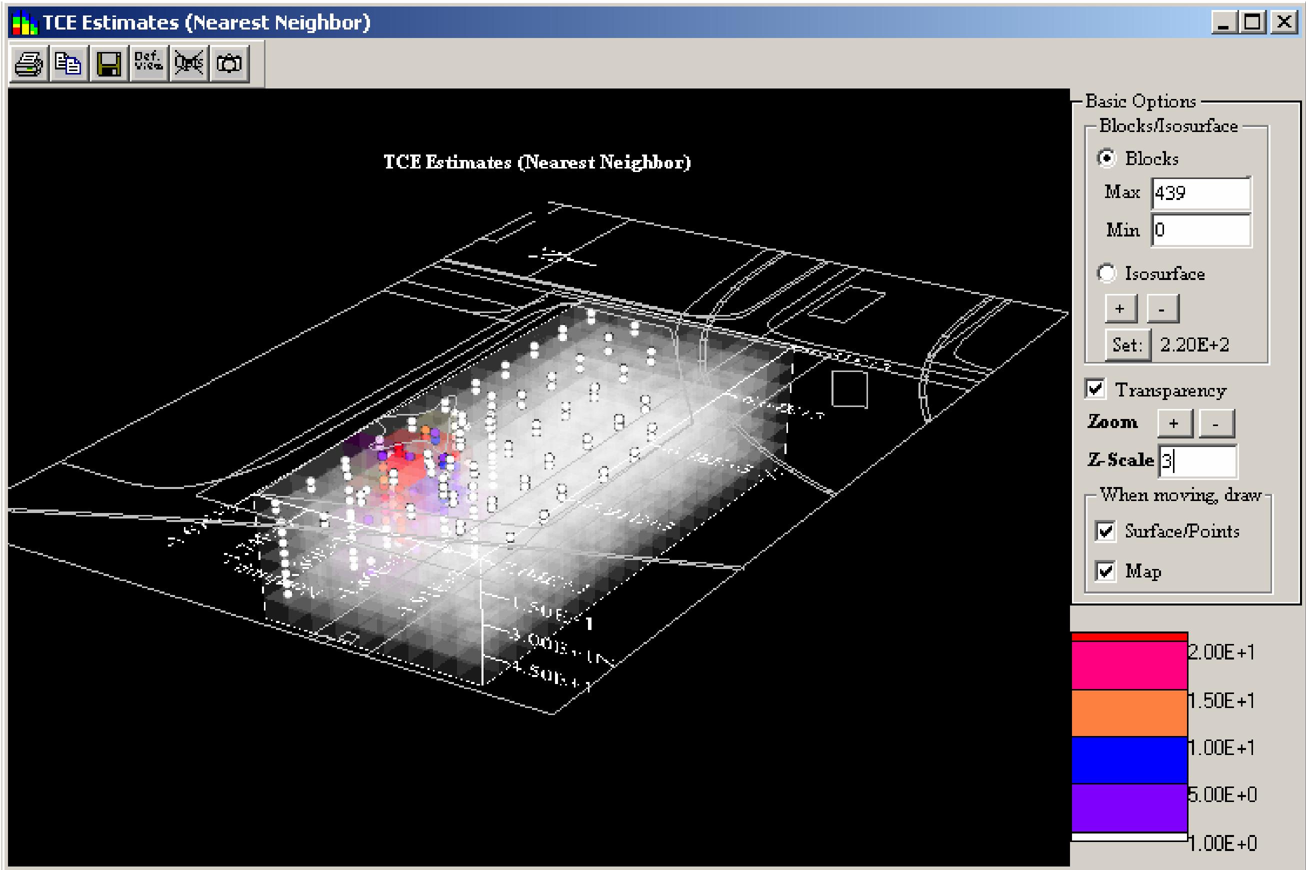


Fig. F.11. Block diagram of TCE soil contamination in the UCRS at SWMU 1 (all values in mg/kg).

Table F.22. Summary of source term characteristics developed by SADA for SWMU 1

Deleted: 8

Layer	Depth (ft)	Average (mg/kg)	Area (ft^2)	Volume (ft^3)	Mass[a] (g)
		Trichloroethene			
Layer 1	00 – 10	7.59	4,375	43,750	13,723
Layer 2	10 – 20	110.8	3,125	31,250	143,177
Layer 3	20 – 30	17.6	6,250	62,500	45,503
Layer 4	30 – 40	13.0	5,625	56,250	30,283
Layer 5	40 – 50	13.6	5,625	56,250	31,516
Layer 6	50 – 55	5.74	7,500	37,500	8,902
		Total Mass			273,104
		cis-1,2-Dichloroethene			
Layer 1	00 – 10	6.00	4,375	43,750	10,852
Layer 2	10 – 20	0.046	3,125	31,250	59
Layer 3	20 – 30	0.086	6,250	62,500	222
Layer 4	30 – 40	1.7	5,625	56,250	3,953
Layer 5	40 – 50	1.0	5,625	56,250	2,326
Layer 6	50 – 55	0.023	7,500	37,500	36
		Total Mass			17,449
		trans-1,2-Dichloroethene			
Layer 1	00 – 10	16.0	4,375	43,750	28,940
Layer 2	10 – 20	1.5	3,125	31,250	1,938
Layer 3	20 – 30	1.5	6,250	62,500	3,876
Layer 4	30 – 40	0.6	5,625	56,250	1,395
Layer 5	40 – 50	1.4	5,625	56,250	3,256
Layer 6	50 – 55	0	7,500	37,500	0
		Total Mass			39,405
		Vinyl chloride			
Layer 1	00 – 10	0.7	4,375	43,750	1,266
Layer 2	10 – 20	0.0033	3,125	31,250	4
Layer 3	20 – 30	0.088	6,250	62,500	227
Layer 4	30 – 40	0.012	5,625	56,250	28
Layer 5	40 – 50	0.0095	5,625	56,250	22
Layer 6	50 – 55	0.018	7,500	37,500	28
		Total Mass			1,576
		Antimony			
Layer 1	00 – 10	1.72	4,375	43,750	3,111
Layer 2	10 – 20	0.6	3,125	31,250	775
Layer 3	20 – 30	0.6	6,250	62,500	1,550
Layer 4	30 – 40	0.7	5,625	56,250	1,628
Layer 5	40 – 50	0	5,625	56,250	0
Layer 6	50 – 55	0	7,500	37,500	0
		Total Mass			7,064

[a] Mass calculated using an average bulk density of 1.46 g/cm^3.

SADA was not utilized for developing the source terms for other COCs from SWMU 1 (e.g., *cis*-1, 2-DCE, *trans*-1, 2-DCE, VC, and antimony) because these COCs were detected sporadically, and the maximum detected concentrations were quite low. Therefore, the source zone sizes used in SESOIL modeling for these other COCs were set equal to those used for TCE, and the source zone concentrations were set at the maximum detected concentration. The source terms for these other COCs are shown in Table F.22. As shown there, the total mass of each of the other COCs in the source area is only a fraction (i.e., 0.6% for VC to 15% for *trans*-1,2-DCE) of that of the total mass of TCE.

Deleted: 8

C-720 Building area

The area around the C-720 Building considered in the SADA modeling occupies an area of approximately 893,000 ft^2 (20.5 acre); however, the area of TCE contamination was found to cover approximately 15,000 ft^2 (0.3 acre). The thickness of contaminated mass within the UCRS was estimated to be 60 ft or to the top of the RGA.

To define the extent of contamination at varying depths, the contaminated mass was divided into six layers of equal thickness (i.e., 10-ft), and a procedure matching that used for SWMU 1 was used to determine the size, TCE concentration, and TCE mass of each source zone. Figure F.12. shows a block diagram of the extent of the TCE source area developed using soil concentration data for the area around the C-720 Building. Consistent with SWMU 1 modeling, these results were derived using nearest neighbor interpolation. The figure indicates that the primary source zone in soil at the C-720 Building is found at the southeastern end of the building, with minor sources on the northeastern side of the building. Consistent with the SWMU 1 analysis, the major source area located in the southeastern end of the building is the focus of the C-720 Building area fate and transport modeling.

The source terms for TCE and the other COCs within the source zones at the C-720 Building are presented in Table F.23. Consistent with the source term delimitation performed for SWMU 1, the source terms for other COCs used their maximum detected concentrations and the source zone sizes developed for TCE. As shown there, the total mass of each of the other COCs in the source area is only a fraction (i.e., 1% for *trans*-1,2-DCE to 13% for antimony) of the total mass of TCE predicted.[2]

Deleted: 9

F3.1.1.3 Leachate modeling for SWMU 1 and the C-720 Building area using SESOIL

The SESOIL model, used for leachate modeling, estimates contaminant concentrations in the soil profile following introduction via direct application and/or interaction with other media. The model defines the soil compartment as a soil column extending from the ground surface through the unsaturated zone to the top of the saturated soil zone/water table. Processes simulated in SESOIL are categorized in three cycles—the hydrologic cycle, sediment cycle, and pollutant cycle. Each cycle is a separate submodule in the SESOIL code. The hydrologic cycle includes rainfall, surface runoff, infiltration, soil-water content, evapotranspiration, and groundwater recharge. The sediment cycle includes sediment washload as a result of rainstorms, i.e., soil erosion that results from surface runoff. The pollutant cycle includes convective transport, volatilization, adsorption/desorption, and degradation/decay. A contaminant in SESOIL can partition in up to four phases (liquid, adsorbed, air, and pure).

[2] The area of each layer used in SESOIL modeling subsequently was set to the area of the source zone with maximum TCE mass (i.e., Layer 3; 15,000 ft^2).

051706

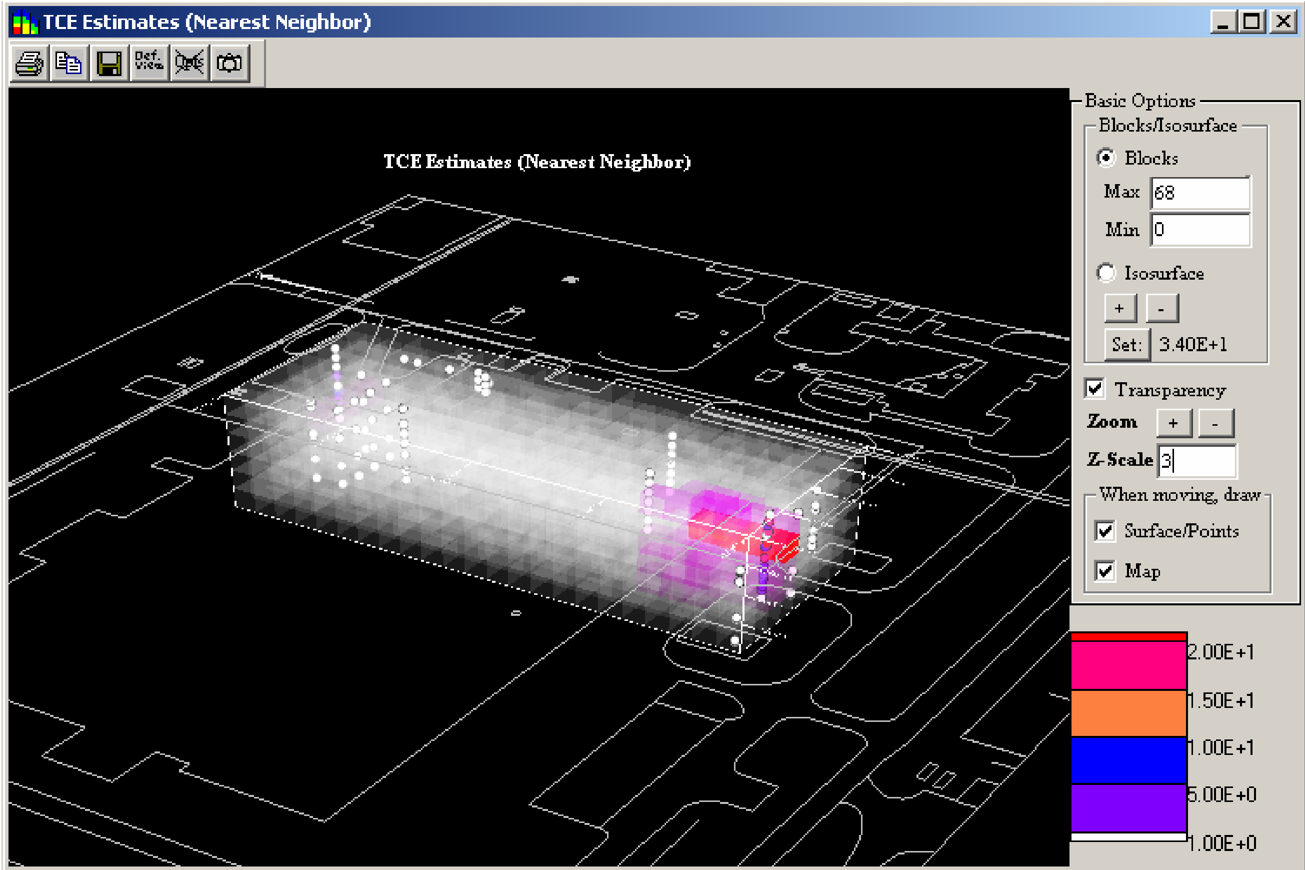


Fig. F.12. Block diagram of TCE soil contamination in the UCRS at C-720 Building area (all values in mg/kg.)

Table F.23. Summary of source term characteristics developed by SADA for the C-720 Building area

Deleted: 9

Layer	Depth (ft)	Average (mg/kg)	Area (ft^2)	Volume (ft^3)	Mass[a] (g)
		Trichloroethene			
Layer 1	00 – 10	2.96	7,500	75,000	9,185
Layer 2	10 – 20	6.37	7,500	75,000	19,751
Layer 3	20 – 30	11.9	15,000	150,000	73,900
Layer 4	30 – 40	1.55	6,875	68,750	4,393
Layer 5	40 – 50	1.20	6,875	68,750	3,411
Layer 6	50 – 60	0.10	6,875	68,750	282
		Total Mass			110,922
		cis-1,2-Dichloroethene			
Layer 1	00 – 10	3.2	7,500	75,000	9,922
Layer 2	10 – 20	0.75	7,500	75,000	2,326
Layer 3	20 – 30	0.019	15,000	150,000	118
Layer 4	30 – 40	0.052	6,875	68,750	148
Layer 5	40 – 50	0	6,875	68,750	0
Layer 6	50 – 60	0	6,875	68,750	0
		Total Mass			12,513
		trans-1,2-Dichloroethene			
Layer 1	00 – 10	0	7,500	75,000	0
Layer 2	10 – 20	0.4	7,500	75,000	1,240
Layer 3	20 – 30	0	15,000	150,000	0
Layer 4	30 – 40	0	6,875	68,750	0
Layer 5	40 – 50	0	6,875	68,750	0
Layer 6	50 – 60	0	6,875	68,750	0
		Total Mass			1,240
		Vinyl chloride			
Layer 1	00 – 10	0.4	7,500	75,000	1,240
Layer 2	10 – 20	0.4	7,500	75,000	1,240
Layer 3	20 – 30	0	15,000	150,000	0
Layer 4	30 – 40	0	6,875	68,750	0
Layer 5	40 – 50	0	6,875	68,750	0
Layer 6	50 – 60	0	6,875	68,750	0
		Total Mass			2,480
		Antimony			
Layer 1	00 – 10	0.54	7,500	75,000	1,674
Layer 2	10 – 20	0.55	7,500	75,000	1,705
Layer 3	20 – 30	1.59	15,000	150,000	9,860
Layer 4	30 – 40	0.61	6,875	68,750	1,734
Layer 5	40 – 50	0	6,875	68,750	0
Layer 6	50 – 60	0	6,875	68,750	0
		Total Mass			14,974

[a] Mass calculated using an average bulk density of 1.46 g/cm^3.

Data requirements for SESOIL are not extensive, utilizing a minimum of soil and chemical parameters and monthly or seasonal meteorological values as input. Output of the SESOIL model includes contaminant concentrations at various soil depths and contaminant loss from the unsaturated soil zone in terms of surface runoff, percolation to groundwater, volatilization, and degradation. SESOIL also predicts the monthly contaminant load to the water table from the area of concern that can be directly input into the AT123D model for contaminant migration in the saturated zone to selected downgradient POEs.

For this modeling effort, the source zones were arranged in four layers. The first, second, and third layers formed the loading zone. The first layer was subdivided into three sublayers, the second layer was subdivided into two sublayers of equal thickness (10 ft each). and, consistent with the SADA modeling, the thickness of the third layer was 5 ft at SWMU 1 and 10 ft at the C-720 Building. The sublayers for the first layer corresponded to Layers 1, 2, and 3 developed using SADA, the sublayers for the second layer corresponded to Layers 4 and 5 developed using SADA, and the third layer corresponded to Layer 6 developed using SADA. Multiple layers were used for the loading zone to help obtain better resolution of contaminant loading and better representation of contaminant concentration by depth. A fourth layer (just above the water table) was used to represent the leaching zone and was set to a thickness of 0.5 ft. This layer was included to allow for the reading of predicted leachate concentrations at the water table/vadose zone interface for later use by AT123D modeling. The application parameters, including initial source concentrations and thickness of each layer with number of sublayers, are shown in Tables F.24 and F.25.

Deleted: 3
Deleted: 2
Deleted: 30
Deleted: 31

The hydrologic modeling parameters used in the SESOIL modeling were based on results in the Southwest Plume SI Report, WAG 27 RI Report, and the GWOU FS Report. The modeling parameters were selected so that they would represent site conditions, could account for expected variability in the hydraulic system, and would be unlikely to underestimate contaminant release and transport. Table F.26 presents the site parameters used for SESOIL modeling.

Deleted: 32

The chemical-specific parameters used in the SESOIL modeling included each COC's solubility in water, organic carbon partition coefficient (K_{oc}), Henry's Law constant, distribution coefficient (K_d), diffusion coefficients in air and water, and, for TCE, degradation rate constant. These chemical properties are presented in Table F.27. The K_d values for TCE; *cis-* and *trans*-1,2-DCE, and VC, which are volatile organic compounds (VOCs), were derived using the following relationship.

Deleted: 33
Deleted: distribution coefficient (
Deleted:)

$$K_d = K_{oc} \times f_{oc}$$

where: K_d is the distribution coefficient,
K_{oc} is the organic carbon partition coefficient, and
f_{oc} is the fraction of organic carbon for source area soils.

The f_{oc} used for the unsaturated zone at SWMU 1 was 0.08%, and that used for the C-720 Building area was 0.09% (DOE 1998). As a first approximation, the degradation rates of all VOCs were assumed to be zero (i.e., no degradation). However, if the predicted modeling results indicated that concentrations of a VOC at a POE could exceed its MCL, then additional analysis using two degradation rates was performed. Because only TCE exceeded its MCL at the POE, these additional analyses were performed for TCE only. In summary, the degradation rates used for TCE matched those used in the earlier TCE modeling completed for SWMU 1 and the C-720 Building area and were (1) no degradation or a half life equal to infinity; (2) literature based degradation half life of 4.5 years (Howard et al. 1991); and (3) PGDP site-specific degradation half life of 26.6 (LMES 1997).

Table F.24. Application data for preliminary SESOIL modeling of SWMU 1

Deleted: 30

Contaminant of Concern	Number of Layers	Layer Number	Thickness of Layer (ft)	Number of Sublayers	Sublayer Number	Concentration (mg/kg)
Trichloroethene	4	1	30	3	1	7.59
					2	110.8
					3	17.61
		2	20	2	1	13.02
					2	13.55
		3	10	1	1	5.74
		4	0.5	1	1	0
cis-1,2-Dichloroethene	4	1	30	3	1	6
					2	0.046
					3	0.086
		2	20	2	1	1.7
					2	1
		3	10	1	1	0.023
		4	0.5	1	1	0.2
trans-1,2-Dichloroethene	4	1	30	3	1	16
					2	1.5
					3	1.5
		2	20	2	1	0.6
					2	1.4
		3	10	1	1	0
		4	0.5	1	1	0
Vinyl chloride	4	1	30	3	1	0.7
					2	0.0033
					3	0.088
		2	20	2	1	0.012
					2	0.0095
		3	10	1	1	0.018
		4	0.5	1	1	0.018
Antimony	4	1	30	3	1	1.72
					2	0.6
					3	0.6
		2	20	2	1	0.7
					2	0
		3	10	1	1	0
		4	0.5	1	1	0

Table F.25. Application data for preliminary SESOIL modeling of the C-720 Building area

Deleted: 31

Contaminant of Concern	Number of Layers	Layer Number	Thickness of Layer (ft)	Number of Sublayers	Sublayer Number	Concentration (mg/kg)
Trichloroethene	4	1	30	3	1	2.96
					2	6.37
					3	11.92
		2	20	2	1	1.55
					2	1.2
		3	10	1	1	0.1
		4	0.5	1	1	0
cis-1,2-Dichloroethene	4	1	30	3	1	3.2
					2	0.75
					3	0.019
		2	20	2	1	0.052
					2	0
		3	10	1	1	0
		4	0.5	1	1	0
trans-1,2-Dichloroethene	4	1	30	3	1	0
					2	0.4
					3	0
		2	20	2	1	0
					2	0
		3	10	1	1	0
		4	0.5	1	1	0
Vinyl chloride	4	1	30	3	1	0.4
					2	0.4
					3	0
		2	20	2	1	0
					2	0
		3	10	1	1	0
		4	0.5	1	1	0
Antimony	4	1	30	3	1	0.54
					2	0.55
					3	1.59
		2	20	2	1	0.61
					2	0
		3	10	1	1	0
		4	0.5	1	1	0

Table F.26. Soil parameters used in preliminary SESOIL modeling of SWMU 1 and the C-720 Building area

Deleted: 32

Input Parameter	SWMU 1	C-720 Building	Source
Soil type	Silty clay	Silty clay	PGDP site-specific
Bulk density (g/cm^3)	1.46	1.46	Laboratory analysis
Percolation rate (cm/year)	11	11	PGDP Calibrated Model
Intrinsic permeability (cm^2)	1.65E-10	1.65E-10	Calibrated
Disconnectedness index	10	10	Calibrated
Porosity	0.45	0.45	Laboratory analysis
Depth to water table (m)	18.3	18.3	Site specific (to RGA) based on field observation
Organic carbon content (f_{oc}) (%)	0.08	0.09	Laboratory analysis
Frendlich equation exponent	1	1	SESOIL default value

Table F.27. Chemical-specific parameters of the contaminants of concern used in preliminary SESOIL modeling

Deleted: 33

Contaminant of Concern	Mol. Wt. (MW) (g/gmol)	Solubility in water (mg/L)	Diffusion in air (cm2/s)	Diffusion in water (m2/hr)	Henry's Constant (atm.m3/mol)	K_{oc} (L/kg)	K_d[a] (L/kg) SWMU-1	K_d[a] (L/kg) C-720	Degradation Half Life[b] (years)
Trichloroethene	131	1,100	0.08	3.28E-06	0.0103	94	0.0752	0.0846	infinite, 4.5, 26.6
cis-1,2-Dichloroethene	97	3,500	0.07	4.07E-06	0.00408	36	0.0288	0.0324	Infinite
trans-1,2-Dichloroethene	97	6,300	0.07	4.28E-06	0.00938	38	0.0304	0.0342	infinite
Vinyl chloride	63	2,760	0.11	4.43E-07	0.0270	19	0.0152	0.0171	infinite
Antimony	122	445	NA	3.60E-07	NA	NA	45	45	NA

[a] K_d of an organic compound depends on the soil's organic carbon content (f_{oc}) and compound's organic carbon partition coefficient (K_{oc}).
[b] TCE was modeled using three degradation rates. Please see the text for additional discussion.

F3.1.1.4 Saturated flow and contaminant transport modeling for SWMU 1 and the C-720 Building area using AT123D

The AT123D model used for saturated flow and contaminant transport modeling computes the spatial-temporal concentration distribution of chemicals in the aquifer system and predicts the transient spread of a chemical plume through a groundwater aquifer. The fate and transport processes accounted for in AT123D are advection, dispersion, adsorption/retardation, and decay. This model can be used as a tool for estimating the dissolved concentration of a chemical in three dimensions in the groundwater resulting from a mass release (either continuous or instant or depleting source) over a source. In the present modeling, the time varying mass loading was transferred from the SESOIL output file, and the concentrations of COCs were estimated at the three selected POEs.

The hydrogeologic parameters used in AT123D modeling were based on results in the WAG 27 RI Report and the GWOU FS Report and are presented in Table F.28. The chemical-specific parameters match those used in SESOIL modeling (see Table F.27), except no degradation of VOCs was assumed.

Deleted: 34

Deleted: 33

Table F.28. Hydrogeologic parameters used in AT123D modeling

Deleted: 34

Input Parameter	SWMU 1	C-720 Building	Source
Bulk density (kg/m^3)	1,670	1,670	Laboratory analysis
Effective porosity	0.3	0.3	PGDP sitewide model calibrated value
Hydraulic conductivity (m/hour)	19.05	19.05	PGDP sitewide model calibrated value
Hydraulic gradient	0.0004	0.0004	PGDP sitewide model calibrated value
Aquifer thickness	9.14 m 30 ft	9.14 m 30 ft	Site average
Longitudinal dispersivity (m)	15	15	Approximate values used in the past
Density of water (kg/m^3)	1,000	1,000	Default
Fraction of organic carbon (%)	0.02	0.02	Laboratory analysis
Distance to Plant Boundary	170 m 558 ft	762 m 2,500 ft	Approximate downgradient distance in the RGA based on particle track.
Distance to Property Boundary	915 m 3,000 ft	1,460 m 4,788 ft	Approximate downgradient distance in the RGA based on particle track.
Distance to Ohio River	7,320 m 24,000 ft	7,910 m 25,944 ft	Approximate downgradient distance in the RGA based on particle track.
Source Area	290 m^2 3,125 ft^2	1,394 m^2 15,000 ft^2	These dimensions derived from SADA analysis and contaminant specific. Please see text.

F3.1.1.5 Results of preliminary modeling of SWMU 1 and the C-720 Building area

The predicted maximum groundwater concentrations at the POEs for the COCs modeled at SWMU 1 and the C-720 Building area are summarized in Table F.29. As shown in the table, the predicted maximum groundwater concentrations of TCE at the plant boundary and property boundary may exceed the MCL for TCE at all degradation rates, except at a degradation half life of 4.5 yrs for SWMU 1. TCE is expected to be below its MCL at the Ohio River POE under scenarios assuming both the 4.5 yr and 26.6 yr TCE half lives, but not under the scenario where degradation is assumed not to occur. Under the scenario that assumes no degradation, the maximum groundwater concentration at the Ohio River POE is predicted to be slightly over the TCE MCL (0.0057 mg/L versus 0.005 mg/L). None of the other COCs are expected to attain concentrations that exceed their respective MCLs at any of the POEs.

Deleted: 35

The HQs and cancer risks calculated using the maximum groundwater concentrations and no action risk-based screening values taken from Appendix A of the Risk Methods Document are presented in Table F.30. As shown there, the predicted TCE concentrations result in the greatest HQs and cancer risks; therefore, TCE is the most important COC for contaminant migration at SWMU 1 and the C-720 Building area.

Deleted: 6

Figures F.13 through F.26 show the predicted concentrations over time at each POE for COCs migrating from SWMU 1 and the C-720 Building area. As shown in these figures, the VOC COCs are predicted to attain their maximum concentrations at the POEs and return to lower concentrations within a short period of time. For TCE, concentrations at the plant boundary POE (Figs. F.13 and F.20) are predicted to fall below the MCL within 60 and 140 years for the C-720 Building area and SWMU 1, respectively, assuming no degradation; and within 40 and 80 years, respectively, assuming a degradation half-life of 26 years. At the property boundary POE (Figs. F.14 and F.21), TCE concentrations are predicted to fall below the MCL within 50 and 95 years for the C-720 Building area and SWMU 1, respectively, assuming no degradation; and within 25 and 55 years, respectively, assuming a degradation half-life of 26.6 years. At the Ohio River POE (Figs. F.15 and F.22), TCE concentrations are predicted to be below MCL at all the time under all degradation scenarios for the C-720 Building area, and TCE concentrations are predicted to fall below the MCL within 70 years for the SWMU 1 area, assuming no degradation.

Table F.29. Concentrations of the contaminants of concern in groundwater predicted in preliminary SESOIL and AT123D modeling of the SWMU 1 and C-720 Building area sources

Deleted: 35

Contaminant of Concern	Predicted Maximum Groundwater Concentration At the Plant Boundary (mg/L)	At the Property Boundary (mg/L)	Near the Ohio River (mg/L)	MCL (mg/L)
		SWMU 1		
Trichloroethene (no degradation)	***2.7E-01***	***4.7E-02***	***5.7E-03***	5E-03
Trichloroethene (26.6 year half life)	***1.9E-01***	***3.0E-02***	1.6E-03	5E-03
Trichloroethene (4.5 year half life)	***5.9E-02***	***1.0E-02***	1.2E-03	5E-03
cis-1,2-Dichloroethene	1.6E-02	3.1E-03	0	7E-02
trans-1,2-Dichloroethene	2.0E-02	3.6E-03	0	1E-01
Vinyl chloride	1.6E-04	3.0E-05	0	2E-03
Antimony	0	0	0	6E-03
		C-720 Building area		
Trichloroethene (no degradation)	***1.9E-02***	***9.9E-03***	1.8E-03	5E-03
Trichloroethene (26.6 year half life)	***1.2E-02***	***5.5E-03***	4.3E-04	5E-03
Trichloroethene (4.5 year half life)	1.7E-03	5.0E-04	7.0E-07	5E-03
cis-1,2-Dichloroethene	3.2E-03	2.1E-03	0	7E-02
trans-1,2-Dichloroethene	1.5E-04	7.0E-05	0	1E-01
Vinyl chloride	8.0E-05	4.0E-05	0	2E-03
Antimony	0	0	0	6E-03

Values in bold, italic font exceed the COC's MCL.

Table F.30. Hazard and cancer risk predicted from maximum groundwater concentrations derived in preliminary modeling of SWMU 1 and the C-720 Building area using SESOIL and AT123D[a,b]

Deleted: 6

Contaminant of Concern	Plant Boundary Hazard Quotient	Plant Boundary Cancer Risk	Property Boundary Hazard Quotient	Property Boundary Cancer Risk	Near Ohio River Hazard Quotient	Near Ohio River Cancer Risk
SWMU 1						
TCE (no degradation)	16.6	1.54E-04	2.9	2.72E-05	0.4	3.31E-06
TCE (26.6 year half life)	11.9	1.10E-04	1.9	1.71E-05	0.1	<1.00E-06
TCE (4.5 year half life)	3.7	3.43E-05	0.6	5.95E-06	<0.1	<1.00E-06
cis-1,2-DCE	0.6	No Value	0.1	No Value	<0.1	No Value
trans-1,2-DCE	0.4	No Value	<0.1	No Value	<0.1	No Value
Vinyl chloride	<0.1	4.57E-06	<0.1	<1.00E-06	<0.1	<1.00E-06
Antimony	<0.1	No Value	<0.1	No Value	<0.1	No Value
C-720 Building area						
TCE (no degradation)	1.2	1.08E-05	0.6	5.70E-06	0.1	1.04E-06
TCE (26.6 year half life)	0.7	6.71E-06	0.3	3.18E-06	<0.1	<1.00E-06
TCE (4.5 year half life)	0.1	<1.00E-06	<0.1	<1.00E-06	<0.1	<1.00E-06
cis-1,2-DCE	0.1	No Value	<0.1	No Value	<0.1	No Value
trans-1,2-DCE	<0.1	No Value	<0.1	No Value	<0.1	No Value
Vinyl chloride	<0.1	2.29E-06	<0.1	1.14E-06	<0.1	<1.00E-06
Antimony	<0.1	No Value	<0.1	No Value	<0.1	No Value

[a] Hazard quotients and cancer risks calculated using no action screening values from Appendix A of the Risk Methods Document. The screening values in mg/L for hazard at a target hazard of 0.1 and cancer risk at a target risk of 1.00E-06 are as follows.

TCE Cancer Risk 1.73E-03	TCE Hazard 1.60E-03
cis-1,2-DCE Cancer Risk No value	*cis*-1,2-DCE Hazard 2.73E-03
trans-1,2-DCE Cancer Risk No value	*trans*-1,2-DCE Hazard 5.48E-03
Vinyl chloride Cancer Risk 3.50E-05	Vinyl chloride Hazard 3.06E-03

[b] Contaminants with a hazard quotient (HQ) greater than 1 or a cancer risk greater than 1.00E-06 are considered contaminants of concern (COCs).

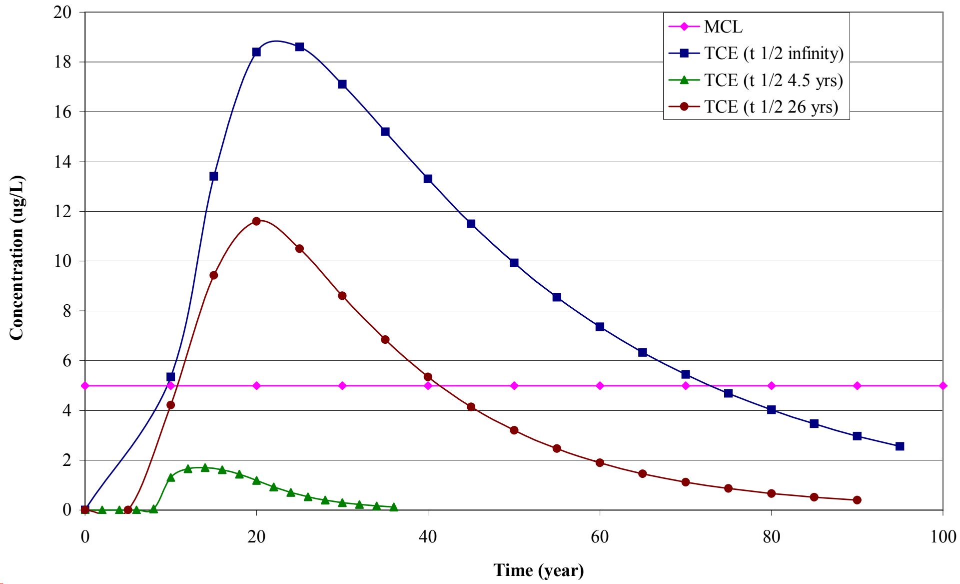


Fig. F.13. Predicted TCE concentration in groundwater at the plant boundary POE based on contaminant leaching from the C-720 Building area.

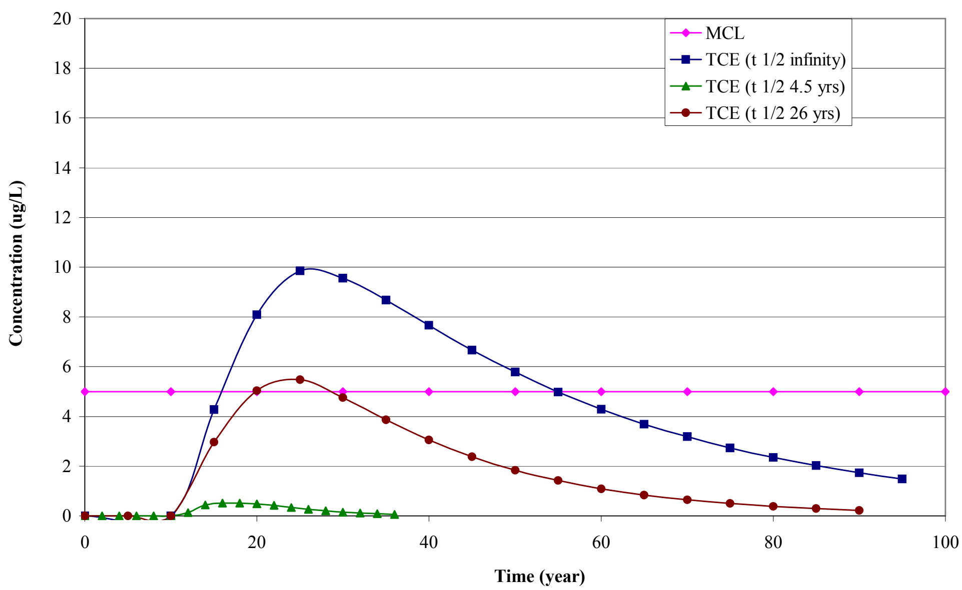


Fig. F.14. Predicted TCE concentration in groundwater at the property boundary POE based on contaminant leaching from the C-720 Building area.

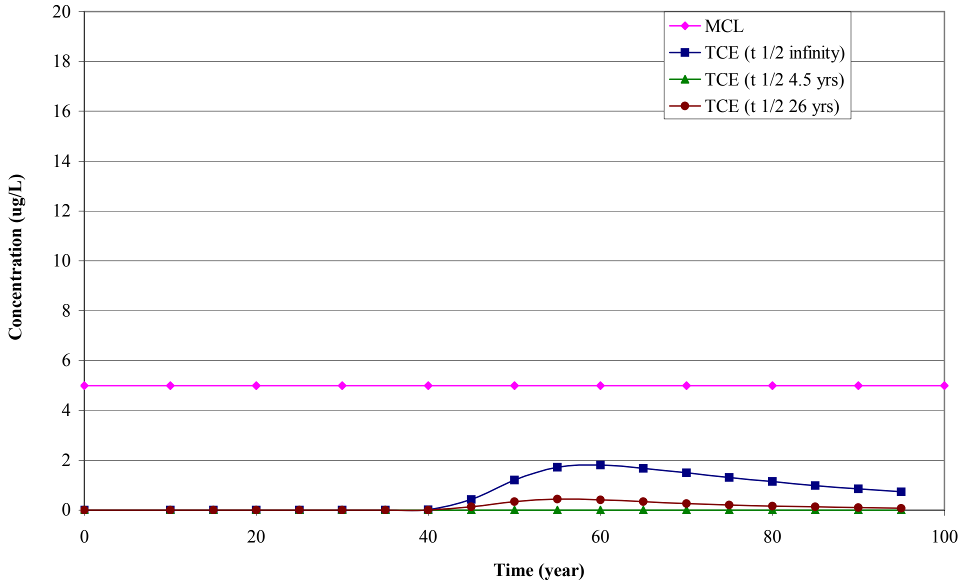


Fig. F.15. Predicted TCE concentration in groundwater at the Ohio River POE based on contaminant leaching from the C-720 Building area.

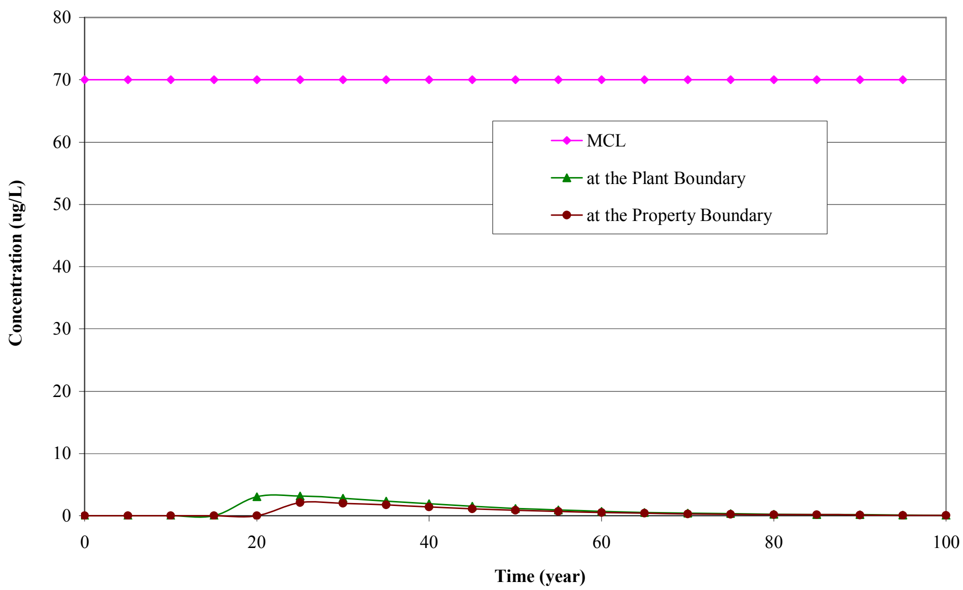


Fig. F.16. Predicted *cis*-1,2-DCE concentration in groundwater at all POEs based on contaminant leaching from the C-720 Building area.

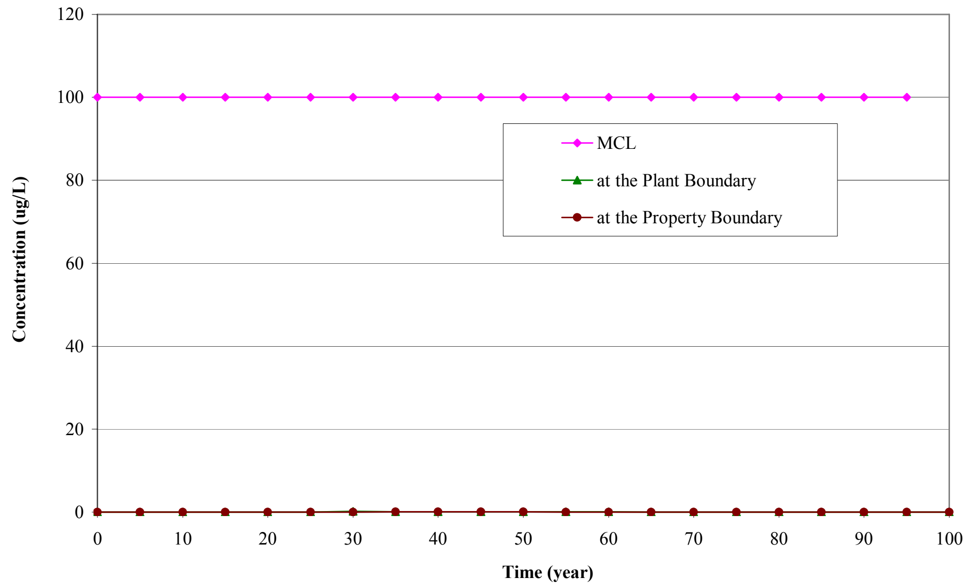


Fig. F.17. Predicted *trans*-1,2-DCE concentration in groundwater at all POEs based on contaminant leaching from the C-720 Building area.

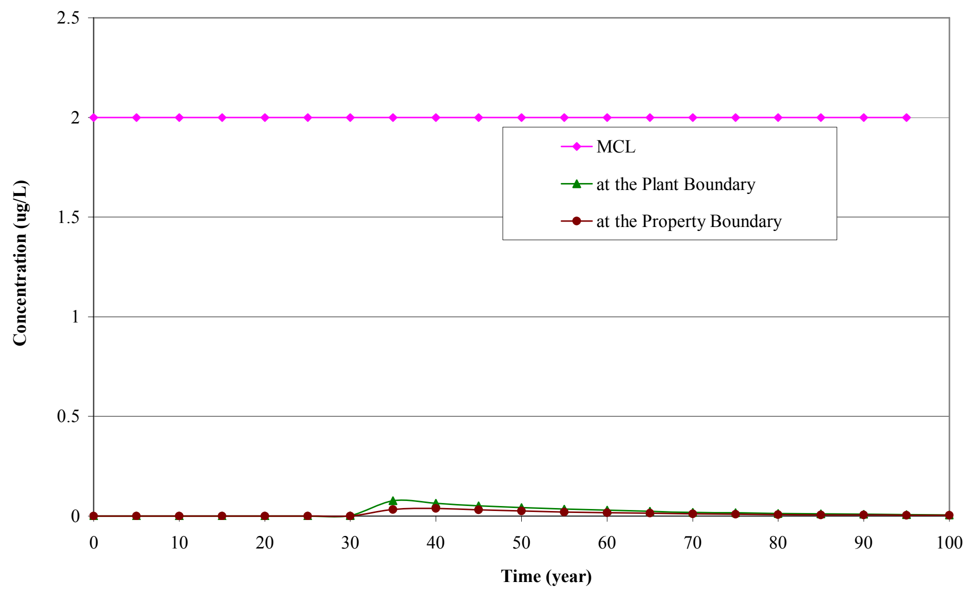


Fig. F.18. Predicted VC concentration in groundwater at all POEs based on contaminant leaching from the C-720 Building area.

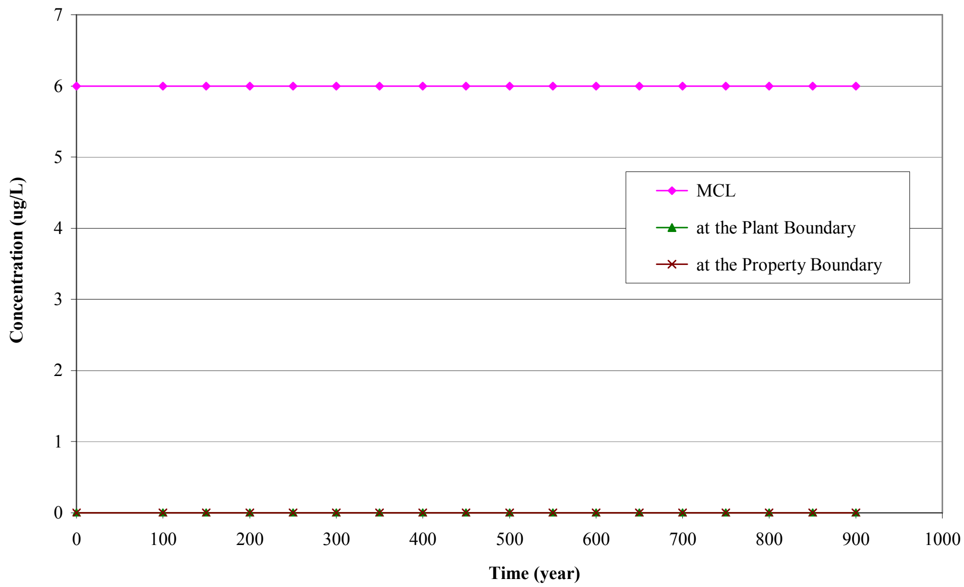


Fig. F.19. Predicted antimony concentration in groundwater at all POEs based on contaminant leaching from the C-720 Building area.

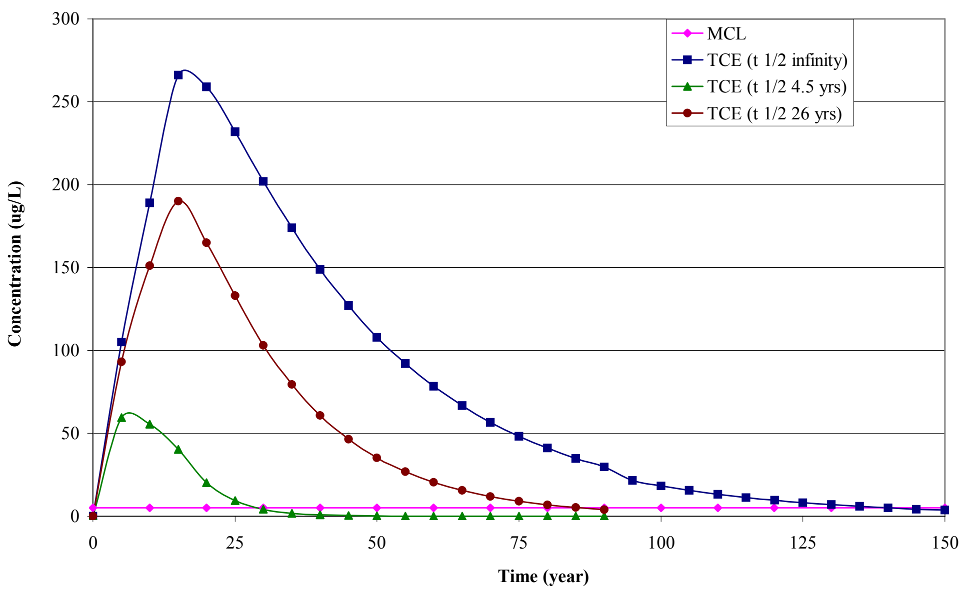


Fig. F.20. Predicted TCE concentration in groundwater at the plant boundary POE based on contaminant leaching from SWMU 1.

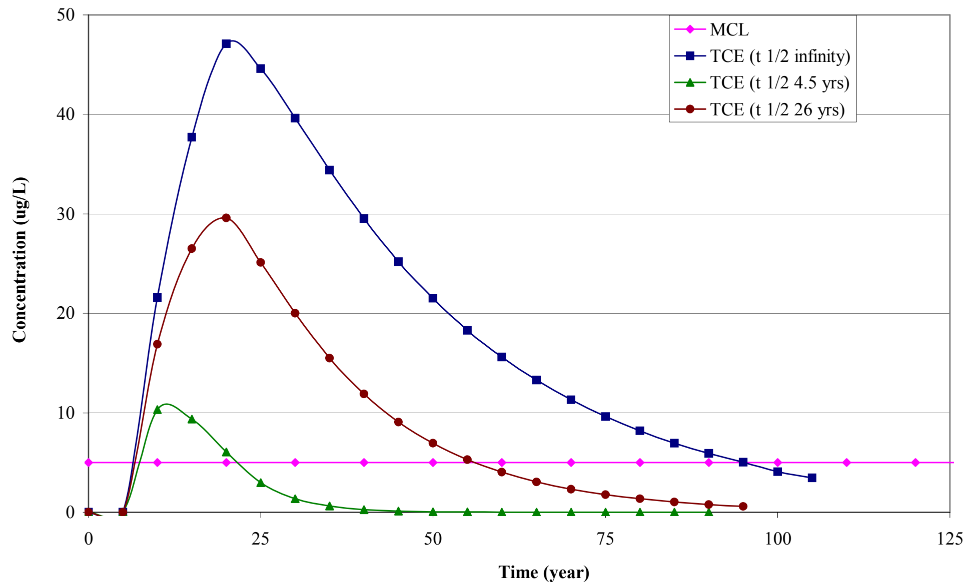


Fig. F.21. Predicted TCE concentration in groundwater at the property boundary POE based on contaminant leaching from SWMU 1.

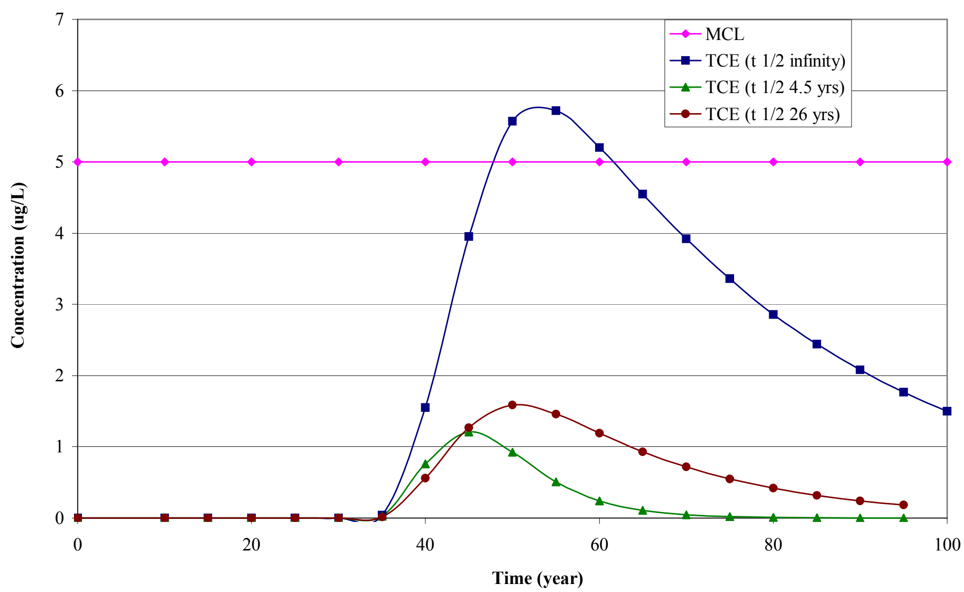


Fig. F.22. Predicted TCE concentration in groundwater at the Ohio River POE based on contaminant leaching from SWMU 1.

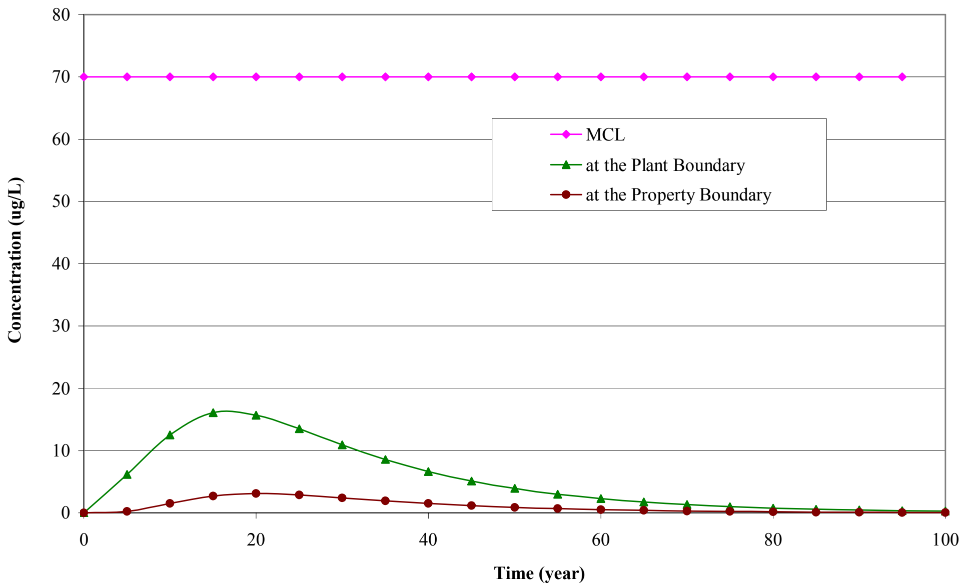


Fig. F.23. Predicted *cis*-1,2-DCE concentration in groundwater at all POEs based on contaminant leaching from SWMU 1.

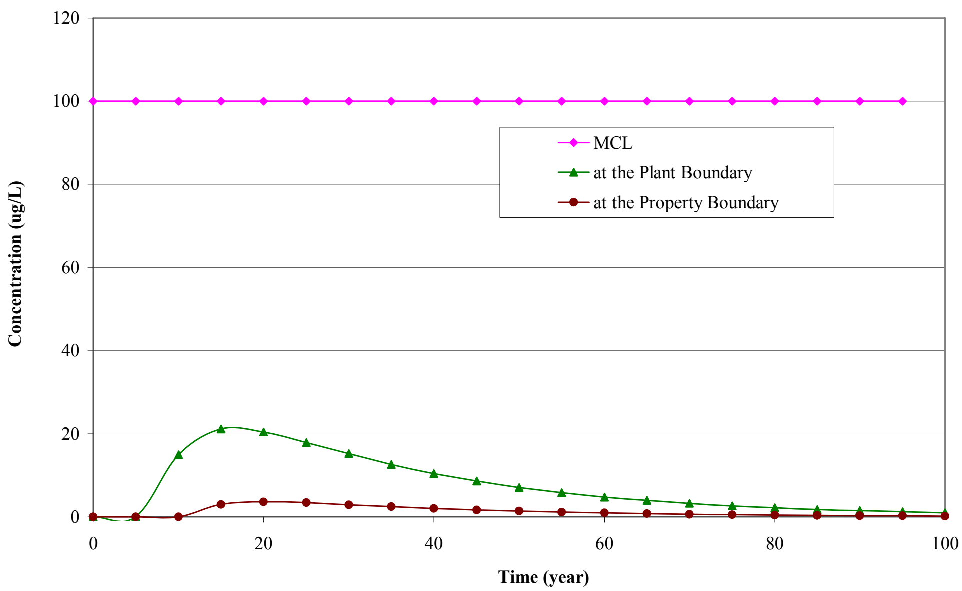


Fig. F.24. Predicted *trans*-1,2-DCE concentration in groundwater from all POEs based on contaminant leaching from SWMU 1.

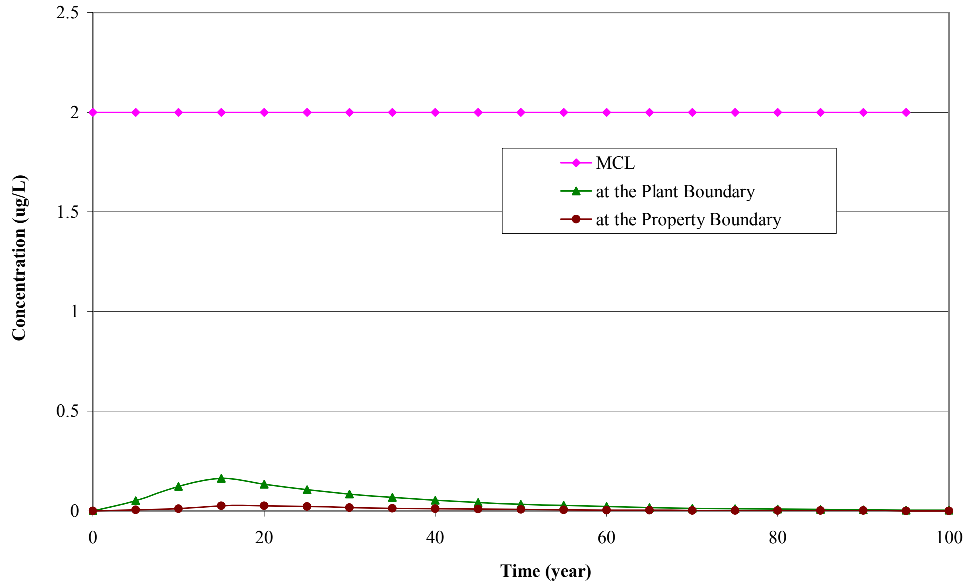


Fig. F.25. Predicted VC concentration in groundwater at all POEs based on contaminant leaching from SWMU 1.

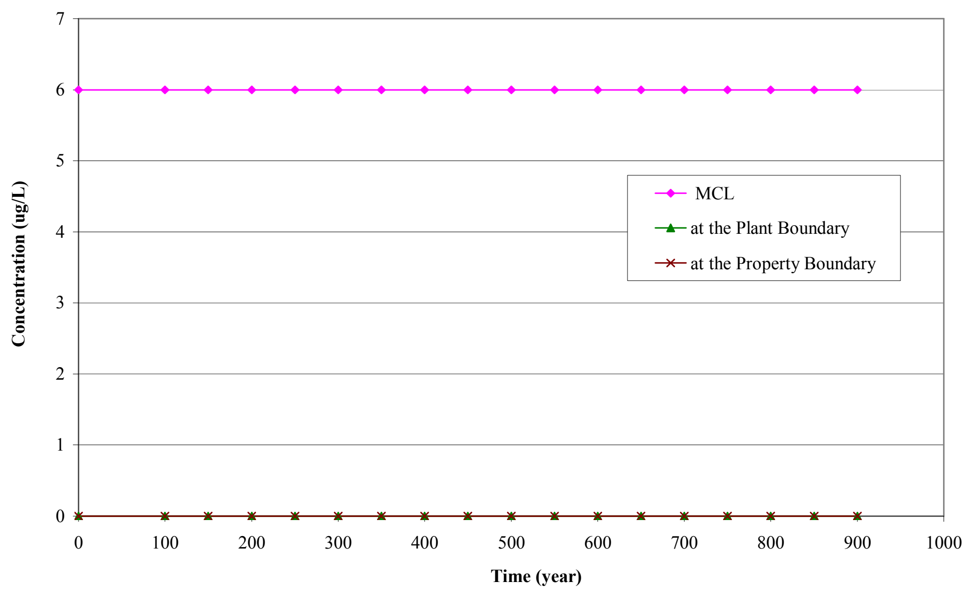


Fig. F.26. Predicted concentration of antimony in groundwater at all POEs based on contaminant leaching from SWMU 1.

F3.2 PROBABILISTIC MODELING

Probabilistic modeling was performed for the TCE sources at SWMU 1 and the C-720 Building area in order to understand better the uncertainties in the transport modeling performed earlier, to estimate the likely TCE concentrations at the POEs using the most likely input parameters, and to determine the error bounds on the predicted TCE concentrations. This modeling was based upon the nature and extent discussion in the SI Report and the transport modeling results completed earlier. Additionally, the completion of probabilistic modeling was consistent with the Risk Methods Document, which allows for the use of more sophisticated modeling to understand better the site modeling uncertainties.

Generally, the nature and extent discussion in the SI Report and the earlier modeling indicated the following.

- The storm sewer area (a portion of SWMU 102) is not a source of TCE or other VOCs to the Southwest Groundwater Plume and does not need to be modeled.

- The contaminant contributing the most to off-site risk and migrating from SWMU 1 and the C-720 Building area is TCE. Other contaminants identified as COCs for these two areas are VC and antimony (at SWMU 1) and VC; *trans*-1,2-DCE; and antimony (at C-720 Building area). Refined SESOIL modeling, which considered TCE; *trans*-1,2-DCE; *cis*-1,2-DCE; VC; and antimony at both locations, determined that only TCE may migrate from SWMU 1 and the C-720 Building area and attain concentrations greater than MCLs at the DOE property boundary. This modeling and additional risk characterization also identified TCE as an important COC at SWMU 1 and the C-720 Building area. Neither *cis*- nor *trans*-1,2-DCE was identified as COCs.

- Based upon risk results at the property boundary POE, the relative ranking of SWMU 1 and the C-720 Building area, in terms of contributions of TCE to the Southwest Plume (assumes degradation of TCE with half-life of 26.6 years), is SWMU 1 (risk = 1.7×10^{-5}), and the C-720 Building area (risk = 3.2×10^{-6}).

F3.2.1 Technical Approach Used for Probabilistic Modeling

The following describes the method used to complete the probabilistic modeling (see Fig. F.27). A more detailed discussion on the probabilistic modeling including the source of modeling parameters and their selected distributions is presented in Attachment F.2.

Deleted: <#>**Preliminary Modeling for SWMU 4¶**
Preliminary modeling for SWMU 4 also was performed using SADA, SESOIL, MODFLOW/ MODPATH, and AT123D models. As with SWMU 1 and C-720 Building area modeling, the selected POEs were the plant boundary, property boundary, and near the Ohio River (see Fig. F.10).¶
The approach used for preliminary modeling of SWMU 4 matched that used for SWMU 1 and the C-720 Building area, except the COCs modeled were carbon tetrachloride; *cis*-1,2-DCE; TCE; and VC. Other COCs identified as part of the MEPAS modeling on the WAG 3 RI Report (see Sect. F2.2) were not modeled because the other COCs were not representative of the contaminants defining the Southwest Plume.¶
F3.1.2.1 Conceptual model for source area at SWMU 4¶
As discussed in the main text of the SI Report, the following is the conceptual model for SWMU 4.¶
SWMU 4: The source of contaminants at SWMU 4 was the past burial in waste pits of potentially contaminated trash and scrap. Subsequently, contaminants in disposed material directly impacted soils below or adjacent to the areas where material was buried and, through vertical infiltration in soil, contaminated the groundwater underlying these sources. Contaminated groundwater migrates laterally and vertically, which could carry the contaminants to the three POEs. As at SWMU 1 and the C-720 area, the UCRS, RGA, and McNairy Formation could have been impacted as contaminar ... [3]

Deleted: ¶
¶
Section Break (Next Page) ... [4]

Deleted: Page Break ... [5]

Deleted: Page Break ... [6]

Deleted: Page Break ... [7]

Deleted: Section Break (Next Page)
Table F.37. Summary of source term characteristics developed by SADA for SWMU 4¶
Layer ... [8]

Deleted: , SWMU 4,

Deleted: ¶
¶
Table F.42. Concentrations of the contaminants of concern in groundwater predicted in ... [9]

Deleted: , SWMU 4,

Deleted: are

Deleted: are SWMU 4 (risk = 1.2×10^{-4}),

Deleted: 3

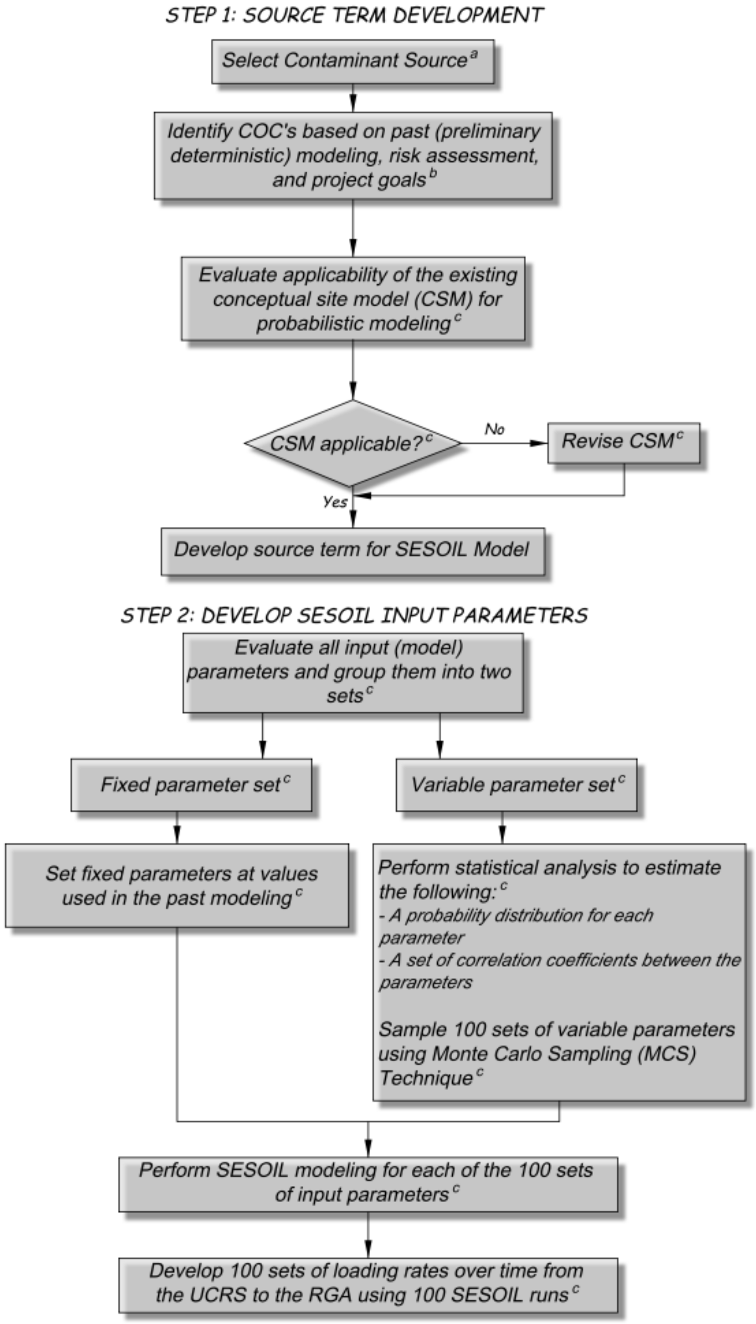


Fig. F.27. Flow Chart for Probabilistic Modeling

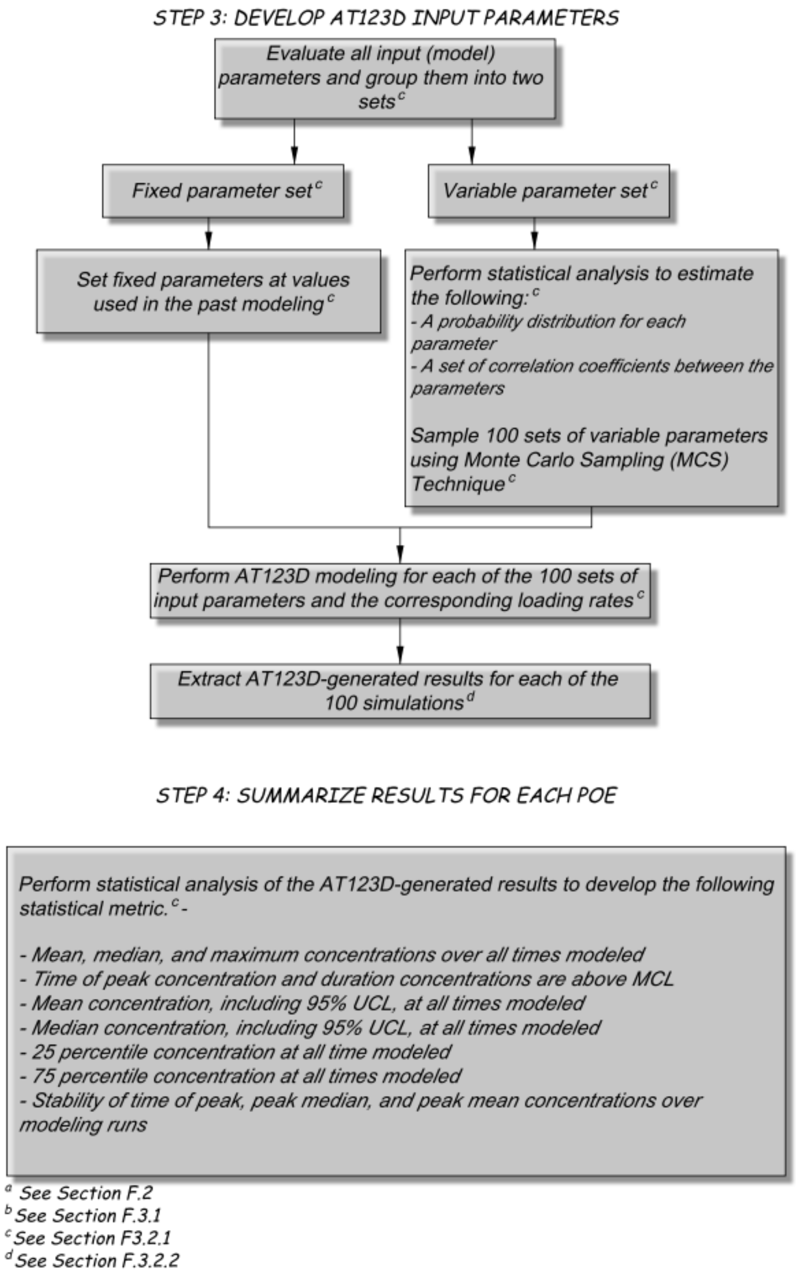


Fig. F.27. Flow Chart for Probabilistic Modeling (continued)

Step 1: Source Term Development

For the soils beneath the source zones, down to the top of the RGA, the TCE source area and volumes developed in preliminary modeling using SADA were used as the source terms in probabilistic modeling. The source concentration (i.e., mass of TCE present) was estimated (sampled) for each of the six layers used in the preliminary modeling. The concentration of a layer was assumed to be log-normally distributed, and the parameters of the distribution were estimated from the observed data available for the layer. In addition, concentrations between layers were assumed to be correlated. Correlations between layers were derived using the grid concentration generated by SADA. To estimate the correlation between two layers, non-zero concentrations from the two layers in the grid was considered. Concentration in a grid cell in the upper-layer was paired with concentration in the grid cell vertically below the upper cell in the lower-layer to develop the concentration pairs needed to estimate the correlations. After selecting the layer concentrations, the contaminant mass per layer was normalized against the source area used in SESOIL modeling (please see the discussion in Attachment F.1). (As noted in the discussion of the preliminary modeling, due to limitations of SESOIL, all layers must be of the same area.) Correlation coefficients between adjacent layers used in the modeling are presented in Table F.31.

Deleted: Fig. F.2

Deleted: 3

Deleted: 7. Flow Chart for Probabilistic Modeling¶
¶

Deleted: 44

Table F.31. Correlation coefficients between adjacent layers used for source term development in probabilistic modeling of SWMU 1 and the C-720 Building

Deleted: , SWMU 4,

Deleted: 44

Pair	SWMU 1	C-720 Building
Layer 1 and 2	0.92	-0.50
Layer 2 and 3	0.35	0.59
Layer 3 and 4	0.21	0.16
Layer 4 and 5	0.40	0.99
Layer 5 and 6	0.92	0.50
UCRS and RGA	NA	NA

NA = not applicable as a secondary source in the RGA does not exist in this source area. [a] Because the secondary source at this area is at bottom of the RGA separated by a significant distance from the bottom of the UCRS (Layer 6) a correlation between UCRS and the RGA source is not expected.

The source terms used in the preliminary deterministic modeling were limited solely to the soils above the top of the RGA because the contamination found in these soils is the dominant influence on the dissolved contaminant levels that are derived from these sources.

Deleted: In the process of developing the SI probabilistic model, a secondary TCE source in the RGA was added for the SWMU 4 area to more completely address the uncertainty for SWMU 4. The derivation of the secondary source term is presented in Attachment F.1.

Step 2: Develop SESOIL Input Parameters

At each source area, the SESOIL model was run 100 times. For each run, a unique set of input variables was generated using Monte Carlo techniques.[3] Most input parameters remained constant. The SESOIL variables that were allowed to vary were the source concentrations (see Step 1), UCRS intrinsic permeability (k), UCRS organic carbon content (f_{oc}), and rate of degradation. For k and $f_{oc,}$ a range, mean, and standard deviation assuming a log normal distribution were selected based on available site data and after consultation and review by site experts. Site-specific data were limited for the degradation half-life of TCE in the UCRS; therefore, a range of values of the half-lives estimated for the RGA, was selected with uniform distribution for the UCRS. (Please see Attachment F.2 of this appendix for additional information on the estimation of degradation half-life of TCE in the RGA at PGDP.) Degradation of TCE in an aerobic setting, which is typical of the UCRS, does not yield the common anaerobic degradation

[3] Monte Carlo selections of SESOIL and AT123D input parameters were made using the Crystal Ball® (Decisioneering, Inc. 2000) add-in to Excel.

products *cis*-1,2-DCE and VC. Thus the SI model does not result in an increase in the concentration of the anaerobic degradation products. Two probabilistic scenarios were run for both SWMU 1 and C-720. One scenario, referred to as the "variable degradation scenario," used the variable degradation rates developed in Attachment F.2. The second scenario, referred to as the "fixed degradation scenario," allowed all the variables specified in Appendix F.2 to vary except for the degradation rate which was fixed at 26.6 years in the UCRS. Also, under this scenario no degradation of TCE was assumed in the RGA. Within each SESOIL run, the same k, f_{oc}, and rate of degradation were used for all layers. Values used in the Monte Carlo runs for the three sources are summarized in Table F.32.

Fixed input parameters used in the SESOIL runs are in Tables F.33 and F.34. Summary statistics derived from the values selected for the variable input parameters are in Table F.35. Histograms of the output values for all the parameters with distributions are presented in Attachment F.2 to this appendix (Figs. F2.1 through F2.18). A complete listing of the 100 sets of input variables for each of the three sources is presented in Attachment F.4 to this appendix.

Deleted: that

Deleted: 45

Deleted: 46

Deleted: 7

Deleted: 48

Deleted: 27????

Deleted: 3

Deleted: ***Step 3: Develop Secondary Source Input Parameters***¶
Observed groundwater concentrations for TCE in the RGA near SWMU 4 supported the probable presence of a secondary source in the RGA. In order to account for this source in the RGA, a mass balance model was run 100 times to predict the amount of TCE going into solution per unit time (by developing uncertainty in the TCE release rates over time from the secondary source). For this modeling, a mass depletion rate term was developed as function of the source concentrations (C_s), RGA hydraulic conductivity (K_h), hydraulic gradient (I), fraction organic carbon (f_{oc}), and the porosity (n). The mass loading was estimated using an analytical approach with first order depletion rate. The derivation of the secondary source term is presented in Attachment F.1. Fixed input parameters as well as variable input parameters for the mass balance modeling are discussed and presented under AT123D input parameters development (see Attachment F.2). With the exception of the aquifer depth (thickness) variable, significant uncertainty remains regarding the quantitative values of these parameters at SWMU 4, so the application of the site-wide range remains suitable. For the case of the aquifer depth (thickness) variable, the upper end of the site-wide range captures the variability of the physical aquifer thickness at SWMU 4, while the lower end of the site-wide range addresses uncertainty introduced into the model when representing a poorly defined, secondary, DNAPL source zone.¶
¶

Deleted: 45

Table F.32. Inputs used in Monte Carlo runs for SESOIL modeling[a]

SWMU 1

Deleted: *SWMU 4* ... [10]

Name	Layer 1 Concentration	Layer 2 Concentration	Layer 3 Concentration	Layer 4 Concentration	Layer 5 Concentration	Layer 6 Concentration	Vertical Hydraulic Conductivity (K_v)	Organic Carbon (f_{oc})	Degradation Half-life
Unit	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(m/hr)	(%)	(yr)
Statistic									
Minimum Value	0.00	0.00	0.00	0.00	0.00	0.00	3.60E-07	0.02	3.20
Likeliest Value	2.14	15.90	7.60	5.12	5.95	0.72	5.92E-04	0.08	NA
Maximum Value	87.00	439.00	85.00	74.00	66.00	3.40	1.15E-03	0.46	11.30
Standard Deviation	11.19	78.68	18.15	14.62	14.22	1.07	NA	0.05	NA
Correlation Pair		Layer 1 with Layer 2	Layer 2 with Layer 3	Layer 3 with Layer 4	Layer 4 with Layer 5	Layer 5 with Layer 6	None	None	None
Correlation Coefficient		0.92	0.35	0.21	0.40	0.92			
Distribution	Log normal	Log normal	Log normal	Log normal	Log normal	Log normal	Triangular	Log normal	Uniform

C-720 Building Area

Name	Layer 1 Concentration	Layer 2 Concentration	Layer 3 Concentration	Layer 4 Concentration	Layer 5 Concentration	Layer 6 Concentration	Vertical Hydraulic Conductivity (K_v)	Organic Carbon (f_{oc})	Degradation Half-life
Unit	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(m/hr)	(%)	(yr)
Statistic									
Minimum Value	0.000	0.000	0.000	0.0000	0.0000	0.0000	3.60E-7	0.02	3.20
Likeliest Value	1.559	1.219	5.943	0.3866	0.2001	0.1169	5.92E-04	0.08	NA
Maximum Value	17.000	19.000	68.000	1.8000	1.3000	0.6300	1.15E-03	0.46	11.30
Standard Deviation	5.121	4.232	15.372	0.6502	0.3694	0.2038	NA	0.05	NA
Correlation Pair		Layer 1 with Layer 2	Layer 2 with Layer 3	Layer 3 with Layer 4	Layer 4 with Layer 5	Layer 5 with Layer 6	None	None	None
Correlation Coefficient		-0.50	0.59	0.16	0.99	0.50			
Distribution	Log normal	Log normal	Log normal	Log normal	Log normal	Log normal	Triangular	Log normal	Uniform

[a] Monte Carlo estimates were generated using Crystal Ball® (Decisioneering, Inc. 2000).
NA = not applicable

Table F.33. Soil parameters used in probabilistic SESOIL modeling of SWMU 1 and the C-720 Building area

Deleted: , SWMU 4

Deleted: 46

Input Parameter	SWMU 1	C-720 Building	Source
Soil type	Silty Loam	Silty Loam	PGDP site-specific
Bulk density (g/cm^3)	1.46	1.46	Laboratory analysis
Percolation rate (cm/year)	Variable	Variable	Varied around the PGDP Calibrated Model value
Intrinsic permeability (cm^2)	Variable	Variable	Varied around a calibration scenario value
Disconnectedness index	10	10	Set to a calibration scenario value
Porosity	0.45	0.45	Laboratory analysis
Depth to water table (m)	16.76	18.29	Site specific (to RGA) based on field observation
Organic carbon content (f_{oc}) (%)	Variable	Variable	Laboratory analysis
Frendlich equation exponent	1	1	SESOIL default value

Table F.34. Chemical-specific parameters for TCE used in probabilistic SESOIL and AT123D modeling for SWMU 1 and the C-720 Building area

Deleted: , SWMU 4,

Deleted: 7

Contaminant of Concern	Mol. Wt. (MW) (g/gmol)	Solubility in water (mg/L)	Diffusion in air (cm2/s)	Diffusion in water[a] (cm2/s)	Henry's Constant (atm.m3/mol)	K_{oc} (L/kg)	K_d (L/kg)	Degradation Half Life (years)
Trichloroethene	131	1,100	0.08	9.11E-06	0.0103	94	Variable	Variable

[a] Noted, 9.11E-06 cm2/s = 3.28E-06 m2/hr.

Table F.35. Summary statistics for variable input parameters used in probabilistic SESOIL modeling of SWMU 1 and the C-720 Building area

Deleted: 48

Deleted: , SWMU 4,

Input Parameter	Units	Minimum	Median	Maximum	Arithmetic Mean	Standard Deviation
SWMU 1						
Layer 1 Concentration[a]	mg/kg	2.86E-03	5.73E-01	3.58E+01	2.37E+00	5.15E+00
Layer 2 Concentration[a]	mg/kg	6.03E-02	3.64E+00	1.88E+02	1.41E+01	3.09E+01
Layer 3 Concentration[a]	mg/kg	1.28E-01	5.80E+00	1.02E+02	1.14E+01	1.63E+01
Layer 4 Concentration[a]	mg/kg	1.28E-01	2.78E+00	1.15E+02	8.93E+00	1.62E+01
Layer 5 Concentration[a]	mg/kg	1.26E-01	4.39E+00	7.50E+01	1.04E+01	1.44E+01
Layer 6 Concentration[a]	mg/kg	5.30E-02	1.04E+00	6.65E+00	1.55E+00	1.53E+00
Organic carbon content	%	2.53E-02	6.76E-02	2.78E-01	7.90E-02	4.71E-02
Degradation Rate	/hr	7.11E-06	1.22E-05	2.43E-05	1.32E-05	4.96E-06
Vertical Hydraulic Conductivity	m/hr	9.89E-05	5.90E-04	1.01E-03	5.76E-04	2.37E-04
Intrinsic permeability	cm^2	2.80E-11	1.67E-10	2.87E-10	1.63E-10	6.70E-11
C-720 Building Area						
Layer 1 Concentration[a]	mg/kg	2.33E-03	2.37E-01	4.63E+00	6.46E-01	1.03E+00
Layer 2 Concentration[a]	mg/kg	5.20E-03	2.14E-01	5.80E+00	5.95E-01	1.12E+00
Layer 3 Concentration[a]	mg/kg	2.34E-02	1.67E+00	4.82E+01	5.08E+00	8.66E+00
Layer 4 Concentration[a]	mg/kg	5.11E-03	7.76E-02	5.91E-01	1.24E-01	1.23E-01
Layer 5 Concentration[a]	mg/kg	1.01E-03	3.56E-02	4.01E-01	6.09E-02	6.68E-02
Layer 6 Concentration[a]	mg/kg	7.50E-04	1.95E-02	1.92E-01	3.31E-02	3.63E-02
Organic carbon content	%	2.67E-02	6.86E-02	3.47E-01	8.37E-02	5.14E-02
Degradation Rate	/hr	7.19E-06	1.13E-05	2.43E-05	1.29E-05	5.02E-06
Vertical Hydraulic Conductivity	m/hr	9.89E-05	5.90E-04	1.02E-03	5.68E-04	2.42E-04
Intrinsic permeability	cm^2	2.80E-11	1.67E-10	2.89E-10	1.61E-10	6.86E-11

Deleted: *SWMU 4* ... [11]

[a] Soil concentrations are normalized using the volume of the layer with the largest mass.

[b] Degradation rate was estimated from degradation half-life in units of hour using the formula: rate = [(ln 2)/degradation half-life].

Deleted: In preliminary modeling of SWMU 4, the concentrations of these layers were set to 0.

Deleted: In the probabilistic modeling, concentrations reflective of the minimal TCE contamination detected in these layers were included.

Step 3: Develop AT123D Input Parameters

Deleted: 4

A set of 100 unique AT123D variables was generated using Monte Carlo techniques. Most input variables remained constant. The input variables allowed to vary were the hydraulic conductivity (K_h), hydraulic gradient (I), effective porosity (n_e), aquifer depth (H), degradation rate, and f_{oc} for RGA. Two probabilistic scenarios were run for both SWMU 1 and C-720. One scenario, referred to as the "variable degradation scenario," allowed all parameters specified above to vary in the modeling runs. The second scenario, referred to as the "fixed degradation scenario," allowed all the variables specified to vary except for the degradation rates, since no degradation in the RGA was assumed. For each input parameter except

Deleted: above

Deleted: that was fixed at 0 years in the RGA.

degradation rate, site data were evaluated, and a range, mean, and standard deviation were developed. Based on this analysis, and after consultation and review by site experts parameter distributions were assumed. In each of these cases (except degradation rate), the input parameter was assumed to be either normally or log normally distributed. Correlations of -0.50, 0.20, and -0.20 were assumed between K_h and I, K_h and n_e, and I and n_e, respectively. Values used in the Monte Carlo runs are summarized in Table F.36.

Deleted: 49

Table F.36. Inputs used in Monte Carlo runs for secondary source term development and AT123D modeling[a]

Deleted: 49

	Parameter					
Name **Unit**	**Hydraulic Conductivity (K_h)** **(m/hr)**	**Hydraulic Gradient (I)** **(m/m)**	**Total Porosity (n)** **(%)**	**Aquifer Depth (H)** **(m)**	**Organic Carbon (f_{oc})** **(%)**	**Degradation Rate (λ)[c]** **(/hr)**
	Statistic					
Minimum Value	0.95	1.00E-04	27.00	3.05	0.003	7.01E-06
Likeliest Value	4.45	1.01E-03	39.11	11.80	0.035	
Maximum Value	19.05	4.00E-03	54.00	19.36	0.253	2.45E-05
Standard deviation	4.45	1.12E-03	5.98	3.61	0.037	
Correlation pair	None	K_h:I	K_h:n	I:n	None	I:BDR
Correlation coefficient		-0.50	0.20	-0.20		1
Distribution	Log normal	Log normal	Normal	Normal	Log normal	Uniform

Deleted: Ground-water Conc (C_w)[d]

Deleted: (ug/L)

Deleted: 0.00E+00

Deleted: 1.59E+03

Deleted: 6.70E+04

Deleted: 6.84E+03

Deleted: None

Deleted: Log normal

[a] Monte Carlo estimates were generated using Crystal Ball® (Decisioneering, Inc. 2000).
[b] Effective porosity was assumed 81% of the total porosity.
[c] Degradation rate was not used for developing the secondary source term in the RGA.

Deleted: [d] Groundwater concentration (Cw) was only used for secondary source term development.

Recently, as part of the development of response actions, the DOE has developed revised biodegradation rates that were incorporated in the modeling effort for the SI report. Attachment F.3 of this appendix presents a detailed discussion of the derivation of the degradation rates. The revised biodegradation rates were developed using regulatory accepted methods presented in *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water* (EPA 1998) and data from the Northwest Plume, the most thoroughly characterized of the dissolved-phase plumes at the PGDP.

Degradation of TCE in aerobic settings yields epoxides, aldehydes, chlorinated oxides, and ethanols, rather than the common anaerobic degradation products *cis*-1,2-DCE and VC. Therefore, the anaerobic degradation products (e.g., 1,2-DCE and VC) were not modeled.

Sampling results collected from the Northwest Plume indicate that TCE concentrations decrease with distance at a faster rate than selected inorganic contaminants (i.e., chloride and ^{99}Tc). Analyses using these inorganic tracers yield a dissolved-phase TCE degradation factor with a range of 0.0614 to 0.2149 year^{-1}. This degradation factor corresponds to a TCE half-life of 11.3 to 3.2 years, respectively; therefore, a uniform distribution with the range from 3.2 to 11.3 years was selected for the degradation half-life for this analysis. Attachment F.3 to this appendix presents a detailed discussion of the derivation the degradation rates.

Aerobic conditions are common in both the RGA and in the UCRS. (Note that anaerobic settings exist locally in some UCRS source areas.) Site-specific TCE degradation factors are not available for the UCRS. The AT123D modeling for the SI uses the same range for the TCE degradation factor in both the RGA and the UCRS. The rates of anaerobic degradation in groundwater typically exceed those attributed to aerobic degradation (EPA 1998).

Deleted: ¶

Deleted: Should anaerobic conditions exist in the UCRS beneath SWMU 4, TCE degradation likely proceeds at a faster rate than that modeled. Thus, the model-derived TCE concentrations from the SWMU 4 model would be biased high.

Fixed input parameters used in the AT123D runs are in Tables F.34 and F.37. Summary statistics derived from the values selected for the variable input parameters are in Table F.38. Histograms of the output values for all the parameters with distributions are presented in Attachment F.2 to this appendix (Figs. F2.19 through F2.24). A complete listing of the set of input variables is presented in Attachment F.4 to this appendix.

Step 4: Summarize Results for Each POE

Each of the 100 sets of input parameters for SWMU 1 and the C-720 Building area were used to generate expected TCE concentrations at POEs at the plant boundary, property boundary, and the Ohio River. Each of the POEs was assumed to be located where the maximum TCE concentration migrating from the source area are attained. The distances between each of the source areas and the POEs are presented in Table F.39.

Summary statistics derived from the probabilistic modeling runs include a description of the distribution of the maximum groundwater concentrations predicted for each POE in each run and curves depicting TCE concentrations over time at each POE derived from each of the two sources for the two scenarios (i.e., variable degradation scenario and fixed degradation scenario). Information presented describing the maximum groundwater concentrations at each POE includes the predicted concentration of the run with the smallest maximum concentration; the predicted concentration of the run with the largest maximum concentration; the median of the maximum predicted concentrations; the 25th and 75th percentile of the maximum concentrations; the arithmetic mean of the maximum predicted concentrations; the geometric mean of the maximum predicted concentrations; the 95% upper confidence limit (UCL) on the median of the maximum predicted concentrations; and histograms of the maximum predicted concentrations. Curves depicting the TCE results include plots of the median and the 25th and 75th percentile concentrations at each time step modeled and plots of the mean geometric mean and the 95% UCL[4] on this mean of the predicted concentrations.

Table F.40 presents the summary statistics for the maximum predicted concentrations at each of the POEs for the two scenarios (i.e., variable degradation scenario and fixed degradation scenario). Histograms developed from each POEs maximum predicted concentrations for each source and degradation scenario are presented in Figs. F.28 through F.39. Plots depicting the median and the 25th and 75th percentile concentrations at each time step modeled are presented in Figs. F.40 to F.51. Plots depicting the log normal mean and the 95% UCL on this mean at each time step at each POE are in Figs. F.52 to F.63. Modeling results from each of the 100 model runs for SWMU 1 and the C-720 Building Area used to generate the summary statistics are presented in Attachment F.4 to this appendix.

---

[4] 95% UCLs were derived using ProUCL, Version 3, software package (EPA 2004). For consistency and to comply with the Risk Methods Document, 95% UCLs based on an assumed log normal distribution were derived for all time steps (i.e., years from present) modeled. In developing the figures, if the 95% UCL exceeded the maximum predicted value, the maximum predicted value is plotted.

Deleted: 7
Deleted: 50
Deleted: 51
Deleted: 28
Deleted: 34????
Deleted: 5
Deleted: , SWMU 4,
Deleted: 52
Deleted: three
Deleted: ,
Deleted: ,
Deleted: ,
Deleted: ,
Deleted: ,
Deleted: ,
Deleted: ,
Deleted:
Deleted: ,
Deleted: ,
Deleted: log normal
Deleted: 53
Deleted: 3
Deleted: 3
Deleted: 46
Deleted: 34
Deleted: 7
Deleted: 39
Deleted: 55
Deleted: 40
Deleted: 56
Deleted: 6
Deleted: 4
Deleted: 5
Deleted: , SWMU 4,
Deleted: 3

Table F.37. Hydrogeologic parameters used in probabilistic AT123D modeling for SWMU 1 and the C-720 Building area

Deleted: , SWMU 4,

Deleted: [a]

Deleted: 50

Input Parameter	SWMU 1	C-720 Building	Source
Bulk density (kg/m^3)	1670	1670	Laboratory analysis
Effective porosity	Variable	Variable	Varied around the PGDP Calibrated Model value
Hydraulic conductivity (m/hr)	Variable	Variable	Varied around the PGDP Calibrated Model value
Hydraulic gradient (m/m)	Variable	Variable	Varied around the PGDP Calibrated Model value
Aquifer thickness (m)	Variable	Variable	Varied around the site average value
Longitudinal dispersivity (m)	15	15	Approximate values used in the past
Density of water (kg/m^3)	1000	1000	Default
Fraction of organic carbon (%)	Variable	Variable	Laboratory analysis
Degradation Rate (/hr)	Variable	Variable	Site-specific value
Source Area (m^2)	324	1394	Derived from SADA analysis for TCE. Please see text.

Deleted: [a] These parameters (excluding dispersivity and degradation rate) were used in probabilistic source term modeling for the secondary source in the RGA at SWMU 4.¶

Table F.38. Summary statistics for variable input parameters used in probabilistic AT123D modeling of SWMU 1, and the C-720 Building area[a]

Deleted: , SWMU 4

Deleted: ,[b]

Deleted: 51

Input Parameter	Units	Minimum	Median	Maximum	Arithmetic Mean	Standard Deviation
Hydraulic conductivity	m/hr	9.68E-01	3.54E+00	1.76E+01	4.77E+00	3.70E+00
Hydraulic gradient	m/m	1.63E-04	1.37E-03	3.98E-03	1.49E-03	9.21E-04
Effective porosity	(%)	2.20E+01	3.10E+01	4.31E+01	3.18E+01	4.97E+00
Aquifer depth	m	3.38E+00	1.13E+01	1.85E+01	1.09E+01	3.44E+00
Organic carbon content	%	3.43E-03	2.36E-02	2.28E-01	3.38E-02	3.39E-02
Degradation rate	1/hr	7.20E-06	1.62E-05	2.45E-05	1.61E-05	5.19E-06
Groundwater concentration	ug/L	2.92E+00	3.63E+02	2.53E+04	2.14E+03	4.53E+03

Deleted: [c]

[a] Because RGA parameters at each of the source area were assumed to be similar, the same set of variable AT123D input parameters were used at each source area.

Deleted: [b] These parameters (excluding dispersivity and degradation rate) were used in probabilistic source term modeling for the secondary source in the RGA at SWMU 4[c] Applicable to SWMU 4 modeling only????

Table F.39. Distances between source areas at SWMU 1 and the C-720 Building area and POEs at the plant boundary, property boundary, and Ohio River used in probabilistic modeling

Deleted: 52

Deleted: , SWMU 4,

Source	Distance to: (ft) Plant Boundary	Property Boundary	Ohio River
SWMU 1	558	3,000	24,000
C-720 Area	2,500	4,789	26,000

Deleted: SWMU 4 ... [12]

Table F.40. Summary statistics[a] for maximum predicted concentrations (mg/L)[b] from probabilistic modeling of SWMU 1 and the C-720 Building area

POE	Minimum	25th Percentile	Median	75th Percentile	Maximum	Arithmetic Mean[c]	Geometric Mean[c]	95% UCL on the Mean[c]
SWMU 1 (Variable Degradation Scenario)								
Plant Boundary	6.30E-04	***1.20E-02***	***3.30E-02***	***6.20E-02***	***7.70E-01***	***5.40E-02***	***2.50E-02***	***6.50E-02***
Property Boundary	5.00E-06	6.00E-04	1.80E-03	4.10E-03	***6.00E-02***	3.80E-03	1.50E-03	4.70E-03
Ohio River	5.00E-06	5.00E-06	5.00E-06	5.00E-06	1.20E-04	9.30E-06	6.30E-06	1.60E-05
SWMU 1 (Fixed Degradation Scenario)								
Plant Boundary	2.50E-03	***2.80E-02***	***8.10E-02***	***1.70E-01***	***1.40E+00***	***1.50E-01***	***6.60E-02***	***1.80E-1***
Property Boundary	5.00E-06	***5.20E-03***	***1.60E-02***	***3.40E-02***	***2.90E-01***	***2.80E-02***	***1.20E-02***	***3.40E-02***
Ohio River	5.00E-06	5.00E-06	9.90E-04	4.40E-03	***6.00E-02***	3.45E-03	3.40E-04	***1.10E-02***
C-720 Building Area (Variable Degradation Scenario)								
Plant Boundary	5.00E-06	2.60E-04	7.10E-04	1.90E-03	***5.40E-02***	2.30E-03	6.40E-04	4.80E-03
Property Boundary	5.00E-06	3.90E-05	1.60E-04	5.50E-04	***1.20E-02***	5.90E-04	1.50E-04	7.60E-04
Ohio River	5.00E-06	5.00E-06	5.00E-06	5.00E-06	3.80E-05	5.70E-06	5.40E-06	6.40E-06
C-720 Building Area (Fixed Degradation Scenario)								
Plant Boundary	***3.60E-01***	2.00E-03	***6.10E-03***	***1.30E-02***	***3.60E-01***	***2.10E-02***	***5.60E-03***	***3.00E-02***
Property Boundary	7.20E-05	1.30E-03	4.00E-03	***8.10E-03***	***2.40E-01***	***1.30E-02***	3.40E-03	***2.00E-02***
Ohio River	5.00E-06	5.00E-06	2.60E-04	1.40E-03	1.50E-03	1.20E-03	1.40E-04	3.90E-03

[a] Calculated over all time steps; therefore, these summary values differ from the values calculated within time step that are used to develop F3.2.1-10 to F3.2.1-27. Values in bold. italic font exceed the TCE MCL (i.e., 5.00E-03 mg/L).

[b] All values less than 1/1000th of the TCE MCL (i.e., 5.00E-06 mg/L) are reported as 5.00E-06 mg/L.

[c] Calculated using 1/1000th of the TCE MCL (i.e., 5.00E-06 mg/L) for all values less than 5.00E-06 mg/L.

Deleted: , SWMU 4

Deleted: 53

Deleted: Log Normal

Deleted: Log Normal

Deleted: *SWMU 4* ... [13]

Deleted: Ohio River ... [14]

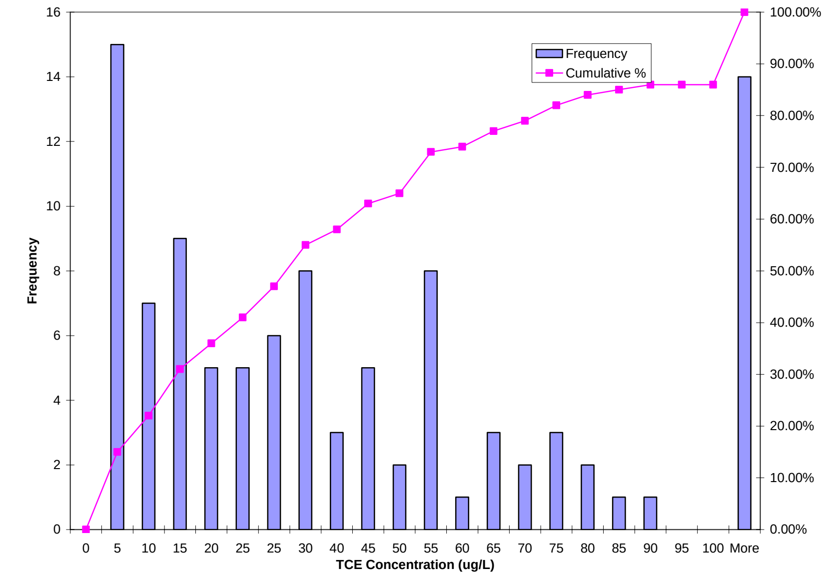


Fig. F.28. Histogram of SWMU 1 maximum predicted TCE concentrations for the plant boundary POE (variable degradation scenario).

Deleted: 38

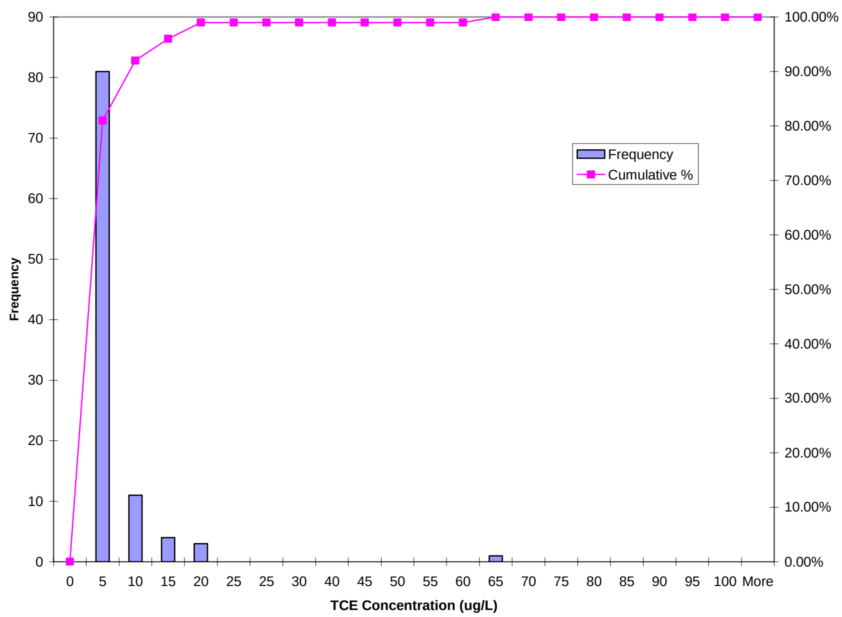


Fig. F.29. Histogram of SWMU 1 maximum predicted TCE concentrations for the property boundary POE (variable degradation scenario).

Deleted: 3

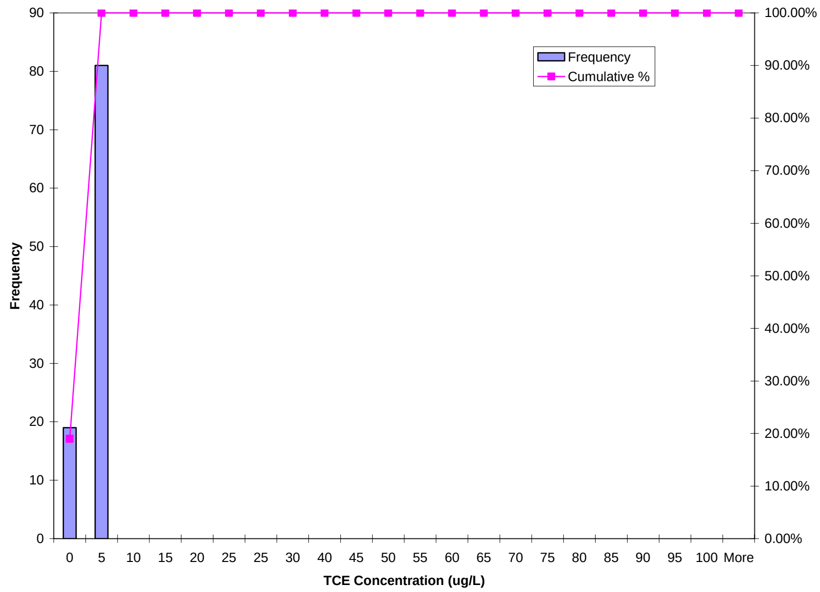
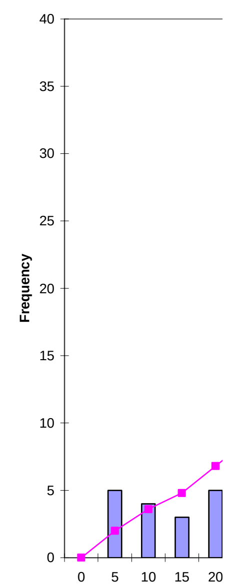


Fig. F.30. Histogram of SWMU 1 maximum predicted TCE concentrations for the Ohio River POE (variable degradation scenario).

Deleted: 4

Deleted:



Deleted: **Fig. F.41. Histogram of SWMU 4 maximum predicted TCE concentrations for the plant boundary POE.¶**

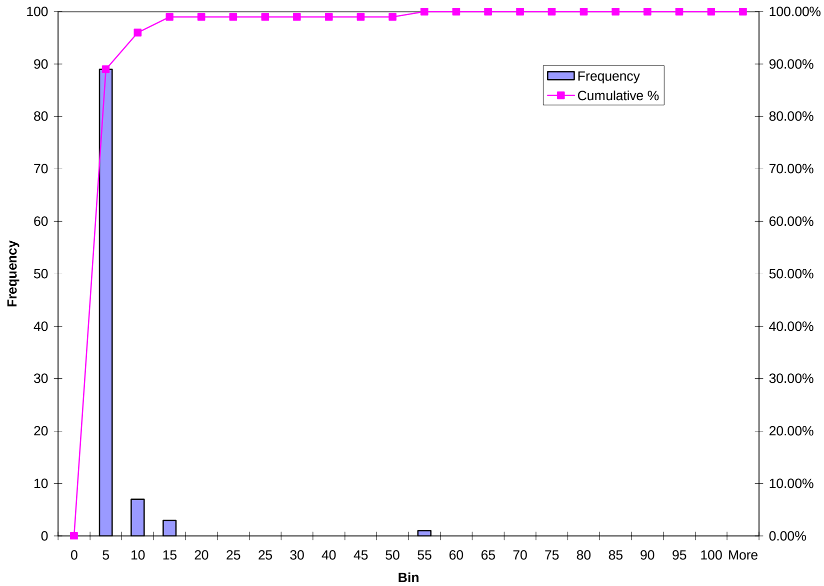


Fig. F.31. Histogram of the C-720 Building area maximum predicted TCE concentrations for the plant boundary POE (variable degradation scenario).

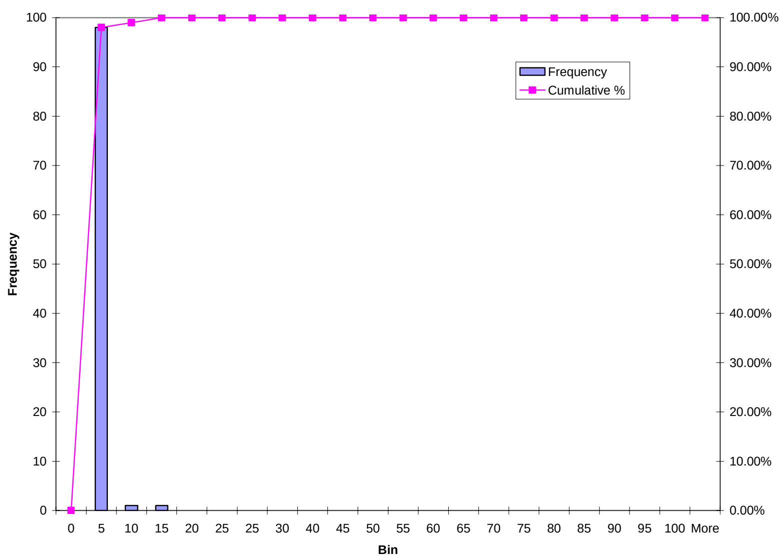
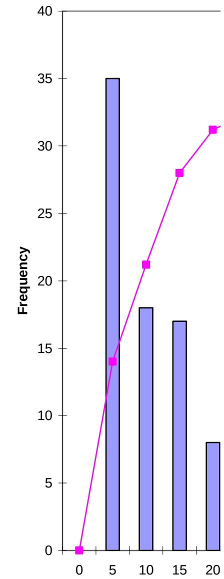


Fig. F.32. Histogram of the C-720 Building area maximum predicted TCE concentrations for the property boundary POE (variable degradation scenario).



Deleted:
Fig. F.42. Histogram of SWMU 4 maximum predicted TCE concentrations for the property boundary POE.¶

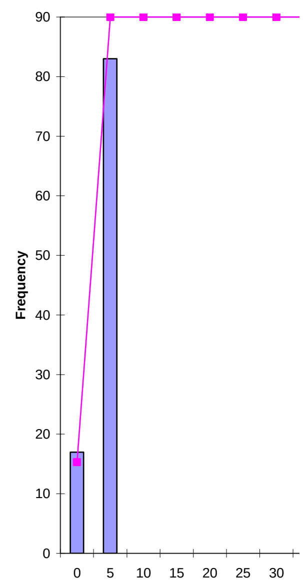


Fig. F.43. Histogram of SWMU ... [15]

Deleted: 44

Deleted: 45

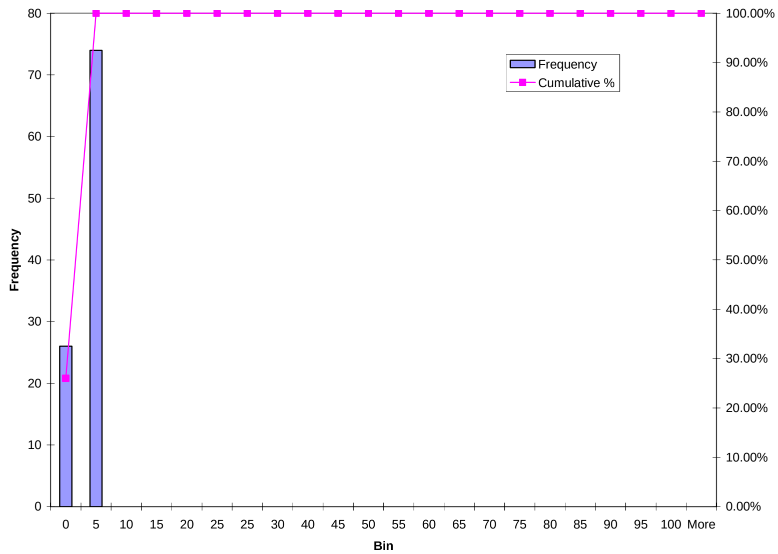


Fig. F.33. Histogram of the C-720 Building area maximum predicted TCE concentrations for the Ohio River boundary POE (variable degradation scenario).

Deleted: 46

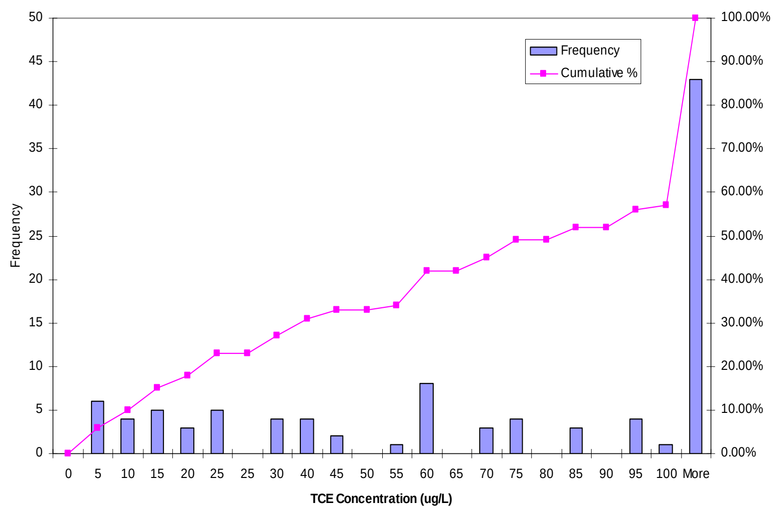


Fig. F.34. Histogram of SWMU 1 Maximum predicted TCE concentrations for the plant boundary POE (fixed degradation scenario).

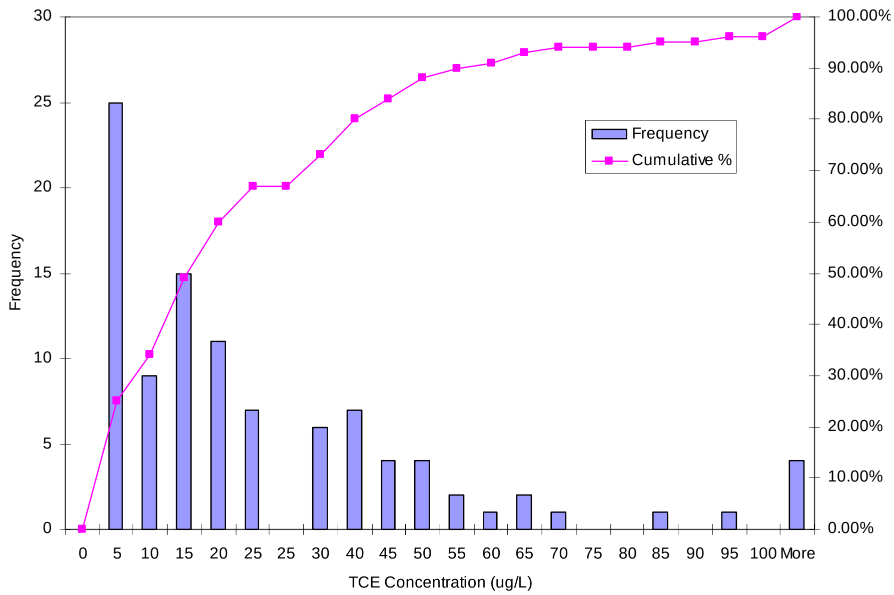


Fig. F.35. Histogram of SWMU 1 Maximum predicted TCE concentrations for the property boundary POE (fixed degradation scenario).

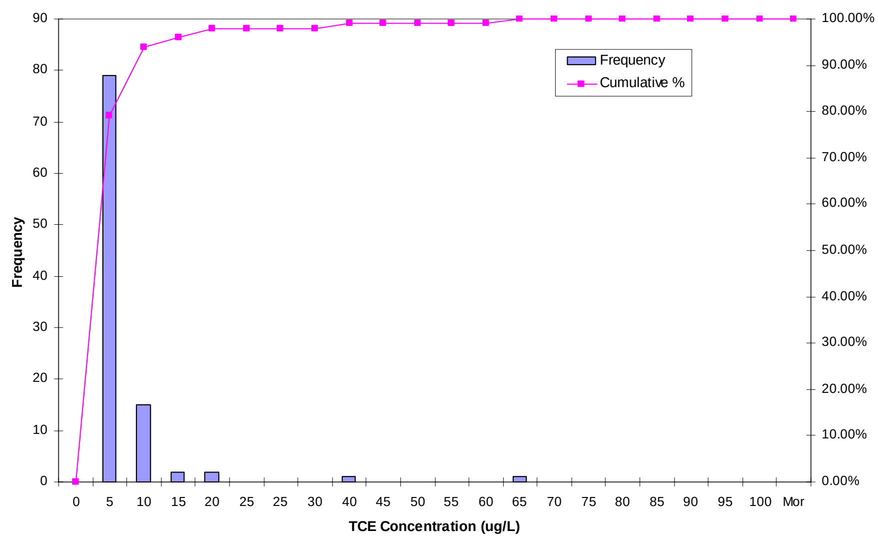


Fig. F.36. Histogram of SWMU 1 Maximum predicted TCE concentrations for the Ohio River POE (fixed degradation scenario).

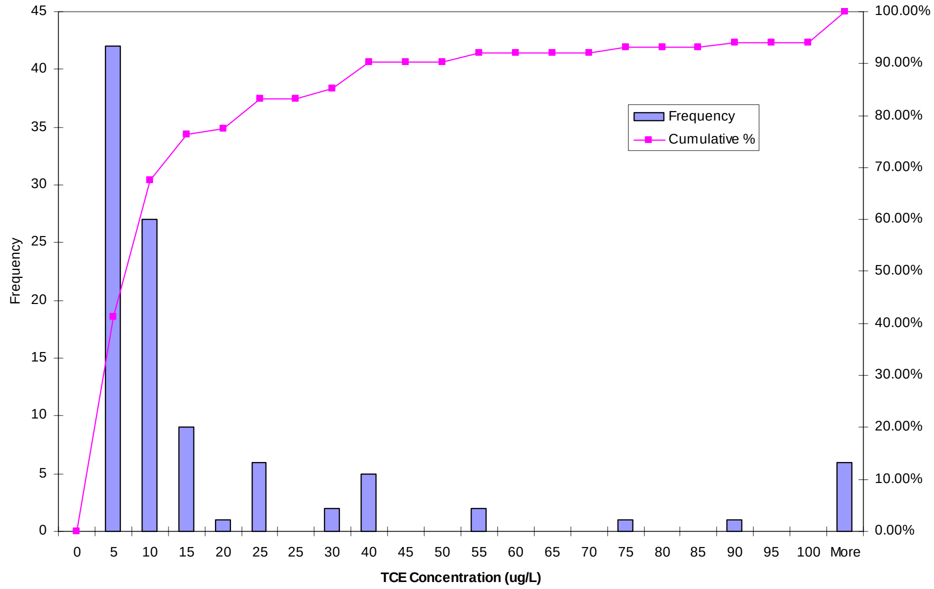


Fig. F.37. Histogram of C-720 Building area maximum predicted TCE concentrations for the plant boundary POE (fixed degradation scenario).

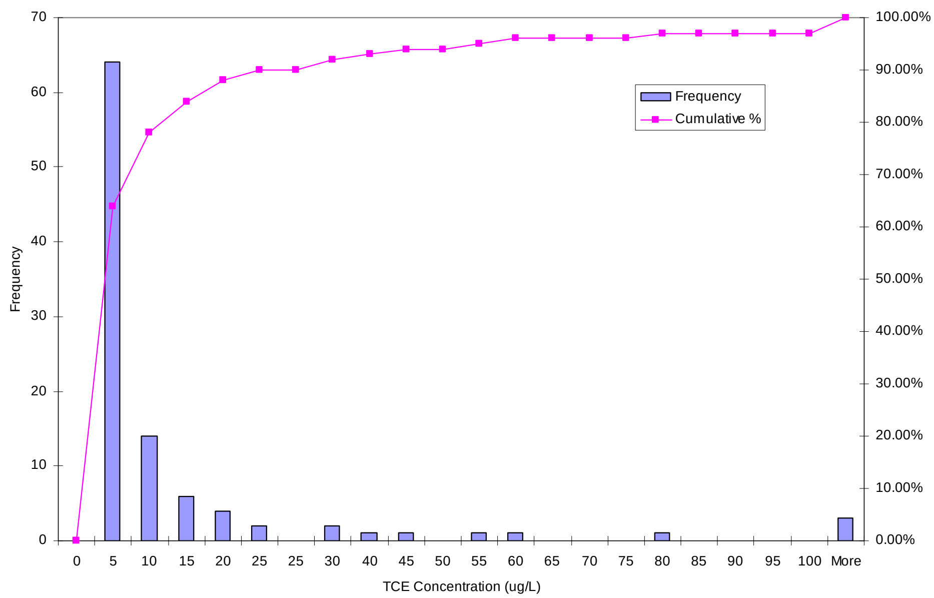


Fig. F.38. Histogram of C-720 Building area maximum predicted TCE concentrations for the property boundary POE.

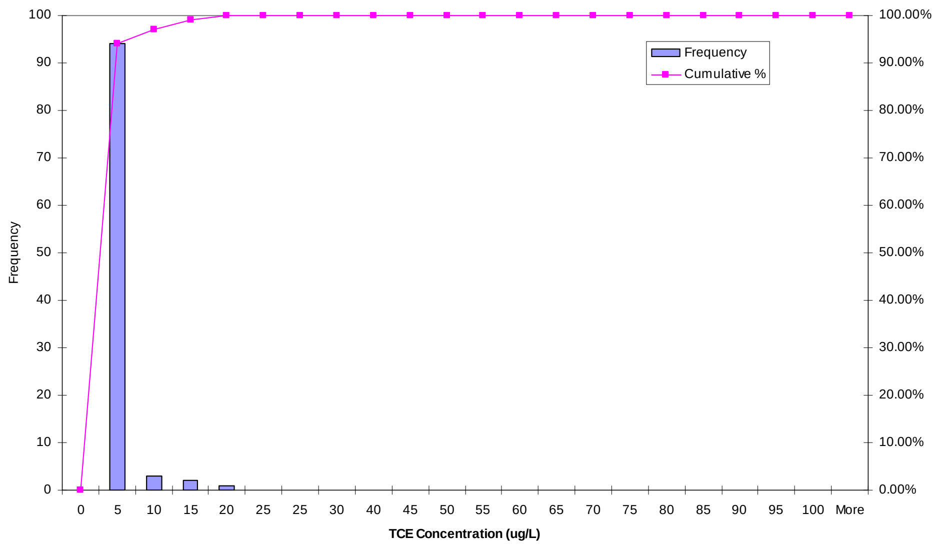


Fig. F.39. Histogram of C-720 Building area maximum predicted TCE concentrations for the Ohio River boundary POE (fixed degradation scenario).

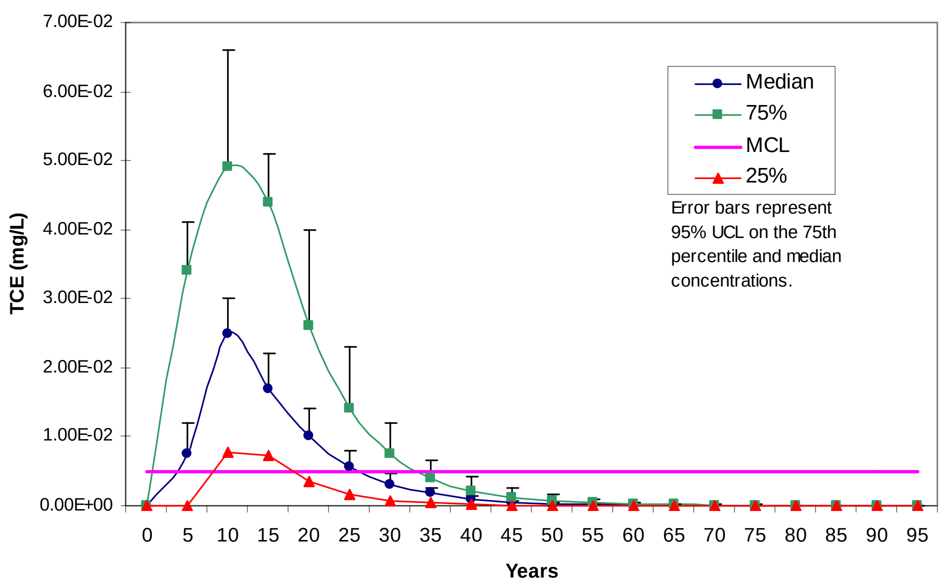
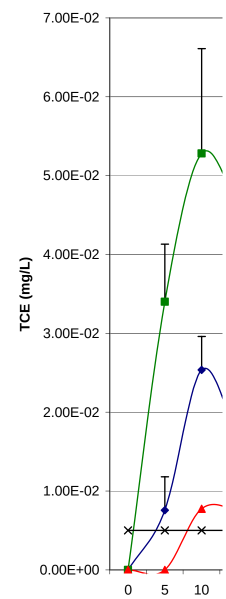


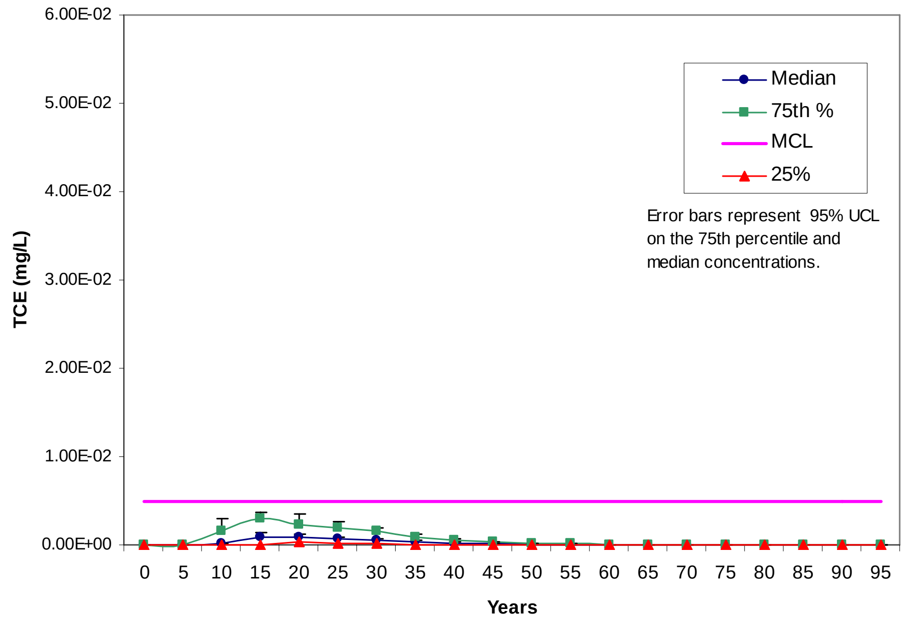
Fig. F.40. SWMU 1 median and 25% and 75% quartile TCE concentrations predicted for the plant boundary POE (variable degradation scenario).

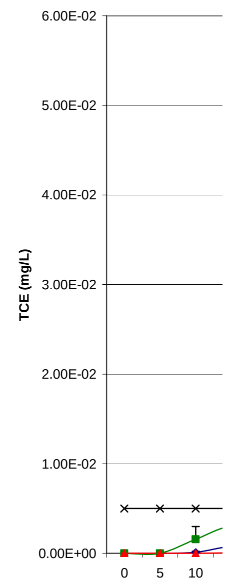


Deleted:

Deleted: 34

Deleted: 7



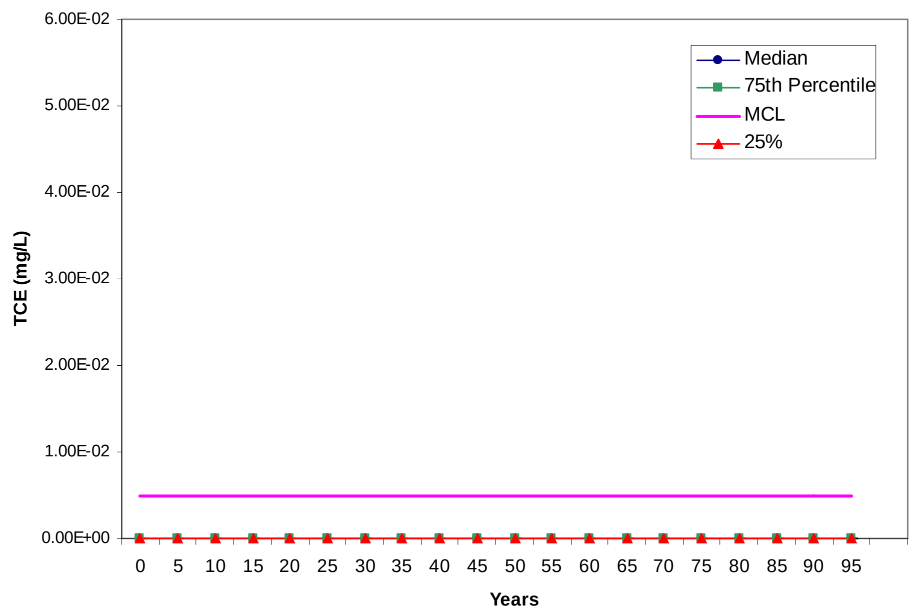


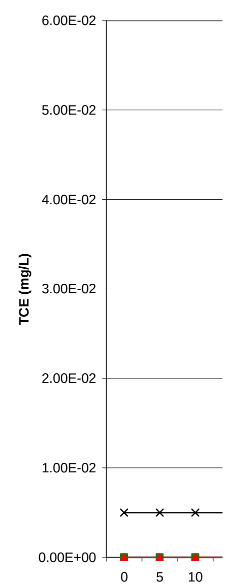
Deleted:

Fig. F.41. SWMU 1 median and 25% and 75% quartile TCE concentrations predicted for the property boundary POE (variable degradation scenario).

Deleted: 35

Deleted: 48





Deleted:

Fig. F.42. SWMU 1 median and 25% and 75% quartile TCE concentrations predicted for the Ohio River POE (variable degradation scenario).

Deleted: 36

Deleted: 49

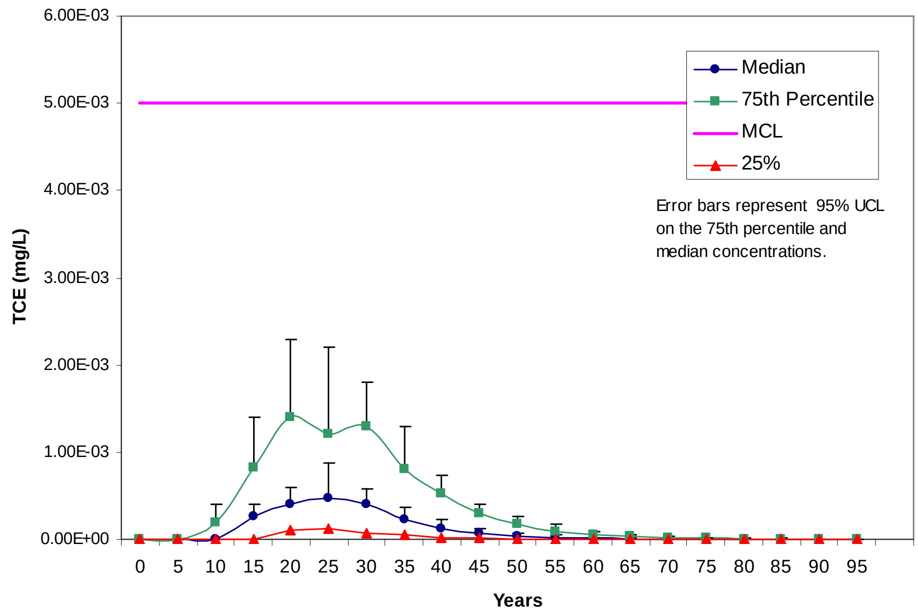


Fig. F.43. C-720 Building area median and 25% and 75% quartile TCE concentration predicted for the plant boundary POE (variable degradation scenario).

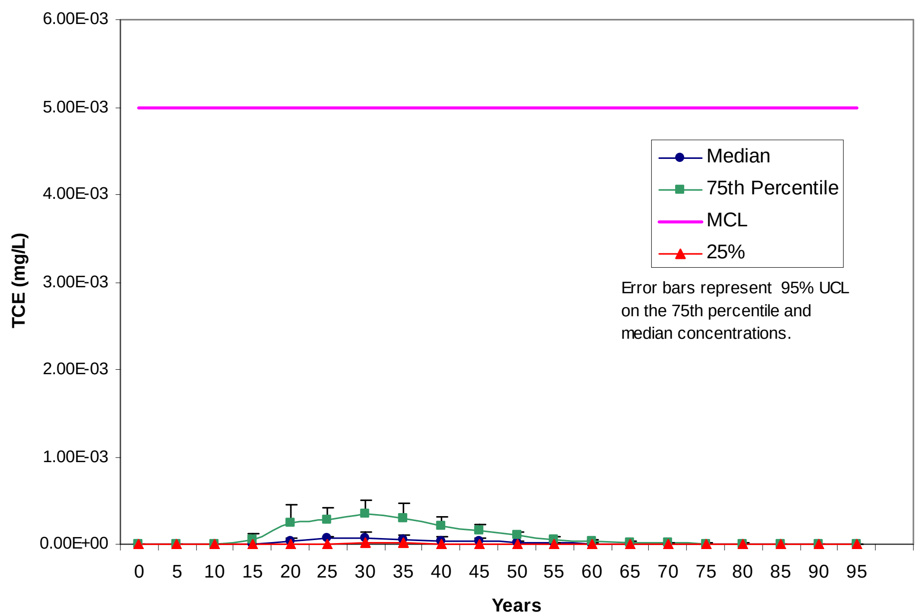
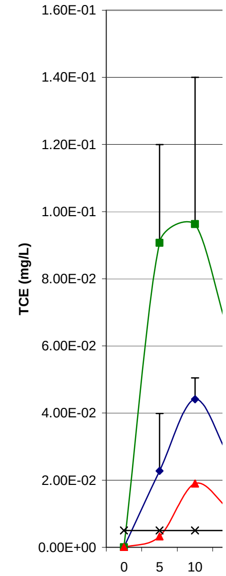
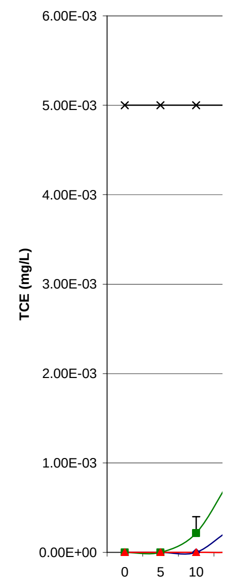


Fig. F.44. C-720 Building area median and 25% and 75% quartile TCE concentrations predicted for the property boundary POE (variable degradation scenario).



Deleted:

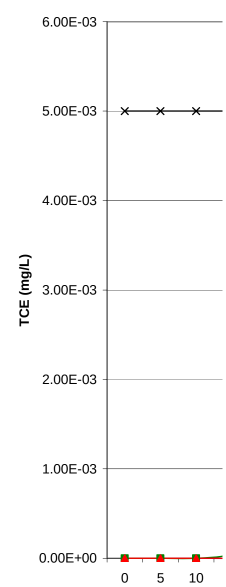
Deleted: Fig. F.50. SWMU 4 median and 25% and 75% quartile TCE concentrations predicted for the plant bounda ... [16]



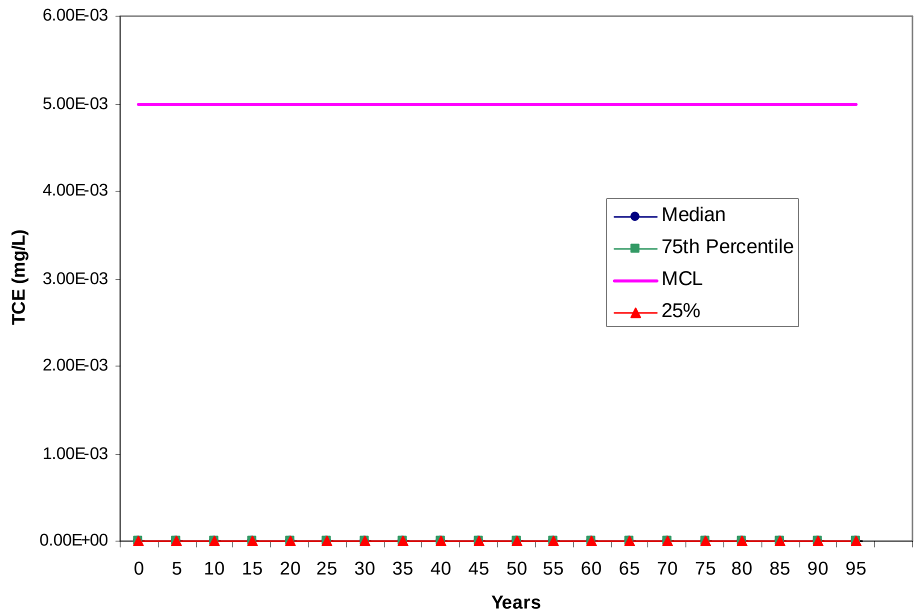
Deleted:

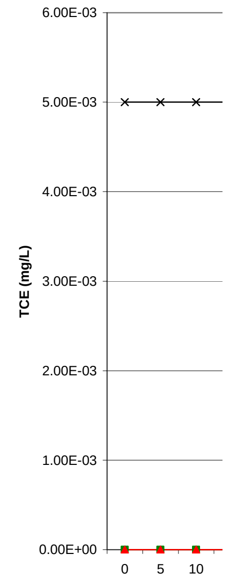
Deleted: 5

Deleted: 37



Deleted:





Deleted:

Deleted: 39

Deleted: 55

Fig. F.45. C-720 Building area median and 25% and 75% quartile TCE concentrations predicted for the Ohio River POE (variable degradation scenario).

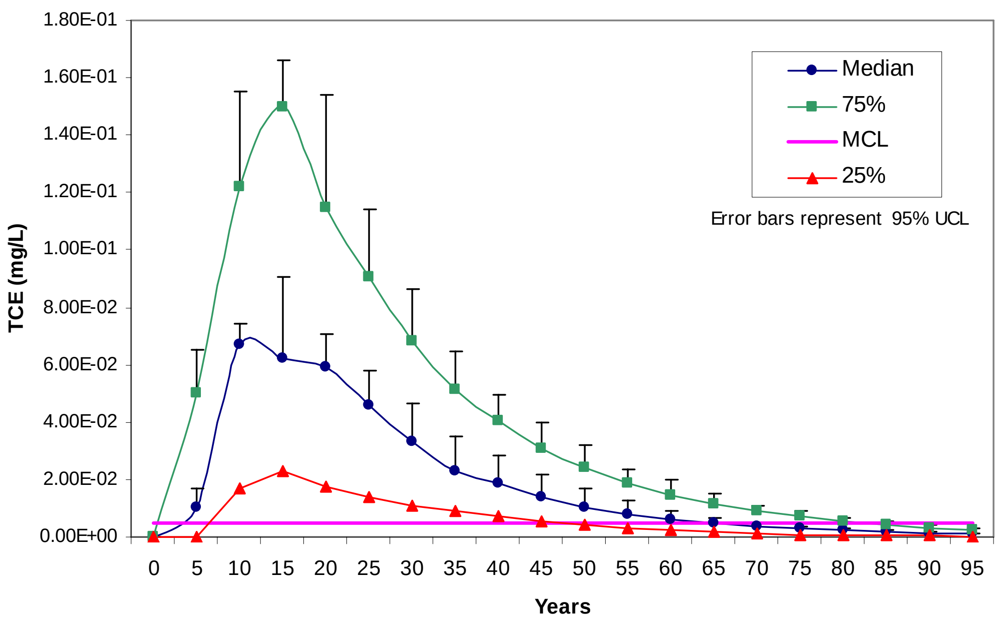


Fig. F.46. SWMU 1 median and 25% and 75% quartile TCE concentrations predicted for the plant boundary POE (fixed degradation scenario).

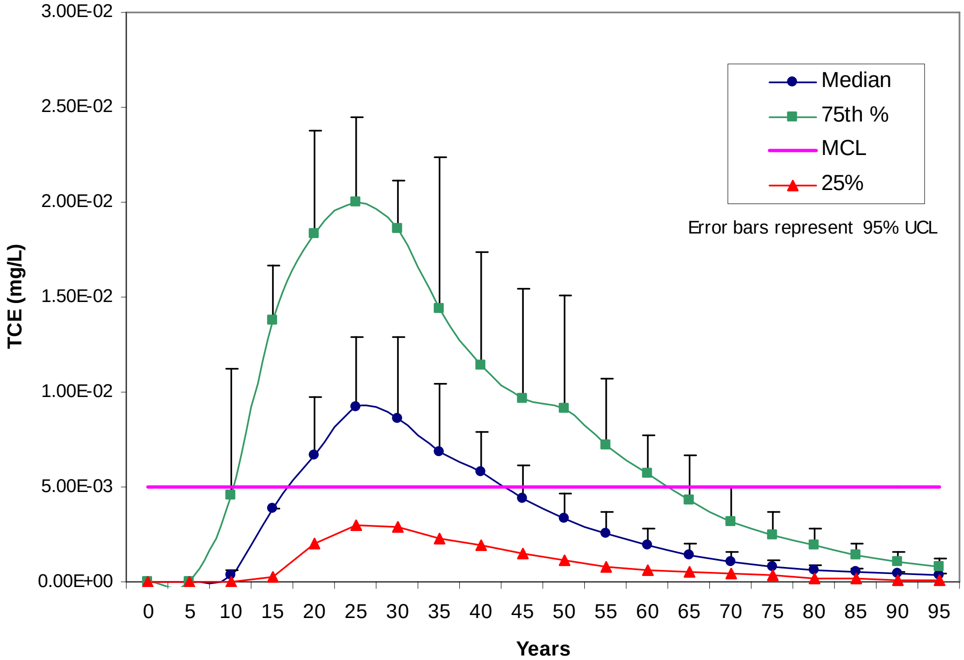


Fig. F.47. SWMU 1 median and 25% and 75% quartile TCE concentrations predicted for the property boundary POE (fixed degradation scenario).

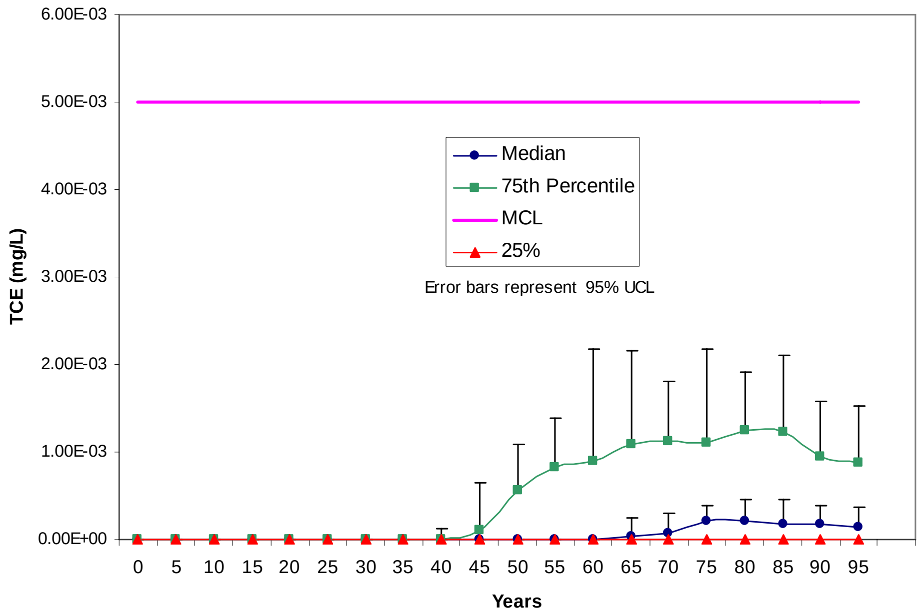


Fig. F.48. SWMU 1 median and 25% and 75% quartile TCE concentrations predicted for the Ohio River POE (fixed degradation scenario).

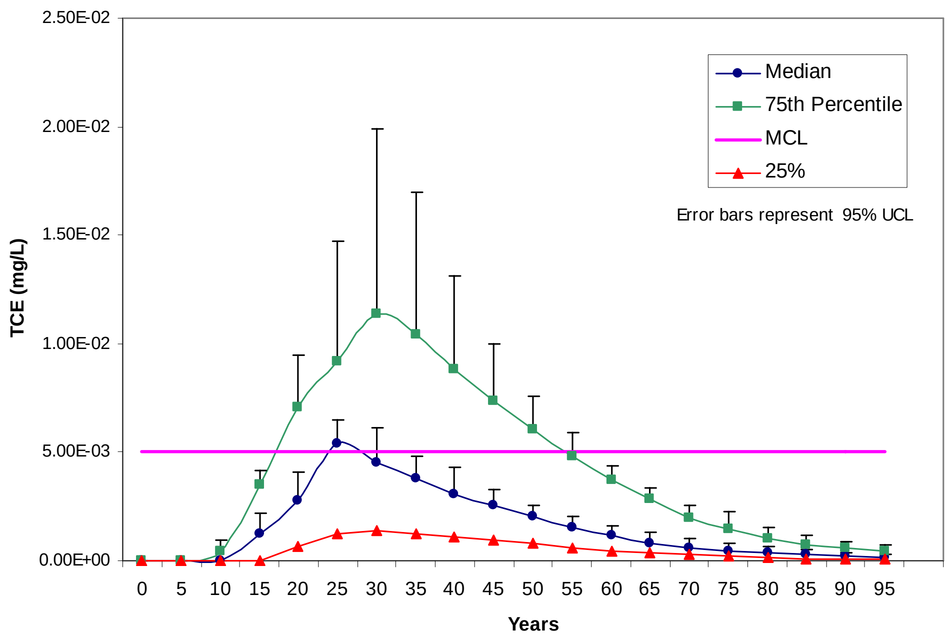


Fig. F.49. C-720 Building area median and 25% and 75% quartile TCE concentrations predicted for the plant boundary POE (fixed degradation scenario).

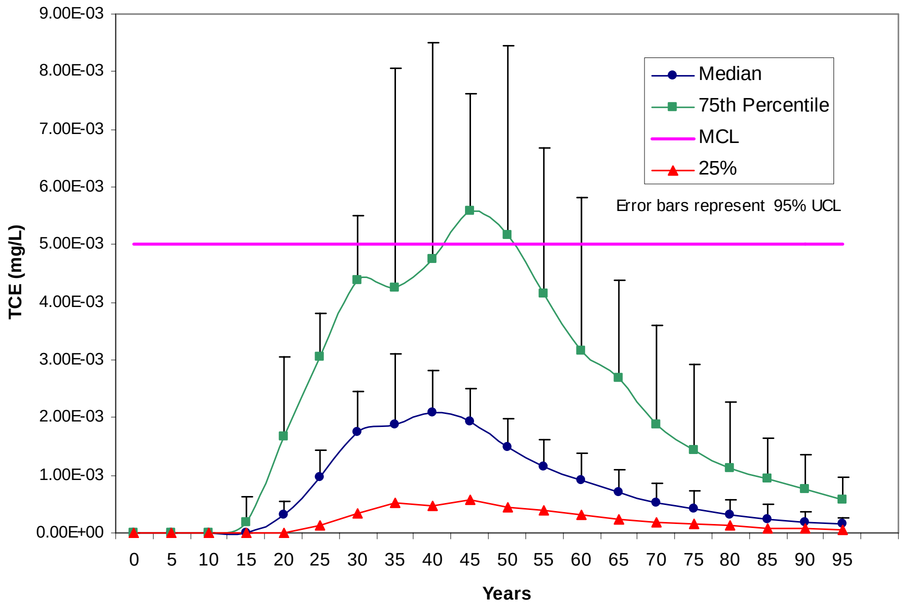


Fig. F.50. C-720 Building area median and 25% and 75% quartile TCE concentrations predicted for the property boundary POE (fixed degradation scenario).

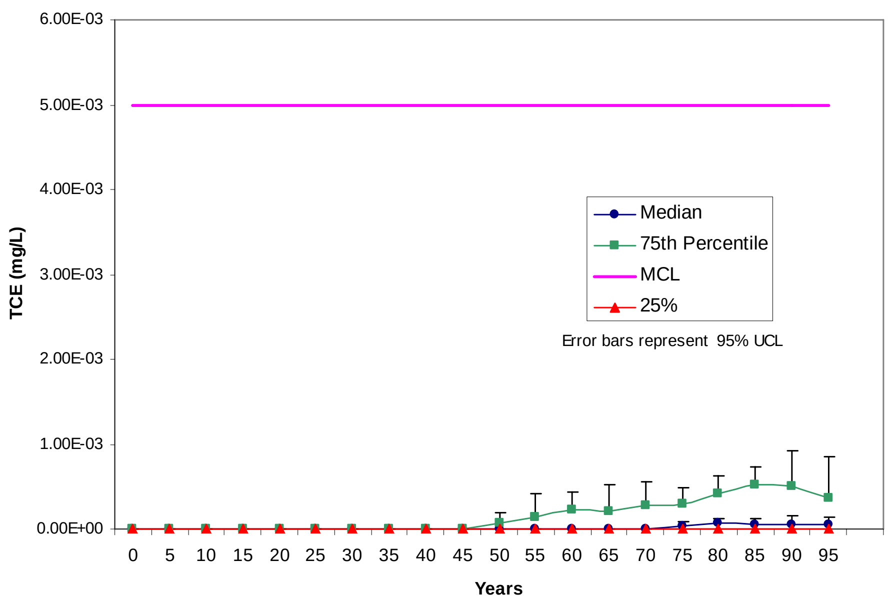


Fig. F.51. C-720 Building area median and 25% and 75% quartile TCE concentrations predicted for the Ohio River POE (fixed degradation scenario).

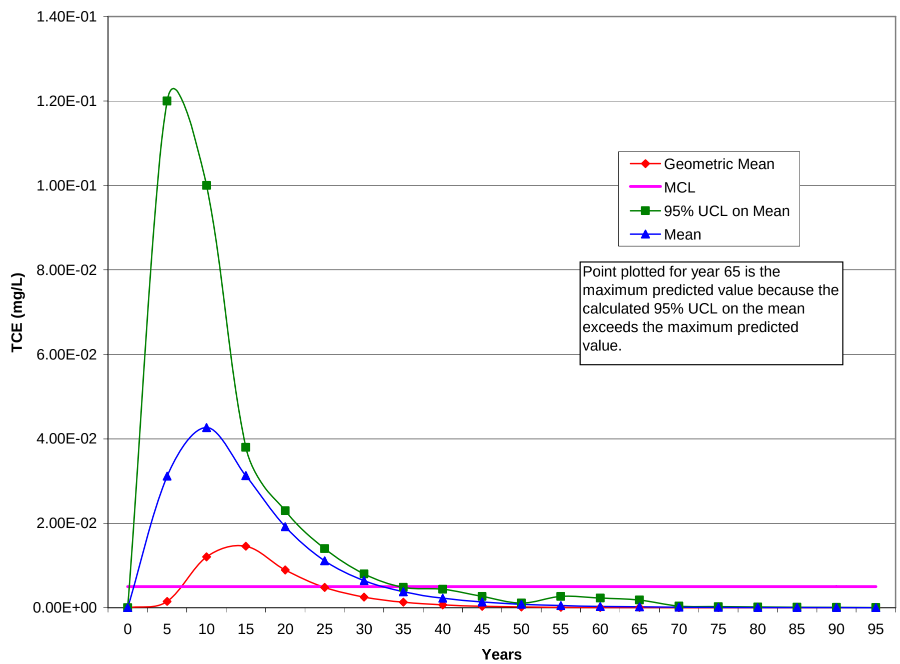
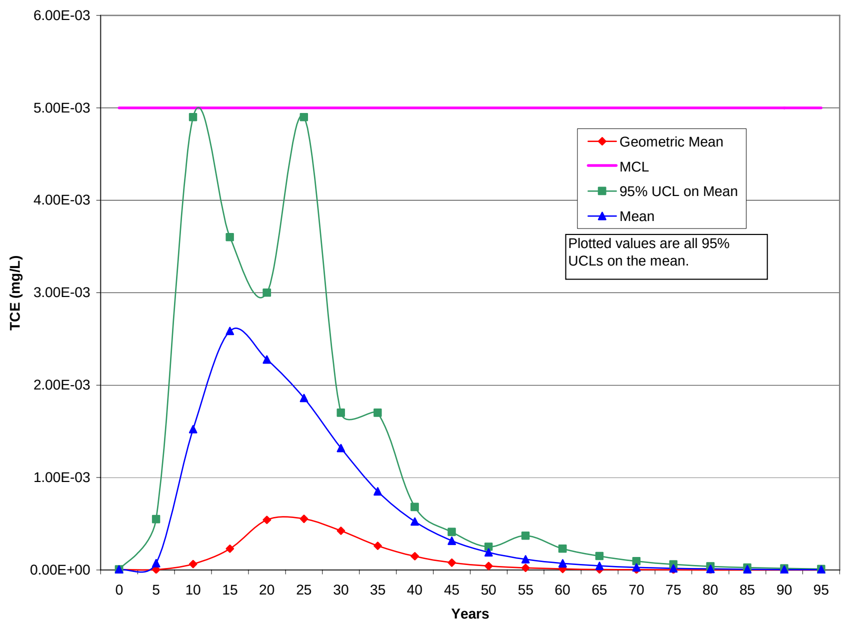


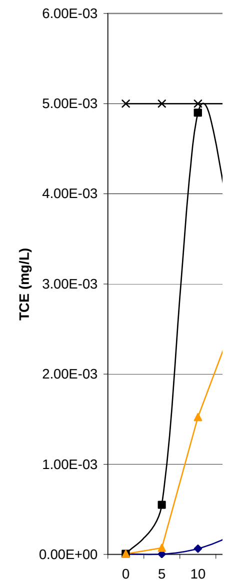
Fig. F.52. SWMU 1 log normal mean TCE concentrations predicted for the plant boundary POE (variable degradation scenario).

Deleted: Page Break <sp>¶

Deleted: 40

Deleted: 56





Deleted:

Fig. F.53. SWMU 1 log normal mean TCE concentrations predicted for the property boundary POE (variable degradation scenario).

Deleted: 41

Deleted: 57

Deleted: <sp>

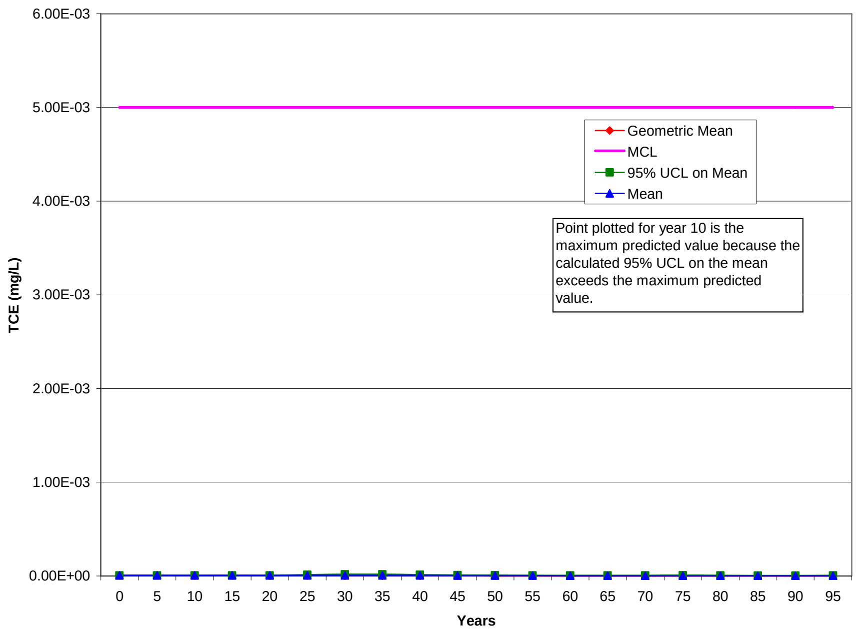


Fig. F.54. SWMU 1 log normal mean TCE concentrations predicted for the Ohio River POE (variable degradation scenario).

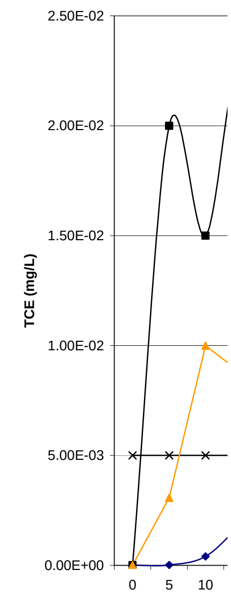
Deleted: 42

Deleted: 58

Deleted:

Deleted: <sp>¶
Fig. F.59. SWMU 4 log normal mean TCE concentrations predicted for the plant boundary POE.¶

Deleted: Page Break



Deleted: ... [17]

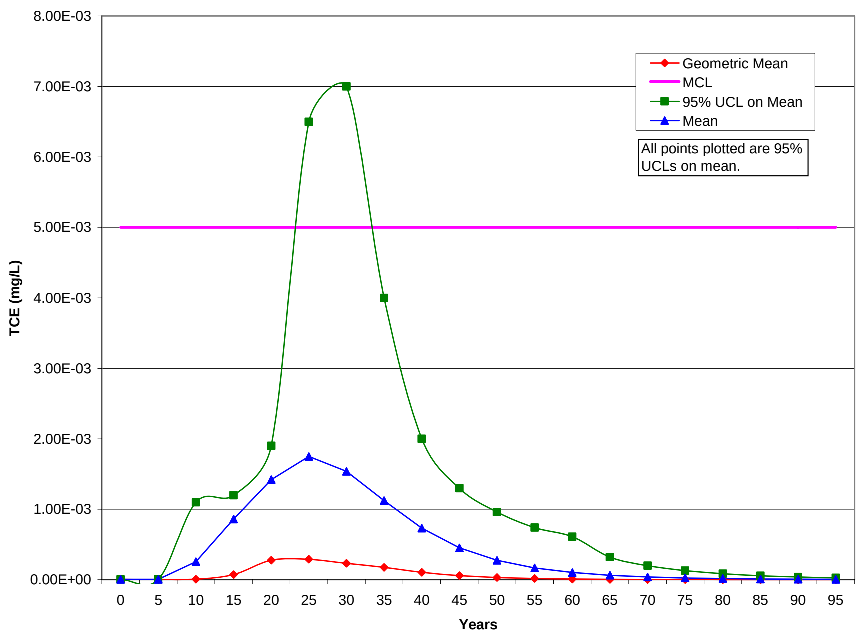
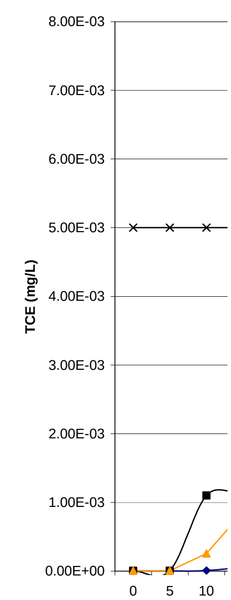


Fig. F.55. C-720 Building area log normal mean TCE concentrations predicted for the plant boundary POE (variable degradation scenario).



Deleted:

Deleted: 43

Deleted: 62

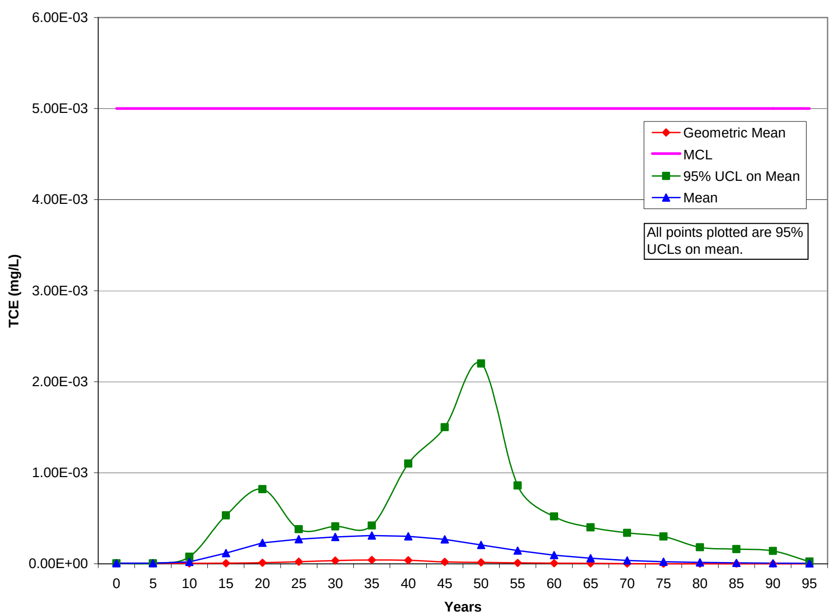
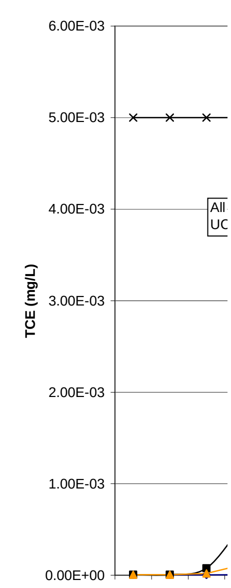
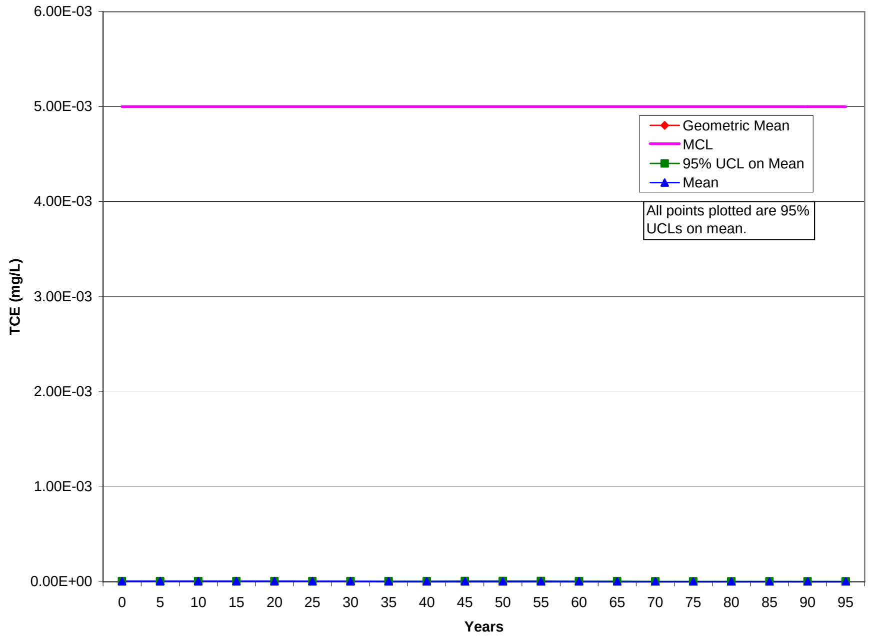


Fig. F.56. C-720 Building area log normal mean TCE concentrations predicted for the property boundary POE (variable degradation scenario).





Deleted: Page Break

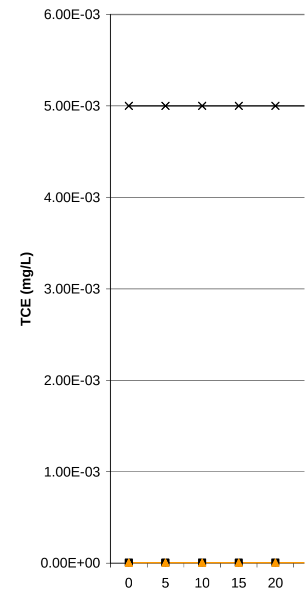


Fig. F.57. C-720 Building area log normal mean TCE concentrations predicted for the Ohio River POE (variable degradation scenario).

Deleted: 45

Deleted: 64

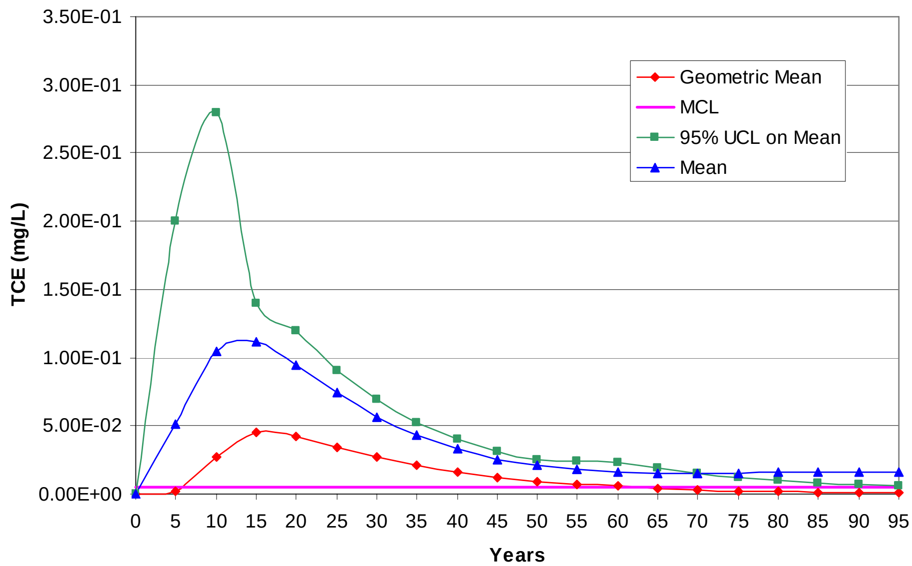


Fig. F.58. SWMU 1 log normal mean TCE concentrations Predicted for the plant boundary POE (fixed degradation scenario).

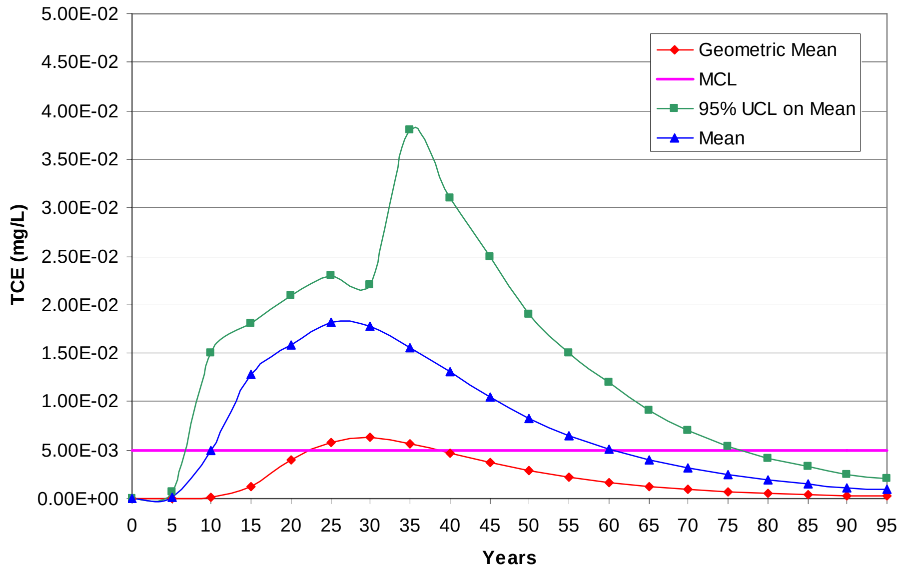


Fig. F.59. SWMU 1 log normal mean TCE concentrations Predicted for the property boundary POE (fixed degradation scenario).

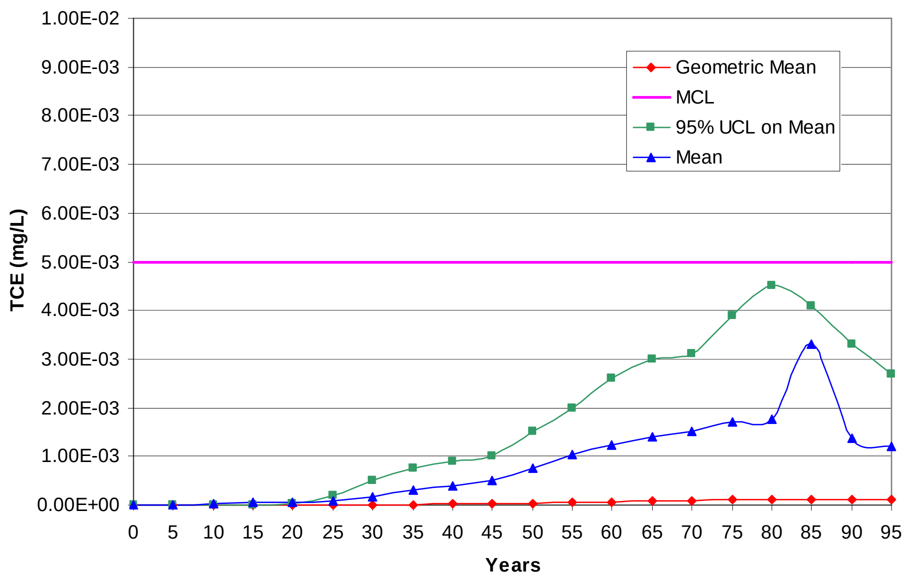


Fig. F.60. SWMU 1 log normal mean TCE concentrations Predicted for the Ohio River POE (fixed degradation scenario).

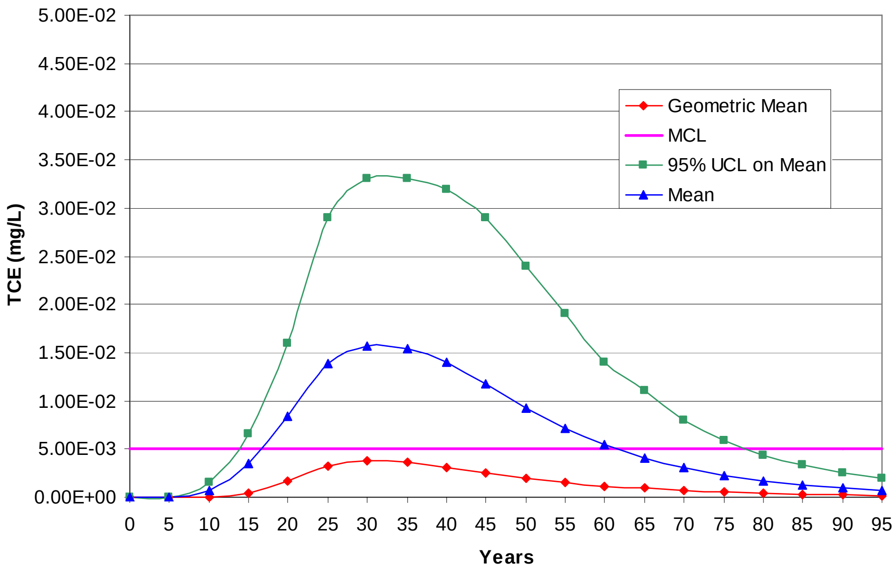


Fig. F.61. C-720 Building area log normal mean TCE concentration Predicted for the plant boundary POE (fixed degradation scenario).

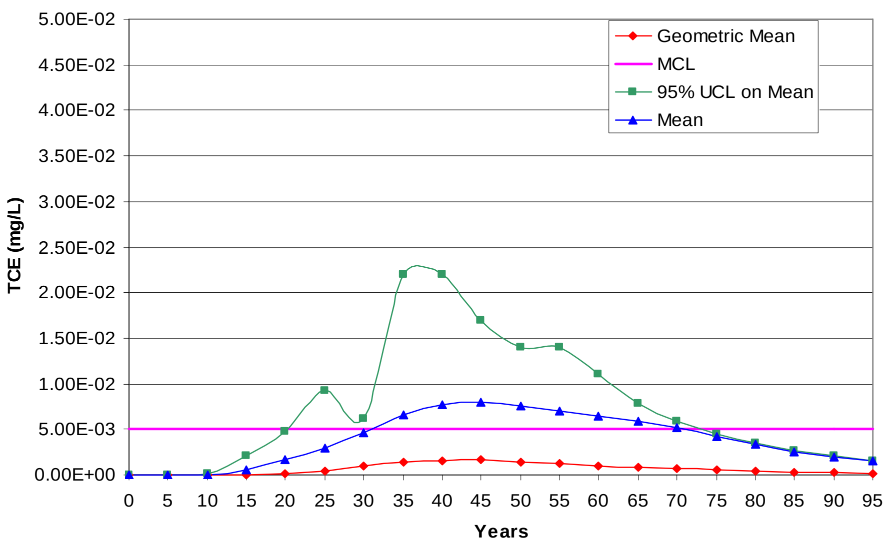


Fig. F.62. C-720 Building area log normal mean TCE concentration Predicted for the property boundary POE (fixed degradation scenario).

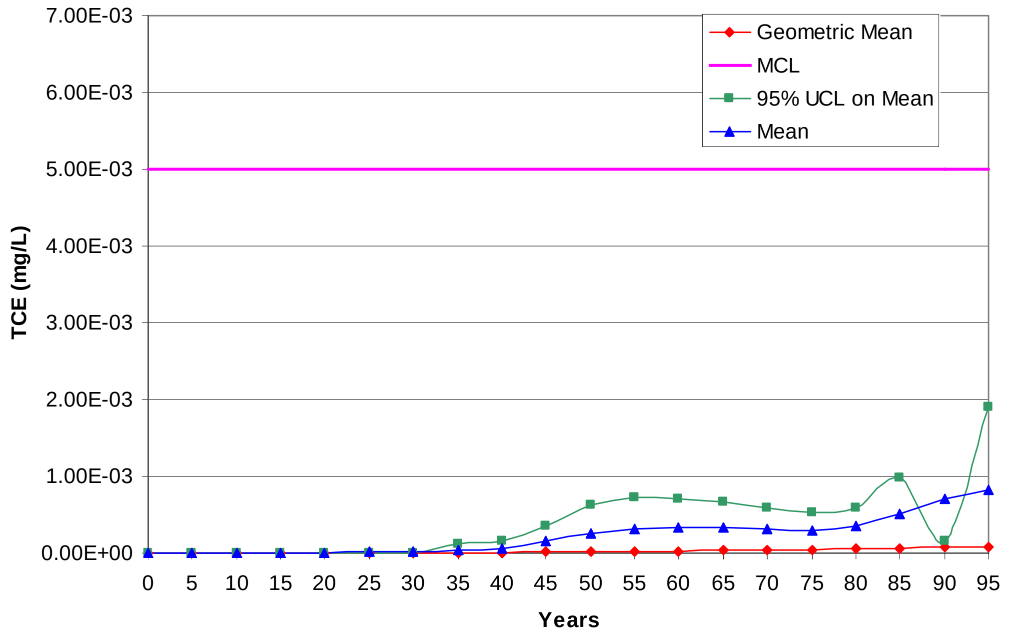


Fig. F.63. C-720 Building area log normal mean TCE concentration Predicted for Ohio River POE (fixed degradation scenario).

F3.2.2 Results of Probabilistic Modeling of TCE Originating at SWMU 1 and the C-720 Building Area

Deleted: , SWMU 4,

Maximum Predicted Concentrations for the Variable Degradation Scenario

Summary statistics for the maximum predicted concentrations at each of the POEs calculated over all time steps for the variable degradation scenario are presented in Table F.40. The maximum predicted value over all time steps were determined to be lognormally distributed at the property boundary and plant boundary, using ProUCL, while results for the Ohio River were non-parametric. As expected with data that are log normally distributed, the median and geometric means for each POE are similar, and the arithmetic means are greater than their corresponding medians and geometric means. For SWMU 1, the median, arithmetic mean, and geometric mean TCE concentrations at the plant boundary exceed the TCE MCL. However, the median, arithmetic mean, and geometric mean TCE concentrations at the property boundary do not exceed the TCE MCL. For the C-720 Building area, the median, arithmetic mean, and geometric mean TCE concentrations at the plant boundary never exceed the TCE MCL.

Deleted: ,
Deleted: ,
Deleted: ,
Deleted: 53
Deleted:
Deleted: The SWMU 4 source has the largest median, arithmetic mean, and geometric mean TCE concentration at all the POEs.
Deleted: and SWMU 4
Deleted: for SWMU 4, only
Deleted:

Figures F.28 through F.30 present histograms developed from the maximum predicted concentrations over all time steps for the SWMU 1 variable degradation scenario. For this SWMU, at the plant boundary POE, few maximum predicted concentrations are less than the TCE MCL (15%), and over 35% of the maximum predicted concentrations are over 10 times greater than the TCE MCL (i.e., greater than 5.00E-02 mg/L or 50 µg/L). At the property boundary, 81% of the maximum predicted

Deleted: 3
Deleted: 4
Deleted: for

concentrations are less than the TCE MCL, but only 1.0% of the maximum predicted concentrations are over 10 times greater than the TCE MCL. At the Ohio River, all maximum predicted concentrations are less than the TCE MCL, and 19% of the maximum predicted values are 0.

Figures F.31 through F.33 present histograms developed from the maximum predicted concentrations over all time steps for the C-720 Building area variable degradation scenario. For this source area at the plant boundary POE, 89% of the maximum predicted concentrations are less than the TCE MCL, and only 1% of the maximum predicted concentrations are over 10 times greater than the TCE MCL. At the property boundary, 98% of the maximum predicted concentrations are less than the TCE MCL, and none of the maximum predicted concentrations are over 10 times greater than the TCE MCL. At the Ohio River, all maximum predicted concentrations are less than the TCE MCL, and 26% of the maximum predicted values are 0.

Generally, this summary of the maximum predicted concentrations indicates that it is likely that SWMU 1, under the variable degradation scenario, may contribute TCE to the RGA at a rate that could result in exceedences of the TCE MCL at the plant boundary POEs. However, at the property boundary POE, exceedences of the TCE MCL are not expected to occur. These results also indicate that the source at the C-720 Building area under the variable degradation scenario is unlikely to contribute TCE to the RGA at a rate that could result in exceedences of TCE MCL at these two POEs. None of the sources are likely to contribute TCE to the RGA at a rate that could result in exceedences of the TCE MCL at the Ohio River.

The results presented above were based on an evaluation of all time steps, which tends to focus on the extremes of the underlying distributions of the probabilistic parameters. Later sections below present results obtained within each timestep, which provides results more representative of the full spectrum of the parameter distributions used in the probabilistic modeling.

Maximum Predicted Concentrations for the Fixed Degradation Scenario

Summary statistics for the maximum predicted concentrations at each of the POEs calculated over all time steps for the fixed degradation scenario are presented in Table F.40. The maximum predicted value over all time steps was determined to be lognormally distributed at the property boundary and plant boundary, using ProUCL, while results for the Ohio River were nonparametric. As expected with data that are log normally distributed, the median and geometric means for each POE are similar, and the arithmetic means are greater than their corresponding medians and geometric means. For SWMU 1, the median, arithmetic mean, and geometric mean TCE concentrations at the plant and property boundaries exceed the TCE MCL. For the C-720 Building area, the median, arithmetic mean, and geometric mean TCE concentrations at the plant boundary exceed the TCE MCL. The TCE concentrations at the property boundary only are exceeded for the arithmetic mean.

Figures F.31 through F.33 present histograms developed from the maximum predicted concentrations over all time steps for the SWMU 1 fixed degradation scenario. For this SWMU at the plant boundary POE, few maximum predicted concentrations are less than the TCE MCL (6%), and over 67% of the maximum predicted concentrations are over 10 times greater than the TCE MCL (i.e., greater than 5.00E-02 mg/L or 50 μg/L). At the property boundary, 25% of the maximum predicted concentrations are less than the TCE MCL, and 16% of the maximum predicted concentrations are over 10 times greater than the TCE MCL. At the Ohio River, 79% of the maximum predicted concentrations are less than the TCE MCL, and 1% of the maximum predicted concentrations are over 10 times greater than the TCE MCL.

Figures F.34 through F.36 present histograms developed from the maximum predicted concentrations over all time steps for the C-720 Building area fixed degradation scenario. For this source

Deleted: Figures F.41 through F.43 present histograms developed from the maximum predicted concentrations over all time steps for SWMU 4. For this SWMU, for the plant boundary POE, few maximum predicted concentrations are less than the TCE MCL (5%), and 57% of the maximum predicted concentrations are over 10 times greater than the TCE MCL. At the property boundary, 35% of the maximum predicted concentrations are less than the TCE MCL, but 5% of the maximum predicted concentrations are over 10 times greater than the TCE MCL. At the Ohio River, only one maximum predicted concentration is greater than the TCE MCL, and 17% of the maximum predicted values are 0.¶

Deleted: 44

Deleted: 46

Deleted: ,

Deleted: for

Deleted: both the

Deleted: and SWMU 4 sources

Deleted: due to contribution from SWMU 4, only.

Deleted: The

Deleted: s

Deleted: ,

Deleted: ,

Deleted: were

Deleted: -

Deleted: only

Deleted: ,

area, at the plant boundary POE, 42% of the maximum predicted concentrations are less than the TCE MCL, and 10% of the maximum predicted concentrations are over 10 times greater than the TCE MCL. At the property boundary, 64% of the maximum predicted concentrations are less than the TCE MCL, and 6% of the maximum predicted concentrations are over 10 times greater than the TCE MCL. At the Ohio River, 94% of the maximum predicted concentrations are less than the TCE MCL, and none of the maximum predicted concentrations are over 10 times greater than the TCE MCL.

Generally, this summary of the maximum predicted concentrations indicates it is likely that SWMU 1, under the fixed degradation scenario, may contribute TCE to the RGA at a rate that could result in exceedence of the TCE MCL at the plant and property boundary POEs. These results also indicate that the source at the C-720 Building area under the fixed degradation scenario may contribute TCE to the RGA at a rate that could result in exceedence of TCE MCL at the plant boundary POE. However, the data indicate that only the mean concentrations exceeded the MCL at the property boundary POE. None of the sources are likely to contribute TCE to the RGA at a rate that could result in exceedence of the TCE MCL at the Ohio River.

The results presented herein were based on an evaluation of all time steps, which tends to focus on the extremes of the underlying distributions of the probabilistic parameters. Subsequent sections present results obtained within each time step, which provides results more representative of the full spectrum of the parameter distributions used in the probabilistic modeling.

Plots of Median and Log Normal Means within Time Steps for the Variable Degradation Scenario

Figures F.40 to F.45, and F.52 to F.57 depict the predicted TCE concentrations for the variable degradation scenario at each of the POEs using summary statistics calculated within each year modeled or within time step. Because the statistics used to develop these plots were derived within time step, they account for the variation over the modeling runs better than the maximum plots presented earlier and depict the most likely concentrations predicted for each of the POEs at each time. Tables F.41 through F.44 present the statistical evaluation of the predicted concentrations, which were the basis for Figs. F.40 to F.45 and F.52 to F.57. UCL95% values presented in the figures and tables are based on the two-sided statistical evaluation.

Deleted: that

Deleted: above

Deleted: Later

Deleted: below

Deleted: ¶

Deleted: 34

Deleted: 47

Deleted: 36

Deleted: 4

Deleted: The graphs for each source unit are displayed with a constant y-axis to emphasize the reduction in contaminant level with travel distance from the source at the different points of exposure.

Deleted: 5

Deleted: 59

Deleted: 34

Deleted: 7

Deleted: 6

Deleted: 2

Deleted: -

Table F.41. Summary statistics for Probabilistic Modeling at SWMU 1 for the Variable Degradation Scenario – percentiles within timesteps

			Median				75th Percentile			
Year	**Minimum**	**Maximum**	**2-sided 95% LCL**	**Conc.**	**2-sided 95% UCL**	**1-sided 95% UCL**	**2-sided 95% LCL**	**Conc.**	**2-sided 95% UCL**	**1-sided 95% UCL**
					Plant					
0	0	0	0	0	0	0	0	0	0	0
5	0	7.7E-01	2.4E-03	7.6E-03	1.2E-02	1.1E-02	2.2E-02	3.4E-02	4.1E-02	4.0E-02
10	0	4.2E-01	1.8E-02	2.5E-02	3.0E-02	2.9E-02	3.9E-02	4.9E-02	6.6E-02	6.5E-02
15	0	1.9E-01	1.3E-02	1.7E-02	2.2E-02	2.0E-02	3.0E-02	4.4E-02	5.1E-02	5.0E-02
20	1.9E-04	1.1E-01	7.3E-03	1.0E-02	1.4E-02	1.2E-02	1.9E-02	2.6E-02	4.0E-02	3.7E-02
25	8.2E-05	7.2E-02	3.6E-03	5.7E-03	8.1E-03	7.4E-03	1.1E-02	1.4E-02	2.3E-02	2.2E-02
30	3.5E-05	4.7E-02	2.2E-03	3.1E-03	4.6E-03	4.1E-03	5.8E-03	7.4E-03	1.2E-02	1.1E-02
35	1.5E-05	3.0E-02	1.1E-03	1.8E-03	2.5E-03	2.2E-03	3.1E-03	4.0E-03	6.6E-03	6.2E-03
40	6.4E-06	1.9E-02	6.2E-04	9.7E-04	1.3E-03	1.2E-03	1.7E-03	2.1E-03	4.2E-03	3.3E-03
45	2.7E-06	1.2E-02	3.7E-04	4.6E-04	7.3E-04	6.3E-04	9.0E-04	1.2E-03	2.7E-03	2.3E-03
50	1.2E-06	7.4E-03	1.6E-04	2.3E-04	3.9E-04	3.8E-04	5.0E-04	7.7E-04	1.7E-03	1.6E-03
55	4.9E-07	4.6E-03	6.4E-05	1.3E-04	2.1E-04	2.1E-04	2.6E-04	4.7E-04	9.5E-04	8.8E-04
60	2.1E-07	2.9E-03	3.7E-05	7.1E-05	1.1E-04	1.1E-04	1.5E-04	2.8E-04	5.2E-04	5.0E-04
65	8.9E-08	1.8E-03	1.8E-05	4.0E-05	5.5E-05	5.3E-05	8.8E-05	1.7E-04	3.3E-04	3.1E-04
70	3.1E-08	1.1E-03	1.1E-05	2.2E-05	3.0E-05	2.8E-05	4.9E-05	1.0E-04	2.1E-04	1.8E-04
75	9.8E-09	7.3E-04	5.2E-06	1.2E-05	1.8E-05	1.5E-05	3.0E-05	6.3E-05	1.3E-04	1.3E-04
80	3.0E-09	5.1E-04	2.6E-06	6.2E-06	1.1E-05	8.0E-06	1.7E-05	3.5E-05	8.8E-05	8.4E-05
85	1.0E-09	3.5E-04	1.5E-06	3.4E-06	5.9E-06	4.4E-06	9.0E-06	1.9E-05	5.3E-05	5.1E-05
90	4.3E-10	2.4E-04	7.9E-07	1.9E-06	3.2E-06	2.7E-06	4.9E-06	1.1E-05	3.4E-05	3.0E-05
95	2.9E-10	1.7E-04	3.9E-07	1.0E-06	1.7E-06	1.6E-06	2.7E-06	6.8E-06	2.1E-05	1.9E-05
					Property					
0	0	0	0	0	0	0	0	0	0	0
5	0	4.3E-03	0	0	0	0	0	0	3.6E-09	3.5E-09
10	0	2.6E-02	1.1E-05	1.1E-04	2.3E-04	2.1E-04	4.2E-04	1.5E-03	3.0E-03	3.0E-03
15	0	6.1E-02	3.7E-04	8.1E-04	1.4E-03	1.3E-03	2.1E-03	3.0E-03	3.6E-03	3.5E-03
20	0	2.6E-02	6.7E-04	9.5E-04	1.3E-03	1.2E-03	1.6E-03	2.3E-03	3.5E-03	3.4E-03
25	4.5E-09	1.9E-02	4.6E-04	7.5E-04	9.5E-04	8.9E-04	1.4E-03	2.0E-03	2.7E-03	2.6E-03
30	7.3E-07	1.6E-02	3.8E-04	5.0E-04	7.0E-04	6.3E-04	1.0E-03	1.5E-03	2.0E-03	2.0E-03
35	3.3E-06	1.1E-02	1.9E-04	3.2E-04	4.9E-04	4.3E-04	5.8E-04	9.6E-04	1.3E-03	1.2E-03

Deleted: 5

Deleted: LCL95

Deleted: Conc.

Deleted: UCL95

Deleted: UCL95

Deleted: LCL95

Deleted: Conc.

Deleted: UCL95

Deleted: UCL95

Table F.41. Summary statistics for Probabilistic Modeling at SWMU 1 for the Variable Degradation Scenario – percentiles within timesteps (continued)

			Median				75th Percentile			
Year	Minimum	Maximum	2-sided 95% LCL	Conc.	2-sided 95% UCL	1-sided 95% UCL	2-sided 95% LCL	Conc.	2-sided 95% UCL	1-sided 95% UCL
40	1.4E-06	6.8E-03	1.1E-04	2.0E-04	2.8E-04	2.7E-04	3.7E-04	5.6E-04	7.1E-04	6.8E-04
45	5.9E-07	4.3E-03	6.1E-05	1.2E-04	1.6E-04	1.6E-04	2.3E-04	3.2E-04	4.2E-04	4.1E-04
50	2.5E-07	2.7E-03	3.1E-05	6.6E-05	9.9E-05	8.8E-05	1.4E-04	1.7E-04	2.5E-04	2.4E-04
55	1.1E-07	1.7E-03	1.6E-05	3.7E-05	5.3E-05	4.9E-05	6.7E-05	9.8E-05	1.5E-04	1.4E-04
60	4.6E-08	1.1E-03	9.1E-06	1.8E-05	2.9E-05	2.7E-05	4.0E-05	5.5E-05	8.3E-05	8.1E-05
65	1.9E-08	6.7E-04	4.9E-06	9.6E-06	1.6E-05	1.5E-05	2.1E-05	2.9E-05	5.6E-05	5.6E-05
70	8.2E-09	4.2E-04	2.0E-06	5.4E-06	9.3E-06	8.1E-06	1.1E-05	1.7E-05	3.5E-05	3.4E-05
75	2.9E-09	2.7E-04	1.2E-06	3.0E-06	4.3E-06	4.2E-06	6.0E-06	1.1E-05	2.2E-05	2.0E-05
80	9.0E-10	1.7E-04	7.0E-07	1.7E-06	2.5E-06	2.0E-06	3.5E-06	6.3E-06	1.3E-05	1.2E-05
85	2.8E-10	1.1E-04	3.6E-07	8.7E-07	1.4E-06	1.0E-06	2.1E-06	3.7E-06	8.0E-06	7.1E-06
90	8.9E-11	7.0E-05	2.2E-07	4.3E-07	6.7E-07	6.0E-07	1.2E-06	2.0E-06	4.9E-06	4.2E-06
95	3.4E-11	4.7E-05	1.1E-07	2.2E-07	3.8E-07	3.3E-07	6.4E-07	1.2E-06	3.0E-06	2.5E-06
River										
0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
10	0	7.7E-11	0	0	0	0	0	0	0	0
15	0	1.3E-05	0	0	0	0	0	0	0	0
20	0	7.6E-06	0	0	0	0	0	0	0	0
25	0	1.1E-04	0	0	0	0	0	0	0	0
30	0	1.2E-04	0	0	0	0	0	0	1.2E-12	1.0E-12
35	0	9.0E-05	0	0	0	0	0	4.8E-12	3.4E-08	1.6E-08
40	0	6.0E-05	0	0	0	0	3.3E-12	1.7E-08	5.7E-07	3.8E-07
45	0	3.9E-05	0	0	1.2E-12	0	8.3E-09	2.4E-07	1.1E-06	9.9E-07
50	0	2.1E-05	0	0	4.7E-10	1.6E-10	8.4E-08	5.7E-07	1.5E-06	9.5E-07
55	0	1.5E-05	0	5.6E-11	2.3E-08	5.7E-09	1.1E-07	3.9E-07	1.0E-06	9.8E-07
60	0	2.3E-05	1.7E-12	1.8E-09	3.3E-08	2.2E-08	1.2E-07	2.4E-07	5.0E-07	5.0E-07
65	0	1.7E-05	1.3E-10	8.9E-09	4.0E-08	2.8E-08	1.1E-07	1.4E-07	3.5E-07	2.7E-07
70	0	2.4E-05	2.1E-09	9.5E-09	4.7E-08	3.8E-08	7.7E-08	1.1E-07	2.4E-07	2.0E-07
75	0	4.2E-05	1.3E-09	1.2E-08	3.1E-08	2.8E-08	4.5E-08	9.1E-08	1.5E-07	1.4E-07

Deleted: 5

Deleted: LCL

Deleted: UCL

Deleted: UCL

Deleted: LCL

Deleted: UCL

Deleted: UCL

Table F.41. Summary statistics for Probabilistic Modeling at SWMU 1 for the Variable Degradation Scenario – percentiles within timesteps (continued)

			Median				75th Percentile			
Year	**Minimum**	**Maximum**	**2-sided 95% LCL**	**Conc.**	**2-sided 95% UCL**	**1-sided 95% UCL**	**2-sided 95% LCL**	**Conc.**	**2-sided 95% UCL**	**1-sided 95% UCL**
80	0	3.3E-05	8.4E-10	6.9E-09	1.6E-08	1.5E-08	2.9E-08	4.4E-08	1.1E-07	9.8E-08
85	0	1.6E-05	6.7E-10	4.7E-09	1.1E-08	9.1E-09	1.8E-08	3.6E-08	6.7E-08	5.6E-08
90	0	2.2E-05	6.2E-10	2.8E-09	6.7E-09	6.1E-09	1.0E-08	2.9E-08	7.8E-08	5.0E-08
95	0	3.3E-05	4.3E-10	2.0E-09	3.7E-09	3.5E-09	6.4E-09	1.9E-08	6.6E-08	4.2E-08

Note: All concentrations are mg/L.
Conc. = concentration.
LCL95 = nonparametric lower confidence limit on the percentile concentration with 95% confidence.
Std. dev. = standard deviation.
UCL95 = nonparametric upper confidence limit on the percentile concentration with 95% confidence.

Deleted: 5
Deleted: LCL
Deleted: UCL
Deleted: UCL
Deleted: LCL
Deleted: UCL
Deleted: UCL

Table F.42. Summary statistics for Probabilistic Modeling at C-720 for the Variable Degradation Scenario – percentiles within timesteps

			Median				75th Percentile			
Year	Minimum	Maximum	2-sided 95% LCL	Conc.	2-sided 95% UCL	1-sided 95% UCL	2-sided 95% LCL	Conc.	2-sided 95% UCL	1-sided 95% UCL
Plant										
0	0	0	0	0	0	0	0	0	0	0
5	0	1.4E-08	0	0	0	0	0	0	0	0
10	0	7.4E-03	0	3.9E-09	1.1E-06	6.4E-07	3.5E-05	1.9E-04	4.0E-04	4.0E-04
15	0	1.4E-02	1.0E-04	2.6E-04	4.0E-04	3.8E-04	6.8E-04	8.2E-04	1.4E-03	1.2E-03
20	0	1.4E-02	2.6E-04	4.1E-04	6.0E-04	5.2E-04	1.0E-03	1.4E-03	2.3E-03	2.3E-03
25	0	4.4E-02	2.5E-04	4.7E-04	8.8E-04	7.2E-04	1.0E-03	1.2E-03	2.2E-03	2.0E-03
30	5.8E-14	5.4E-02	1.9E-04	4.0E-04	5.7E-04	5.4E-04	7.0E-04	1.3E-03	1.8E-03	1.8E-03
35	1.6E-08	4.3E-02	1.2E-04	2.2E-04	3.6E-04	3.3E-04	5.6E-04	8.0E-04	1.3E-03	1.3E-03
40	6.3E-07	2.9E-02	6.5E-05	1.2E-04	2.2E-04	2.0E-04	3.6E-04	5.2E-04	7.4E-04	7.0E-04
45	4.0E-07	1.8E-02	4.1E-05	7.2E-05	1.3E-04	1.1E-04	2.3E-04	3.0E-04	4.0E-04	3.7E-04
50	1.5E-07	1.0E-02	2.4E-05	4.1E-05	7.5E-05	6.6E-05	1.2E-04	1.7E-04	2.6E-04	2.6E-04
55	5.8E-08	6.1E-03	1.4E-05	2.4E-05	4.6E-05	4.2E-05	5.9E-05	9.6E-05	1.7E-04	1.5E-04
60	2.2E-08	3.6E-03	7.8E-06	1.4E-05	2.3E-05	2.0E-05	3.7E-05	6.1E-05	9.4E-05	9.0E-05
65	8.2E-09	2.1E-03	4.4E-06	8.1E-06	1.2E-05	9.8E-06	2.2E-05	3.8E-05	5.2E-05	5.2E-05
70	3.1E-09	1.2E-03	1.9E-06	4.2E-06	6.2E-06	5.8E-06	1.2E-05	2.4E-05	3.4E-05	3.1E-05
75	1.1E-09	7.8E-04	1.0E-06	2.1E-06	3.4E-06	2.9E-06	6.0E-06	1.4E-05	2.2E-05	2.2E-05
80	3.8E-10	5.7E-04	6.2E-07	1.2E-06	1.9E-06	1.6E-06	3.5E-06	8.7E-06	1.4E-05	1.3E-05
85	1.6E-10	4.1E-04	3.5E-07	6.8E-07	1.0E-06	8.0E-07	2.2E-06	5.2E-06	9.1E-06	7.4E-06
90	7.2E-11	3.0E-04	1.6E-07	3.6E-07	6.5E-07	5.1E-07	1.5E-06	3.2E-06	5.4E-06	4.6E-06
95	5.7E-11	2.1E-04	8.2E-08	1.9E-07	3.5E-07	3.1E-07	8.8E-07	2.0E-06	3.2E-06	3.0E-06
Property										
0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
10	0	3.5E-04	0	0	0	0	0	0	6.4E-07	1.3E-07
15	0	3.7E-03	0	2.1E-08	1.6E-06	8.1E-07	9.0E-06	4.6E-05	1.3E-04	1.3E-04
20	0	5.2E-03	4.6E-06	2.8E-05	7.5E-05	5.7E-05	1.1E-04	2.4E-04	4.6E-04	4.4E-04
25	0	4.1E-03	3.3E-05	6.2E-05	8.4E-05	8.2E-05	1.6E-04	2.7E-04	4.1E-04	4.0E-04
30	0	2.8E-03	3.5E-05	7.3E-05	1.4E-04	9.7E-05	2.2E-04	3.5E-04	5.0E-04	4.8E-04

Deleted: 56

Deleted: Table F.55. Summary statistics for Probabilistic Modeling at SWMU 4 – Percentiles within timesteps¶ ... [18]

Deleted: 2-sided

Deleted: 2-sided

Deleted: 1-sided

Deleted: 2-sided

Deleted: 2-sided

Deleted: 1-sided

Deleted: LCL95

Deleted: Conc.

Deleted: UCL95

Deleted: UCL95

Deleted: LCL95

Deleted: Conc.

Deleted: UCL95

Deleted: UCL95

35	0	4.0E-03	3.2E-05	5.7E-05	1.0E-04	8.7E-05	1.8E-04	2.9E-04	4.7E-04	4.6E-04

Table F.42. Summary statistics for Probabilistic Modeling at C-720 for the Variable Degradation Scenario – percentiles within timesteps (continued)

			Median				75th Percentile			
Year	Minimum	Maximum	2-sided 95% LCL	Conc.	2-sided 95% UCL	1-sided 95% UCL	2-sided 95% LCL	Conc.	2-sided 95% UCL	1-sided 95% UCL
40	0	9.1E-03	2.1E-05	3.9E-05	8.8E-05	6.8E-05	1.3E-04	2.1E-04	3.2E-04	3.2E-04
45	1.1E-12	1.2E-02	1.7E-05	3.3E-05	6.1E-05	5.0E-05	9.7E-05	1.5E-04	2.2E-04	2.0E-04
50	1.9E-10	1.1E-02	9.7E-06	1.9E-05	4.0E-05	3.9E-05	6.8E-05	1.0E-04	1.4E-04	1.3E-04
55	4.1E-09	7.7E-03	5.8E-06	1.1E-05	2.5E-05	2.3E-05	4.1E-05	5.8E-05	8.8E-05	8.7E-05
60	1.8E-08	4.9E-03	3.5E-06	6.8E-06	1.6E-05	1.3E-05	2.1E-05	3.6E-05	5.6E-05	5.0E-05
65	6.7E-09	2.9E-03	2.1E-06	3.7E-06	9.2E-06	6.9E-06	1.3E-05	2.2E-05	3.5E-05	3.4E-05
70	2.3E-09	1.7E-03	1.1E-06	2.2E-06	4.2E-06	3.9E-06	8.0E-06	1.3E-05	2.1E-05	2.1E-05
75	7.6E-10	1.0E-03	6.2E-07	1.3E-06	2.2E-06	1.9E-06	4.4E-06	7.8E-06	1.4E-05	1.4E-05
80	2.5E-10	6.0E-04	3.4E-07	7.1E-07	1.3E-06	1.2E-06	2.5E-06	4.9E-06	8.8E-06	7.5E-06
85	8.4E-11	3.5E-04	1.7E-07	3.7E-07	7.4E-07	5.7E-07	1.6E-06	3.1E-06	5.7E-06	4.2E-06
90	3.8E-11	2.1E-04	9.0E-08	2.1E-07	3.6E-07	3.3E-07	9.6E-07	1.9E-06	3.7E-06	2.4E-06
95	2.1E-11	1.5E-04	5.6E-08	1.2E-07	2.1E-07	1.6E-07	6.5E-07	1.2E-06	1.7E-06	1.7E-06
River										
0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0
15	0	2.5E-06	0	0	0	0	0	0	0	0
20	0	1.5E-05	0	0	0	0	0	0	0	0
25	0	1.4E-05	0	0	0	0	0	0	0	0
30	0	9.8E-06	0	0	0	0	0	0	0	0
35	0	8.5E-06	0	0	0	0	0	0	0	0
40	0	1.1E-05	0	0	0	0	0	3.3E-13	4.6E-09	1.9E-10
45	0	2.5E-05	0	0	0	0	3.7E-16	3.2E-09	7.8E-08	7.0E-08
50	0	3.8E-05	0	0	0	0	4.3E-11	7.4E-08	3.0E-07	2.7E-07
55	0	3.2E-05	0	0	2.7E-13	1.8E-14	1.4E-09	7.4E-08	4.6E-07	4.4E-07
60	0	2.2E-05	0	0	1.9E-10	1.0E-11	1.2E-08	4.5E-08	3.9E-07	3.6E-07

Deleted: 56

Deleted: 2-sided

Deleted: 2-sided

Deleted: 1-sided

Deleted: 2-sided

Deleted: 2-sided

Deleted: 1-sided

Deleted: LCL95

Deleted: Conc.

Deleted: UCL95

Deleted: UCL95

Deleted: LCL95

Deleted: Conc.

Deleted: UCL95

Deleted: UCL95

Table F.42. Summary statistics for Probabilistic Modeling at C-720 for the Variable Degradation Scenario – percentiles within timesteps (continued)

			Median				75th Percentile			
Year	Minimum	Maximum	2-sided 95% LCL	Conc.	2-sided 95% UCL	1-sided 95% UCL	2-sided 95% LCL	Conc.	2-sided 95% UCL	1-sided 95% UCL
65	0	1.4E-05	5.1E-17	1.1E-11	8.1E-10	6.6E-10	9.5E-09	3.8E-08	2.7E-07	2.3E-07
70	0	8.9E-06	4.0E-13	4.1E-10	3.9E-09	1.5E-09	6.1E-09	4.6E-08	1.5E-07	1.5E-07
75	0	5.5E-06	1.8E-11	5.2E-10	1.6E-09	1.4E-09	8.6E-09	7.3E-08	1.5E-07	1.3E-07
80	0	3.5E-06	7.3E-11	5.6E-10	1.4E-09	1.1E-09	5.1E-09	6.0E-08	1.2E-07	1.1E-07
85	0	4.8E-06	1.3E-10	3.3E-10	1.7E-09	1.2E-09	5.2E-09	3.9E-08	9.3E-08	8.8E-08
90	0	6.6E-06	6.2E-11	3.2E-10	1.4E-09	8.8E-10	5.0E-09	2.8E-08	6.1E-08	5.9E-08
95	0	6.1E-06	3.4E-11	2.3E-10	7.9E-10	6.3E-10	4.5E-09	2.0E-08	3.7E-08	3.4E-08

Conc. = concentration.
LCL95 = nonparametric lower confidence limit on the percentile concentration with 95% confidence.
Std. dev. = standard deviation.
UCL95 = nonparametric upper confidence limit on the percentile concentration with 95% confidence.

Deleted: 56
Deleted: 2-sided
Deleted: 2-sided
Deleted: 1-sided
Deleted: 2-sided
Deleted: 2-sided
Deleted: 1-sided
Deleted: LCL95
Deleted: Conc.
Deleted: UCL95
Deleted: UCL95
Deleted: LCL95
Deleted: Conc.
Deleted: UCL95
Deleted: UCL95

Table F.43. Summary statistics for Probabilistic Modeling at SWMU 1 for the Variable Degradation Scenario – means within timesteps

Deleted: 57

Deleted: UCL

Year	Minimum	Maximum	Arithmetic Mean	Geometric Mean	95% UCL of Mean [a]
			Plant		
0	0	0	5.0E-06	5.0E-06	5.0E-06
5	0	7.7E-01	3.1E-02	1.5E-03	1.2E-01
10	0	4.2E-01	4.3E-02	1.2E-02	1.0E-01
15	0	1.9E-01	3.1E-02	1.5E-02	3.8E-02
20	1.9E-04	1.1E-01	1.9E-02	9.0E-03	2.3E-02
25	8.2E-05	7.2E-02	1.1E-02	4.8E-03	1.4E-02
30	3.5E-05	4.7E-02	6.4E-03	2.5E-03	8.0E-03
35	1.5E-05	3.0E-02	3.8E-03	1.3E-03	4.8E-03
40	6.4E-06	1.9E-02	2.2E-03	6.8E-04	4.4E-03
45	2.7E-06	1.2E-02	1.3E-03	3.5E-04	2.7E-03
50	1.2E-06	7.4E-03	8.2E-04	1.8E-04	1.1E-03
55	4.9E-07	4.6E-03	5.1E-04	9.3E-05	2.7E-03
60	2.1E-07	2.9E-03	3.2E-04	4.8E-05	2.3E-03
65	8.9E-08	1.8E-03	2.0E-04	2.5E-05	2.1E-03
70	3.1E-08	1.1E-03	1.3E-04	1.3E-05	3.8E-04
75	9.8E-09	7.3E-04	8.0E-05	6.5E-06	2.4E-04
80	3.0E-09	5.1E-04	5.1E-05	3.4E-06	1.6E-04
85	1.0E-09	3.5E-04	3.3E-05	1.7E-06	1.1E-04
90	4.3E-10	2.4E-04	2.1E-05	8.9E-07	6.9E-05
95	2.9E-10	1.7E-04	1.4E-05	4.7E-07	4.6E-05
			Property		
0	0	0	5.0E-06	5.0E-06	5.2E-06
5	0	4.3E-03	7.3E-05	3.4E-06	5.5E-04
10	0	2.6E-02	1.5E-03	6.3E-05	4.9E-03
15	0	6.1E-02	2.6E-03	2.3E-04	3.6E-03
20	0	2.6E-02	2.3E-03	5.4E-04	3.0E-03
25	4.5E-09	1.9E-02	1.9E-03	5.5E-04	4.9E-03
30	7.3E-07	1.6E-02	1.3E-03	4.2E-04	1.7E-03
35	3.3E-06	1.1E-02	8.5E-04	2.6E-04	1.7E-03
40	1.4E-06	6.8E-03	5.2E-04	1.5E-04	6.8E-04
45	5.9E-07	4.3E-03	3.2E-04	7.9E-05	4.1E-04
50	2.5E-07	2.7E-03	1.9E-04	4.2E-05	2.5E-04
55	1.1E-07	1.7E-03	1.2E-04	2.2E-05	3.7E-04
60	4.6E-08	1.1E-03	7.1E-05	1.1E-05	2.3E-04
65	1.9E-08	6.7E-04	4.4E-05	5.9E-06	1.5E-04
70	8.2E-09	4.2E-04	2.8E-05	3.0E-06	9.5E-05
75	2.9E-09	2.7E-04	1.7E-05	1.6E-06	6.0E-05
80	9.0E-10	1.7E-04	1.1E-05	8.1E-07	3.9E-05
85	2.8E-10	1.1E-04	6.9E-06	4.2E-07	2.5E-05
90	8.9E-11	7.0E-05	4.4E-06	2.1E-07	1.6E-05
95	3.4E-11	4.7E-05	2.8E-06	1.1E-07	1.0E-05

Table F.43. Summary statistics for Probabilistic Modeling at SWMU 1 for the Variable Degradation Scenario – means within timesteps (continued)

Deleted: 57

Deleted: UCL

Year	Minimum	Maximum	Arithmetic Mean	Geometric Mean	95% UCL of Mean [a]
			River		
0	0	0	5.0E-06	5.0E-06	5.0E-06
5	0	0	5.0E-06	5.0E-06	5.0E-06
10	0	7.7E-11	5.0E-06	4.5E-06	5.3E-06
15	0	1.3E-05	5.1E-06	5.0E-06	5.2E-06
20	0	7.6E-06	4.8E-06	3.7E-06	5.5E-06
25	0	1.1E-04	5.8E-06	3.8E-06	1.2E-05
30	0	1.2E-04	6.0E-06	1.9E-06	1.8E-05
35	0	9.0E-05	6.2E-06	1.6E-06	1.8E-05
40	0	6.0E-05	5.1E-06	9.9E-07	1.3E-05
45	0	3.9E-05	4.2E-06	1.2E-06	8.6E-06
50	0	2.1E-05	3.6E-06	7.3E-07	6.5E-06
55	0	1.5E-05	3.0E-06	2.6E-07	6.1E-06
60	0	2.3E-05	2.7E-06	2.4E-07	6.1E-06
65	0	1.7E-05	2.3E-06	2.2E-07	5.2E-06
70	0	2.4E-05	2.2E-06	1.5E-07	5.4E-06
75	0	4.2E-05	2.2E-06	1.4E-07	6.8E-06
80	0	3.3E-05	2.0E-06	1.2E-07	5.8E-06
85	0	1.6E-05	1.7E-06	6.4E-08	4.4E-06
90	0	2.2E-05	1.6E-06	3.0E-08	4.5E-06
95	0	3.3E-05	1.4E-06	1.1E-08	5.1E-06

Note: All concentrations are mg/L.
Conc. = concentration.
[a] Upper confidence limit on the mean concentration with 95% confidence as determined by ProUCL.

Table F.44. Summary statistics for Probabilistic Modeling at C-720 for the Variable Degradation Scenario – means within timesteps

Year	Minimum	Maximum	Arithmetic Mean	Geometric Mean	95% UCL of Mean [a]
Plant					
0	0	0	5.0E-06	5.0E-06	5.0E-06
5	0	7.7E-01	4.8E-06	3.5E-06	5.4E-06
10	0	4.2E-01	2.5E-04	6.2E-06	1.1E-03
15	0	1.9E-01	8.6E-04	7.3E-05	1.2E-03
20	1.9E-04	1.1E-01	1.4E-03	2.8E-04	1.9E-03
25	8.2E-05	7.2E-02	1.7E-03	2.9E-04	6.5E-03
30	3.5E-05	4.7E-02	1.5E-03	2.3E-04	7.0E-03
35	1.5E-05	3.0E-02	1.1E-03	1.7E-04	4.0E-03
40	6.4E-06	1.9E-02	7.3E-04	1.1E-04	2.0E-03
45	2.7E-06	1.2E-02	4.5E-04	5.9E-05	1.3E-03
50	1.2E-06	7.4E-03	2.7E-04	3.2E-05	9.6E-04
55	4.9E-07	4.6E-03	1.7E-04	1.7E-05	7.4E-04
60	2.1E-07	2.9E-03	1.0E-04	9.2E-06	6.1E-04
65	8.9E-08	1.8E-03	6.3E-05	4.9E-06	3.2E-04
70	3.1E-08	1.1E-03	4.0E-05	2.6E-06	2.0E-04
75	9.8E-09	7.3E-04	2.5E-05	1.3E-06	1.3E-04
80	3.0E-09	5.1E-04	1.6E-05	7.1E-07	8.5E-05
85	1.0E-09	3.5E-04	1.0E-05	3.7E-07	5.7E-05
90	4.3E-10	2.4E-04	6.9E-06	2.0E-07	3.9E-05
95	2.9E-10	1.7E-04	4.5E-06	1.1E-07	2.7E-05
Property					
0	0	0	5.0E-06	5.0E-06	5.0E-06
5	0	4.3E-03	5.0E-06	5.0E-06	5.0E-06
10	0	2.6E-02	2.0E-05	3.5E-06	7.7E-05
15	0	6.1E-02	1.2E-04	4.7E-06	5.3E-04
20	0	2.6E-02	2.3E-04	1.2E-05	8.2E-04
25	4.5E-09	1.9E-02	2.7E-04	2.3E-05	3.8E-04
30	7.3E-07	1.6E-02	2.9E-04	3.4E-05	4.1E-04
35	3.3E-06	1.1E-02	3.1E-04	4.1E-05	4.2E-04
40	1.4E-06	6.8E-03	3.0E-04	3.9E-05	1.1E-03
45	5.9E-07	4.3E-03	2.7E-04	2.0E-05	1.5E-03
50	2.5E-07	2.7E-03	2.1E-04	1.4E-05	2.2E-03
55	1.1E-07	1.7E-03	1.4E-04	8.8E-06	8.6E-04
60	4.6E-08	1.1E-03	9.4E-05	5.2E-06	5.2E-04
65	1.9E-08	6.7E-04	6.0E-05	2.9E-06	4.0E-04
70	8.2E-09	4.2E-04	3.7E-05	1.6E-06	3.4E-04
75	2.9E-09	2.7E-04	2.3E-05	8.6E-07	3.0E-04
80	9.0E-10	1.7E-04	1.4E-05	4.6E-07	1.8E-04
85	2.8E-10	1.1E-04	8.9E-06	2.4E-07	1.6E-04
90	8.9E-11	7.0E-05	5.7E-06	1.3E-07	1.4E-04
95	3.4E-11	4.7E-05	3.7E-06	6.9E-08	2.3E-05

Deleted: Table F.58. Summary statistics for Probabilistic Modeling at SWMU 4 – means within timesteps¶
Year ... [19]

Deleted: 59

Deleted: UCL

Table F.44. Summary statistics for Probabilistic Modeling at C-720 for the Variable Degradation Scenario – means within timesteps (continued)

Year	Minimum	Maximum	Arithmetic Mean	Geometric Mean	95% UCL of Mean [a]
			River		
0	0	0	5.0E-06	5.0E-06	5.0E-06
5	0	0	5.0E-06	5.0E-06	5.0E-06
10	0	7.7E-11	5.0E-06	5.0E-06	5.0E-06
15	0	1.3E-05	5.0E-06	5.0E-06	5.0E-06
20	0	7.6E-06	5.0E-06	4.7E-06	5.5E-06
25	0	1.1E-04	4.9E-06	3.7E-06	5.7E-06
30	0	1.2E-04	4.8E-06	3.6E-06	5.6E-06
35	0	9.0E-05	4.5E-06	2.0E-06	6.1E-06
40	0	6.0E-05	4.0E-06	8.5E-07	6.1E-06
45	0	3.9E-05	4.1E-06	8.2E-07	7.4E-06
50	0	2.1E-05	3.9E-06	6.7E-07	8.1E-06
55	0	1.5E-05	3.5E-06	3.6E-07	7.2E-06
60	0	2.3E-05	3.0E-06	2.7E-07	6.1E-06
65	0	1.7E-05	2.3E-06	6.0E-08	5.0E-06
70	0	2.4E-05	2.0E-06	5.5E-08	4.5E-06
75	0	4.2E-05	1.9E-06	6.4E-08	4.3E-06
80	0	3.3E-05	1.8E-06	5.4E-08	4.1E-06
85	0	1.6E-05	1.8E-06	4.5E-08	4.1E-06
90	0	2.2E-05	1.7E-06	3.0E-08	4.0E-06
95	0	3.3E-05	1.4E-06	1.2E-08	3.7E-06

Note: All concentrations are mg/L.
Conc. = concentration.
[a] Upper confidence limit on the mean concentration with 95% confidence as determined by ProUCL.

The median predicted concentrations and the 25% and 75% quartiles for the SWMU 1 variable degradation scenario are presented in Figs. F.40 to F.42. At the plant boundary POE, the peak median and quartile concentrations are greater than the TCE MCL, with the peak median concentration being more than 5 times the TCE MCL. The median concentrations are predicted to be greater than the TCE MCL from year 5 to year 25. Both at the property boundary and at the Ohio River POEs, the median and quartile concentrations are below the TCE MCL at all times.

The median predicted concentrations and the 25% and 75% quartiles for the C-720 Building variable degradation scenario are presented in Figs. F.43 to F.45. At the plant boundary, property boundary and Ohio River POEs, the peak median and quartile concentrations are less than the TCE MCL.

The summaries for SWMU 1 calculated within time each step for the variable degradation scenario are presented in Figs. F.52 to F.54. As shown in these plots, the peak mean and geometric mean at the plant boundary POE exceeds the TCE MCL. The mean concentration at the plant boundary POE is predicted to be greater than the TCE MCL from about year 5 to year 35. The geometric mean at the plant boundary POE also is predicted to be greater than the TCE MCL from about year 5 to year 25. Peak mean and geometric mean concentrations at the property boundary and Ohio River POEs are less than the TCE MCL. The peak 95% UCL concentration for the plant boundary POE exceeds the TCE MCL; however,

Deleted: 59
Deleted: UCL
Deleted: Page Break
Deleted: 34
Deleted: 47
Deleted: 36
Deleted: 49
Deleted: The median predicted concentrations and the 25% and 75% quartiles for SWMU 4 are presented in Figs. F.50 to F.52. At the plant boundary POE, the peak median and quartile concentrations are greater than the TCE MCL, with the peak median concentration being about 9 times the TCE MCL. The median concentrations at the plant boundary POE are predicted to be greater than the TCE MCL from year less than 5 to year 35. At the property boundary POE, only the peak 75% quartile concentrations exceed the TCE MCL. At the Ohio River POE, the median and quartile concentrations are below the TCE MCL at all times.¶
Deleted: a
Deleted: are
Deleted: 37
Deleted: 53
Deleted: 39
Deleted: 55
Deleted: 40
Deleted: 56
Deleted: 42
Deleted: 58
Deleted: peak
Deleted: 25
Deleted: is
Deleted: 35
Deleted: s

the peak 95% UCL concentration for the property boundary and Ohio River POE is less than the TCE MCL.

The summaries for the C-720 Building area variable degradation scenario calculated within each time step are presented in Figs. F.55 to F.57. As shown in these plots, the peak mean, geometric mean, and UCL 95% at all POEs is less than the TCE MCL; however, the TCE MCL is exceeded by the 95% UCL concentrations at the plant boundary POE, but not at the property boundary and Ohio River POEs.

Plots of Median and Log Normal Means within Time Steps for the Fixed Degradation Scenario

Figures F.46 to F.51 and F.58 to F.63 depict the predicted TCE concentrations for the fixed degradation scenario at each of the POEs using summary statistics calculated within each year modeled or within time step. Because the statistics used to develop these plots were derived within time step, they account for the variation over the modeling runs better than the maximum plots presented earlier and depict the most likely concentrations predicted for each of the POEs at each time. Tables F.45 through F.48 present the statistical evaluation of the predicted concentrations, which were the basis for Figs. F.40 to F.45 and F.52 to F.57. UCL 95% values presented in the figures and tables are based on the two-sided statistical evaluation.

The median predicted concentrations and the 25% and 75% quartiles for the SWMU 1 fixed degradation scenario are presented in Figs. F.46 to F.48. At the plant boundary POE, the peak median and quartile concentrations are greater than the TCE MCL, with the peak median concentration being more than 30 times the TCE MCL. The median concentrations are predicted to be greater than the TCE MCL from year 5 to year 65. At the property boundary POE, the peak median and 75^{th} percentile or 3^{rd} quartile concentrations are greater than the TCE MCL, with the peak median concentration being more than 15 times the TCE MCL. The median concentrations are predicted to be greater than the TCE MCL from year 20 to year 40. At the Ohio River POEs, the median and quartile concentrations are below the TCE MCL at all times.

The median predicted concentrations and the 25% and 75% quartiles for the C-720 Building fixed degradation scenario are presented in Figs. F.49 to F.51. At the plant boundary POE, the peak median and 75% quartile concentrations are greater than the TCE MCL, with the peak median concentration being slightly greater than the TCE MCL. The median concentration is predicted to be greater than the TCE MCL at year 25. At the property boundary POE, the peak 75^{th} percentile or 3^{rd} quartile concentrations are greater than the TCE MCL The median concentrations are predicted to be greater than the TCE MCL from year 20 to year 40. At the Ohio River POEs, the median and quartile concentrations are below the TCE MCL at all times.

The summaries for SWMU 1 calculated within time each step for the fixed degradation scenario are presented in Figs. F.52 to F.54. As shown in these plots, the peak mean and geometric mean at the plant boundary POE exceeds the TCE MCL. The mean concentration at the plant boundary POE is predicted to be greater than the TCE MCL from about year 0 to year 100. The geometric mean at the plant boundary POE also is predicted to be greater than the TCE MCL from about year 5 to year 65. The mean concentration at the property boundary POE is predicted to be greater than the TCE MCL from about year 10 to year 60. The geometric mean at the property boundary POE also is predicted to be greater than the TCE MCL from about year 25 to year 35. The mean and geometric mean concentrations at the Ohio River POE are less than the TCE MCL. The peak 95% UCL concentrations for the plant and property boundary POEs exceed the TCE MCL; however, the peak 95% UCL concentration for the Ohio River POE is less than the TCE MCL.

Deleted: The summaries for SWMU 4 calculated within time each step are presented in Figs. F.59 to F.61. As shown in these plots, the peak mean and the geometric mean TCE concentrations at the plant boundary POE exceed the TCE MCL. The geometric mean at the plant boundary POE is predicted to be greater than the TCE MCL from about year 5 to year 35. The peak mean at the plant boundary POE is predicted to be greater than the TCE MCL from about year 5 to year 85. The peak geometric mean concentrations at the property boundary and Ohio River POEs are less than the TCE MCL. The peak 95% UCL concentrations for both the plant and property boundary POEs exceed the TCE MCL; however, the peak 95% UCL concentration for the Ohio River POE is less than the TCE MCL.¶

Deleted: 43

Deleted: 62

Deleted: 45

Deleted: 64

Deleted: ,

Deleted: 2-

Deleted:

Deleted: is

Deleted: is

Table F.45. Summary statistics for Probabilistic Modeling at SWMU 1 for the Fixed Degradation Scenario – percentiles within timesteps

-	-	-	Median				75th Percentile			
Year	**Minimum**	**Maximum**	**2-Sided 95% LCL**	**Conc.**	**2-Sided 95% UCL**	**1-Sided 95% UCL**	**2-Sided 95% LCL**	**Conc.**	**2-Sided 95% UCL**	**1-Sided 95% UCL**
					Plant					
0	5.0E-06	5.0E-06	NA	5.0E-06	NA	NA	NA	5.0E-06	NA	NA
5	5.0E-06	1.4E+00	3.0E-03	1.0E-02	1.7E-02	1.6E-02	2.3E-02	5.0E-02	6.5E-02	6.1E-02
10	5.0E-06	1.4E+00	3.8E-02	6.7E-02	7.4E-02	7.1E-02	8.1E-02	1.2E-01	1.6E-01	1.3E-01
15	5.0E-06	1.3E+00	4.8E-02	6.2E-02	9.0E-02	8.7E-02	1.0E-01	1.5E-01	1.7E-01	1.7E-01
20	7.0E-06	1.0E+00	4.1E-02	5.9E-02	7.1E-02	7.0E-02	8.4E-02	1.2E-01	1.5E-01	1.4E-01
25	3.2E-04	7.4E-01	3.1E-02	4.6E-02	5.8E-02	5.7E-02	6.4E-02	9.1E-02	1.1E-01	1.1E-01
30	8.5E-04	5.1E-01	2.4E-02	3.3E-02	4.7E-02	4.5E-02	4.9E-02	6.8E-02	8.6E-02	8.2E-02
35	6.1E-04	3.5E-01	1.8E-02	2.3E-02	3.5E-02	3.5E-02	4.0E-02	5.2E-02	6.5E-02	6.4E-02
40	4.4E-04	2.4E-01	1.4E-02	1.9E-02	2.9E-02	2.8E-02	3.3E-02	4.1E-02	5.0E-02	4.9E-02
45	3.2E-04	1.6E-01	1.0E-02	1.4E-02	2.2E-02	2.1E-02	2.5E-02	3.1E-02	4.0E-02	3.9E-02
50	2.3E-04	2.2E-01	7.6E-03	1.1E-02	1.7E-02	1.6E-02	2.0E-02	2.4E-02	3.2E-02	2.9E-02
55	1.6E-04	3.6E-01	5.9E-03	7.9E-03	1.3E-02	1.2E-02	1.4E-02	1.9E-02	2.4E-02	2.0E-02
60	1.2E-04	5.3E-01	4.3E-03	6.3E-03	9.3E-03	9.1E-03	1.1E-02	1.5E-02	2.0E-02	1.8E-02
65	8.4E-05	7.0E-01	3.2E-03	4.7E-03	6.9E-03	6.5E-03	7.8E-03	1.1E-02	1.5E-02	1.3E-02
70	6.0E-05	8.7E-01	2.6E-03	3.7E-03	5.1E-03	4.9E-03	6.1E-03	8.9E-03	1.1E-02	1.1E-02
75	4.3E-05	1.0E+00	2.0E-03	2.9E-03	3.7E-03	3.6E-03	4.5E-03	7.3E-03	8.9E-03	8.7E-03
80	3.1E-05	1.2E+00	1.4E-03	2.2E-03	2.9E-03	2.8E-03	3.4E-03	5.3E-03	6.8E-03	6.7E-03
85	2.2E-05	1.3E+00	1.1E-03	1.8E-03	2.2E-03	2.1E-03	2.7E-03	4.1E-03	5.4E-03	5.3E-03
90	1.6E-05	1.4E+00	8.3E-04	1.4E-03	1.7E-03	1.6E-03	2.1E-03	3.0E-03	4.1E-03	4.1E-03
95	1.2E-05	1.4E+00	6.9E-04	1.0E-03	1.3E-03	1.3E-03	1.7E-03	2.2E-03	3.2E-03	3.1E-03
					Property					
0	5.0E-06	5.0E-06	NA	5.0E-06	NA	NA	NA	5.0E-06	NA	NA
5	5.0E-06	8.6E-03	NA	5.0E-06	NA	NA	NA	5.0E-06	NA	NA
10	5.0E-06	6.8E-02	6.5E-06	3.4E-04	6.1E-04	5.7E-04	9.1E-04	4.6E-03	1.1E-02	9.4E-03

Table F.45. Summary statistics for Probabilistic Modeling at SWMU 1 for the Fixed Degradation Scenario – percentiles within timesteps (continued)

			Median				75th Percentile			
Year	Minimum	Maximum	2-Sided 95% LCL	Conc.	2-Sided 95% UCL	1-Sided 95% UCL	2-Sided 95% LCL	Conc.	2-Sided 95% UCL	1-Sided 95% UCL
15	5.0E-06	3.0E-01	NA	3.8E-03	NA	NA	8.1E-03	1.4E-02	1.7E-02	1.6E-02
20	5.0E-06	2.4E-01	4.7E-03	6.7E-03	9.7E-03	8.6E-03	1.4E-02	1.8E-02	2.4E-02	2.2E-02
25	5.0E-06	2.5E-01	5.2E-03	9.2E-03	1.3E-02	1.2E-02	1.6E-02	2.0E-02	2.5E-02	2.5E-02
30	5.0E-06	2.6E-01	5.8E-03	8.6E-03	1.3E-02	1.2E-02	1.5E-02	1.9E-02	2.1E-02	2.1E-02
35	5.0E-06	2.0E-01	4.9E-03	6.9E-03	1.0E-02	9.6E-03	1.2E-02	1.4E-02	2.2E-02	1.9E-02
40	5.0E-06	1.4E-01	3.8E-03	5.8E-03	7.9E-03	7.6E-03	9.4E-03	1.1E-02	1.7E-02	1.7E-02
45	5.0E-06	1.3E-01	3.2E-03	4.4E-03	6.2E-03	5.9E-03	7.6E-03	9.6E-03	1.5E-02	1.5E-02
50	5.0E-06	1.1E-01	2.3E-03	3.3E-03	4.7E-03	4.3E-03	6.0E-03	9.1E-03	1.5E-02	1.3E-02
55	5.0E-06	8.5E-02	1.8E-03	2.6E-03	3.7E-03	3.6E-03	4.7E-03	7.2E-03	1.1E-02	1.0E-02
60	5.0E-06	6.3E-02	1.3E-03	1.9E-03	2.8E-03	2.6E-03	3.4E-03	5.7E-03	7.7E-03	6.9E-03
65	5.0E-06	4.5E-02	9.2E-04	1.4E-03	2.1E-03	2.0E-03	2.5E-03	4.3E-03	6.7E-03	5.4E-03
70	5.0E-06	4.3E-02	6.7E-04	1.0E-03	1.6E-03	1.5E-03	2.0E-03	3.2E-03	5.0E-03	4.3E-03
75	5.0E-06	3.8E-02	5.2E-04	8.1E-04	1.2E-03	1.1E-03	1.5E-03	2.5E-03	3.7E-03	3.3E-03
80	5.0E-06	3.2E-02	3.9E-04	6.6E-04	9.0E-04	8.5E-04	1.1E-03	1.9E-03	2.8E-03	2.7E-03
85	5.0E-06	2.6E-02	3.1E-04	5.5E-04	7.0E-04	6.4E-04	8.5E-04	1.4E-03	2.0E-03	1.8E-03
90	5.0E-06	2.1E-02	2.1E-04	4.3E-04	5.0E-04	4.9E-04	6.6E-04	1.0E-03	1.5E-03	1.5E-03
95	5.0E-06	1.7E-02	1.7E-04	3.2E-04	4.0E-04	3.8E-04	5.5E-04	7.7E-04	1.2E-03	1.2E-03
					River					
0	5.0E-06	5.0E-06	NA	5.0E-06	NA	NA	NA	5.0E-06	NA	NA
5	5.0E-06	5.0E-06	NA	5.0E-06	NA	NA	NA	5.0E-06	NA	NA
10	5.0E-06	1.5E-03	NA	5.0E-06	NA	NA	NA	5.0E-06	NA	NA
15	5.0E-06	5.4E-03	NA	5.0E-06	NA	NA	NA	5.0E-06	NA	NA
20	5.0E-06	4.5E-03	NA	5.0E-06	NA	NA	NA	5.0E-06	NA	NA

Table F.45. Summary statistics for Probabilistic Modeling at SWMU 1 for the Fixed Degradation Scenario – percentiles within timesteps (continued)

			Median				75th Percentile			
Year	**Minimum**	**Maximum**	**2-Sided 95% LCL**	**Conc.**	**2-Sided 95% UCL**	**1-Sided 95% UCL**	**2-Sided 95% LCL**	**Conc.**	**2-Sided 95% UCL**	**1-Sided 95% UCL**
25	5.0E-06	3.6E-03	NA	5.0E-06	NA	NA	NA	5.0E-06	NA	NA
30	5.0E-06	7.2E-03	NA	5.0E-06	NA	NA	NA	5.0E-06	NA	NA
35	5.0E-06	7.4E-03	NA	5.0E-06	NA	NA	NA	5.0E-06	NA	NA
40	5.0E-06	7.3E-03	NA	5.0E-06	NA	NA	5.0E-06	8.0E-06	1.2E-04	1.2E-04
45	5.0E-06	7.5E-03	NA	5.0E-06	NA	NA	5.0E-06	1.1E-04	6.5E-04	6.2E-04
50	5.0E-06	8.0E-03	NA	5.0E-06	NA	NA	7.4E-05	5.7E-04	1.1E-03	9.5E-04
55	5.0E-06	1.4E-02	NA	5.0E-06	NA	NA	2.1E-04	8.3E-04	1.4E-03	1.4E-03
60	5.0E-06	2.4E-02	NA	5.0E-06	NA	NA	3.7E-04	8.9E-04	2.2E-03	1.8E-03
65	5.0E-06	3.1E-02	5.0E-06	2.9E-05	2.4E-04	1.5E-04	4.4E-04	1.1E-03	2.2E-03	2.1E-03
70	5.0E-06	2.7E-02	1.5E-05	7.9E-05	3.0E-04	2.7E-04	3.9E-04	1.1E-03	1.8E-03	1.8E-03
75	5.0E-06	4.1E-02	2.8E-05	2.1E-04	3.8E-04	3.5E-04	6.4E-04	1.1E-03	2.2E-03	1.8E-03
80	5.0E-06	6.0E-02	2.6E-05	2.2E-04	4.6E-04	3.7E-04	7.6E-04	1.2E-03	1.9E-03	1.8E-03
85	5.0E-06	5.5E-02	5.6E-05	1.7E-04	4.6E-04	4.2E-04	6.3E-04	1.2E-03	2.1E-03	1.8E-03
90	5.0E-06	4.1E-02	5.1E-05	1.7E-04	3.9E-04	3.8E-04	6.3E-04	9.5E-04	1.6E-03	1.6E-03
95	5.0E-06	2.9E-02	3.9E-05	1.5E-04	3.8E-04	3.2E-04	5.8E-04	8.8E-04	1.5E-03	1.2E-03

Table F.46. Summary statistics for Probabilistic Modeling at C-720 for the Fixed Degradation Scenario – percentiles within timesteps

-	-	-	Median				75th Percentile			
Year	**Minimum**	**Maximum**	**2-Sided 95% LCL**	**Conc.**	**2-Sided 95% UCL**	**1-Sided 95% UCL**	**2-Sided 95% LCL**	**Conc.**	**2-Sided 95% UCL**	**1-Sided 95% UCL**
Plant										
0	5.00E-06	5.00E-06	NA	5.00E-06	NA	NA	NA	5.00E-06	NA	NA
5	5.00E-06	5.00E-06	NA	5.00E-06	NA	NA	NA	5.00E-06	NA	NA
10	5.00E-06	1.43E-02	NA	5.00E-06	NA	NA	5.00E-05	4.34E-04	9.31E-04	9.24E-04
15	5.00E-06	4.77E-02	3.39E-04	1.22E-03	2.21E-03	2.17E-03	2.49E-03	3.50E-03	4.13E-03	3.96E-03
20	5.00E-06	1.16E-01	1.75E-03	2.81E-03	4.09E-03	3.82E-03	5.30E-03	7.05E-03	9.44E-03	9.42E-03
25	5.00E-06	2.75E-01	3.11E-03	5.42E-03	6.48E-03	6.23E-03	7.30E-03	9.16E-03	1.47E-02	1.32E-02
30	5.00E-06	2.75E-01	2.99E-03	4.52E-03	6.09E-03	5.70E-03	6.81E-03	1.14E-02	1.99E-02	1.85E-02
35	5.00E-06	2.72E-01	2.46E-03	3.77E-03	4.80E-03	4.73E-03	5.74E-03	1.04E-02	1.70E-02	1.56E-02
40	3.10E-05	3.40E-01	2.04E-03	3.10E-03	4.32E-03	4.19E-03	4.69E-03	8.79E-03	1.31E-02	1.29E-02
45	8.90E-05	3.58E-01	1.61E-03	2.52E-03	3.27E-03	3.15E-03	3.77E-03	7.33E-03	9.99E-03	9.95E-03
50	7.40E-05	3.16E-01	1.25E-03	2.07E-03	2.58E-03	2.45E-03	3.04E-03	6.06E-03	7.61E-03	7.42E-03
55	6.20E-05	2.54E-01	8.91E-04	1.51E-03	2.02E-03	1.83E-03	2.36E-03	4.83E-03	5.90E-03	5.85E-03
60	5.10E-05	1.95E-01	6.39E-04	1.13E-03	1.59E-03	1.45E-03	1.89E-03	3.74E-03	4.39E-03	4.25E-03
65	4.20E-05	1.47E-01	5.21E-04	8.05E-04	1.32E-03	1.18E-03	1.54E-03	2.82E-03	3.34E-03	3.33E-03
70	3.50E-05	1.10E-01	3.95E-04	5.71E-04	1.05E-03	9.60E-04	1.17E-03	1.99E-03	2.53E-03	2.39E-03
75	2.30E-05	8.18E-02	3.15E-04	4.16E-04	8.36E-04	7.66E-04	8.96E-04	1.44E-03	2.23E-03	1.88E-03
80	1.50E-05	6.07E-02	2.34E-04	3.36E-04	6.36E-04	5.99E-04	7.33E-04	1.04E-03	1.50E-03	1.46E-03
85	1.00E-05	4.50E-02	1.79E-04	2.61E-04	4.82E-04	4.53E-04	6.02E-04	7.63E-04	1.20E-03	1.11E-03
90	6.00E-06	3.33E-02	1.25E-04	2.11E-04	3.45E-04	3.30E-04	4.33E-04	5.50E-04	8.39E-04	6.99E-04
95	5.00E-06	2.47E-02	1.00E-04	1.73E-04	2.68E-04	2.61E-04	3.62E-04	4.26E-04	7.22E-04	6.37E-04
Property										
0	5.00E-06	5.00E-06	NA	5.00E-06	NA	NA	NA	5.00E-06	NA	NA
5	5.00E-06	5.00E-06	NA	5.00E-06	NA	NA	NA	5.00E-06	NA	NA
10	5.00E-06	1.26E-03	NA	5.00E-06	NA	NA	NA	5.00E-06	NA	NA

Table F.46. Summary statistics for Probabilistic Modeling at C-720 for the Fixed Degradation Scenario – percentiles within timesteps
(continued)

			Median				75th Percentile			
Year	Minimum	Maximum	2-Sided 95% LCL	Conc.	2-Sided 95% UCL	1-Sided 95% UCL	2-Sided 95% LCL	Conc.	2-Sided 95% UCL	1-Sided 95% UCL
15	5.00E-06	1.14E-02	NA	5.00E-06	NA	NA	3.20E-05	1.87E-04	6.22E-04	5.89E-04
20	5.00E-06	1.95E-02	3.60E-05	3.02E-04	5.48E-04	4.93E-04	9.26E-04	1.67E-03	3.06E-03	2.42E-03
25	5.00E-06	4.28E-02	3.80E-04	9.61E-04	1.43E-03	1.36E-03	1.76E-03	3.04E-03	3.82E-03	3.71E-03
30	5.00E-06	5.51E-02	1.05E-03	1.74E-03	2.47E-03	2.21E-03	3.57E-03	4.38E-03	5.51E-03	5.17E-03
35	5.00E-06	1.33E-01	1.11E-03	1.87E-03	3.10E-03	2.86E-03	3.46E-03	4.25E-03	8.07E-03	6.20E-03
40	5.00E-06	1.45E-01	1.22E-03	2.10E-03	2.82E-03	2.77E-03	3.42E-03	4.74E-03	8.50E-03	8.06E-03
45	5.00E-06	1.67E-01	1.00E-03	1.93E-03	2.50E-03	2.33E-03	3.14E-03	5.57E-03	7.61E-03	7.14E-03
50	5.00E-06	1.89E-01	8.66E-04	1.49E-03	1.99E-03	1.94E-03	2.49E-03	5.17E-03	8.46E-03	6.62E-03
55	5.00E-06	1.67E-01	7.96E-04	1.14E-03	1.62E-03	1.58E-03	2.21E-03	4.16E-03	6.68E-03	6.58E-03
60	5.00E-06	1.76E-01	5.62E-04	9.17E-04	1.39E-03	1.25E-03	1.80E-03	3.15E-03	5.83E-03	5.43E-03
65	2.70E-05	2.28E-01	4.17E-04	6.93E-04	1.10E-03	9.96E-04	1.53E-03	2.70E-03	4.39E-03	4.29E-03
70	2.20E-05	2.39E-01	3.16E-04	5.31E-04	8.62E-04	7.22E-04	1.22E-03	1.88E-03	3.59E-03	3.47E-03
75	1.80E-05	2.16E-01	2.66E-04	4.09E-04	7.30E-04	6.27E-04	9.50E-04	1.43E-03	2.92E-03	2.92E-03
80	1.20E-05	1.79E-01	2.14E-04	3.02E-04	5.86E-04	5.32E-04	7.72E-04	1.11E-03	2.26E-03	2.12E-03
85	8.00E-06	1.41E-01	1.64E-04	2.27E-04	4.89E-04	3.98E-04	5.88E-04	9.39E-04	1.65E-03	1.57E-03
90	5.00E-06	1.07E-01	1.21E-04	1.82E-04	3.68E-04	3.27E-04	4.69E-04	7.67E-04	1.36E-03	1.15E-03
95	5.00E-06	8.07E-02	8.65E-05	1.54E-04	2.51E-04	2.45E-04	3.74E-04	5.68E-04	9.74E-04	7.94E-04
					River					
0	5.00E-06	5.00E-06	NA	5.00E-06	NA	NA	NA	5.00E-06	NA	NA
5	5.00E-06	5.00E-06	NA	5.00E-06	NA	NA	NA	5.00E-06	NA	NA
10	5.00E-06	5.00E-06	NA	5.00E-06	NA	NA	NA	5.00E-06	NA	NA
15	5.00E-06	2.40E-05	NA	5.00E-06	NA	NA	NA	5.00E-06	NA	NA
20	5.00E-06	2.11E-04	NA	5.00E-06	NA	NA	NA	5.00E-06	NA	NA
25	5.00E-06	2.51E-04	NA	5.00E-06	NA	NA	NA	5.00E-06	NA	NA

Table F.46. Summary statistics for Probabilistic Modeling at C-720 for the Fixed Degradation Scenario – percentiles within timesteps (continued)

-	-	-	Median				75th Percentile			
Year	**Minimum**	**Maximum**	**2-Sided 95% LCL**	**Conc.**	**2-Sided 95% UCL**	**1-Sided 95% UCL**	**2-Sided 95% LCL**	**Conc.**	**2-Sided 95% UCL**	**1-Sided 95% UCL**
30	5.00E-06	6.48E-04	NA	5.00E-06	NA	NA	NA	5.00E-06	NA	NA
35	5.00E-06	1.18E-03	NA	5.00E-06	NA	NA	NA	5.00E-06	NA	NA
40	5.00E-06	1.54E-03	NA	5.00E-06	NA	NA	NA	5.00E-06	NA	NA
45	5.00E-06	2.92E-03	NA	5.00E-06	NA	NA	NA	5.00E-06	NA	NA
50	5.00E-06	5.79E-03	NA	5.00E-06	NA	NA	5.00E-06	7.60E-05	1.91E-04	1.85E-04
55	5.00E-06	6.27E-03	NA	5.00E-06	NA	NA	5.00E-06	1.37E-04	4.19E-04	3.63E-04
60	5.00E-06	5.27E-03	NA	5.00E-06	NA	NA	2.20E-05	2.20E-04	4.40E-04	4.15E-04
65	5.00E-06	4.25E-03	NA	5.00E-06	NA	NA	7.80E-05	2.16E-04	5.20E-04	4.74E-04
70	5.00E-06	3.34E-03	NA	5.00E-06	NA	NA	8.80E-05	2.70E-04	5.54E-04	4.33E-04
75	5.00E-06	2.58E-03	7.00E-06	3.10E-05	8.10E-05	7.20E-05	1.15E-04	2.91E-04	4.88E-04	4.31E-04
80	5.00E-06	2.80E-03	8.50E-06	6.60E-05	1.25E-04	1.20E-04	1.99E-04	4.22E-04	6.32E-04	6.12E-04
85	5.00E-06	7.73E-03	4.00E-05	6.00E-05	1.27E-04	1.08E-04	2.36E-04	5.26E-04	7.32E-04	7.08E-04
90	5.00E-06	1.22E-02	3.50E-05	5.80E-05	1.54E-04	1.41E-04	2.56E-04	5.12E-04	9.26E-04	6.60E-04
95	5.00E-06	1.51E-02	2.80E-05	5.25E-05	1.34E-04	1.29E-04	2.41E-04	3.62E-04	8.45E-04	6.82E-04

Table F.47. Summary statistics for Probabilistic Modeling at SWMU 1 for the Fixed Degradation Scenario – means within timesteps

Year	Minimum	Maximum	Arithmetic Mean	Geometric Mean	95% UCL on Mean[a]
Plant					
0	5.00E-06	5.00E-06	0.00E+00	5.00E-06	5.00E-06
5	5.00E-06	1.38E+00	5.10E-02	2.03E-03	2.00E-01
10	5.00E-06	1.42E+00	1.04E-01	2.67E-02	2.80E-01
15	5.00E-06	1.25E+00	1.12E-01	4.56E-02	1.40E-01
20	7.33E-06	1.03E+00	9.50E-02	4.21E-02	1.20E-01
25	3.19E-04	7.42E-01	7.43E-02	3.47E-02	9.10E-02
30	8.50E-04	5.12E-01	5.66E-02	2.73E-02	6.90E-02
35	6.14E-04	3.48E-01	4.29E-02	2.12E-02	5.20E-02
40	4.42E-04	2.35E-01	3.28E-02	1.63E-02	4.00E-02
45	3.17E-04	1.59E-01	2.56E-02	1.25E-02	3.10E-02
50	2.28E-04	2.24E-01	2.08E-02	9.55E-03	2.50E-02
55	1.64E-04	3.62E-01	1.78E-02	7.28E-03	2.38E-02
60	1.17E-04	5.25E-01	1.61E-02	5.54E-03	2.30E-02
65	8.42E-05	6.99E-01	1.53E-02	4.22E-03	1.90E-02
70	6.04E-05	8.72E-01	1.52E-02	3.21E-03	1.50E-02
75	4.34E-05	1.03E+00	1.53E-02	2.44E-03	1.20E-02
80	3.11E-05	1.17E+00	1.56E-02	1.85E-03	1.00E-02
85	2.23E-05	1.27E+00	1.57E-02	1.40E-03	8.40E-03
90	1.60E-05	1.35E+00	1.59E-02	1.07E-03	7.00E-03
95	1.15E-05	1.40E+00	1.59E-02	8.09E-04	5.80E-03
Property					
0	5.00E-06	5.00E-06	5.00E-06	5.00E-06	5.00E-06
5	5.00E-06	8.57E-03	1.40E-04	6.58E-06	7.30E-04
10	5.00E-06	6.77E-02	4.92E-03	1.87E-04	1.50E-02
15	5.00E-06	2.95E-01	1.28E-02	1.26E-03	1.80E-02
20	5.00E-06	2.36E-01	1.59E-02	4.03E-03	2.10E-02
25	5.00E-06	2.53E-01	1.81E-02	5.80E-03	2.30E-02
30	5.00E-06	2.57E-01	1.77E-02	6.27E-03	2.20E-02
35	5.00E-06	1.96E-01	1.56E-02	5.71E-03	3.80E-02
40	5.00E-06	1.37E-01	1.31E-02	4.73E-03	3.10E-02
45	5.00E-06	1.33E-01	1.05E-02	3.75E-03	2.50E-02
50	5.00E-06	1.11E-01	8.30E-03	2.91E-03	1.90E-02
55	5.00E-06	8.51E-02	6.51E-03	2.24E-03	1.50E-02
60	5.00E-06	6.26E-02	5.12E-03	1.71E-03	1.20E-02
65	5.00E-06	4.53E-02	4.02E-03	1.30E-03	9.10E-03
70	5.00E-06	4.31E-02	3.16E-03	9.91E-04	7.00E-03
75	5.00E-06	3.83E-02	2.47E-03	7.53E-04	5.40E-03
80	5.00E-06	3.23E-02	1.92E-03	5.72E-04	4.20E-03
85	5.00E-06	2.63E-02	1.50E-03	4.34E-04	3.30E-03
90	5.00E-06	2.10E-02	1.17E-03	3.30E-04	2.50E-03
95	5.00E-06	1.66E-02	9.10E-04	2.51E-04	2.00E-03
River					
0	5.00E-06	5.00E-06	5.00E-06	5.00E-06	5.00E-06
5	5.00E-06	5.00E-06	5.00E-06	5.00E-06	5.00E-06

Table F.47. Summary statistics for Probabilistic Modeling at SWMU 1 for the Fixed Degradation Scenario – means within timesteps (continued)

Year	Minimum	Maximum	Arithmetic Mean	Geometric Mean	95% UCL on Mean[a]
10	5.00E-06	1.49E-03	1.99E-05	5.29E-06	5.00E-06
15	5.00E-06	5.36E-03	6.03E-05	5.56E-06	5.00E-06
20	5.00E-06	4.45E-03	5.12E-05	5.58E-06	1.43E-05
25	5.00E-06	3.58E-03	8.86E-05	6.80E-06	2.10E-04
30	5.00E-06	7.24E-03	1.74E-04	8.62E-06	5.10E-04
35	5.00E-06	7.40E-03	2.97E-04	1.07E-05	7.70E-04
40	5.00E-06	7.34E-03	3.84E-04	1.54E-05	9.00E-04
45	5.00E-06	7.53E-03	4.93E-04	2.35E-05	1.00E-03
50	5.00E-06	7.99E-03	7.57E-04	3.66E-05	1.50E-03
55	5.00E-06	1.42E-02	1.04E-03	4.83E-05	2.00E-03
60	5.00E-06	2.39E-02	1.23E-03	6.19E-05	2.60E-03
65	5.00E-06	3.06E-02	1.39E-03	7.53E-05	3.00E-03
70	5.00E-06	2.67E-02	1.52E-03	9.65E-05	3.10E-03
75	5.00E-06	4.14E-02	1.71E-03	1.14E-04	3.90E-03
80	5.00E-06	6.02E-02	1.77E-03	1.18E-04	4.50E-03
85	5.00E-06	5.46E-02	3.30E-03	1.19E-04	4.10E-03
90	5.00E-06	4.07E-02	1.37E-03	1.17E-04	3.30E-03
95	5.00E-06	2.86E-02	1.21E-03	1.13E-04	2.70E-03

Note: All concentrations are mg/L.

[a] Upper confidence limit on the mean concentration with 95% confidence as determined by ProUCL.

Table F.48. Summary statistics for Probabilistic Modeling at C-720 for the Fixed Degradation Scenario – means within timesteps

Year	Minimum	Maximum	Arithmetic Mean	Geometric Mean	95% UCL on Mean
Plant					
0	5.00E-06	5.00E-06	5.00E-06	5.00E-06	5.00E-06
5	5.00E-06	5.00E-06	5.00E-06	5.00E-06	5.00E-06
10	5.00E-06	1.43E-02	6.89E-04	3.39E-05	1.50E-03
15	5.00E-06	4.77E-02	3.53E-03	3.97E-04	6.60E-03
20	5.00E-06	1.16E-01	8.36E-03	1.72E-03	1.60E-02
25	5.00E-06	2.75E-01	1.38E-02	3.25E-03	2.90E-02
30	5.00E-06	2.75E-01	1.57E-02	3.79E-03	3.30E-02
35	5.00E-06	2.72E-01	1.55E-02	3.60E-03	3.30E-02
40	3.08E-05	3.40E-01	1.40E-02	3.09E-03	3.20E-02
45	8.88E-05	3.58E-01	1.17E-02	2.52E-03	2.90E-02
50	7.42E-05	3.16E-01	9.30E-03	1.99E-03	2.40E-02
55	6.16E-05	2.54E-01	7.15E-03	1.55E-03	1.90E-02
60	5.10E-05	1.95E-01	5.40E-03	1.19E-03	1.40E-02
65	4.22E-05	1.47E-01	4.06E-03	9.12E-04	1.10E-02
70	3.48E-05	1.10E-01	3.05E-03	6.98E-04	8.00E-03
75	2.34E-05	8.18E-02	2.29E-03	5.33E-04	5.90E-03
80	1.51E-05	6.07E-02	1.73E-03	4.07E-04	4.40E-03
85	9.81E-06	4.50E-02	1.30E-03	3.10E-04	3.30E-03
90	6.36E-06	3.33E-02	9.85E-04	2.37E-04	2.50E-03
95	5.00E-06	2.47E-02	7.47E-04	1.81E-04	1.90E-03
Property					
0	5.00E-06	5.00E-06	5.00E-06	5.00E-06	5.00E-06
5	5.00E-06	5.00E-06	5.00E-06	5.00E-06	5.00E-06
10	5.00E-06	1.26E-03	5.10E-05	7.75E-06	1.60E-04
15	5.00E-06	1.14E-02	5.43E-04	2.94E-05	2.10E-03
20	5.00E-06	1.95E-02	1.64E-03	1.47E-04	4.80E-03
25	5.00E-06	4.28E-02	2.99E-03	4.36E-04	9.20E-03
30	5.00E-06	5.51E-02	4.62E-03	9.38E-04	6.10E-03
35	5.00E-06	1.33E-01	6.58E-03	1.34E-03	2.20E-02
40	5.00E-06	1.45E-01	7.71E-03	1.60E-03	2.20E-02
45	5.00E-06	1.67E-01	7.97E-03	1.64E-03	1.70E-02
50	5.00E-06	1.89E-01	7.56E-03	1.47E-03	1.40E-02
55	5.00E-06	1.67E-01	6.99E-03	1.23E-03	1.40E-02
60	5.25E-06	1.76E-01	6.49E-03	1.00E-03	1.10E-02
65	2.68E-05	2.28E-01	5.92E-03	8.17E-04	7.90E-03
70	2.22E-05	2.39E-01	5.14E-03	6.51E-04	5.90E-03
75	1.83E-05	2.16E-01	4.22E-03	5.11E-04	4.50E-03
80	1.23E-05	1.79E-01	3.33E-03	3.97E-04	3.50E-03
85	7.99E-06	1.41E-01	2.57E-03	3.07E-04	2.70E-03
90	5.18E-06	1.07E-01	1.95E-03	2.36E-04	2.10E-03
95	5.00E-06	8.07E-02	1.48E-03	1.82E-04	1.60E-03

Table F.48. Summary statistics for Probabilistic Modeling at C-720 for the Fixed Degradation Scenario – means within timesteps (continued)

Year	Minimum	Maximum	Arithmetic Mean	Geometric Mean	95% UCL on Mean
			River		
0	5.00E-06	5.00E-06	5.00E-06	5.00E-06	5.00E-06
5	5.00E-06	5.00E-06	5.00E-06	5.00E-06	5.00E-06
10	5.00E-06	5.00E-06	5.00E-06	5.00E-06	5.00E-06
15	5.00E-06	2.36E-05	5.19E-06	5.08E-06	5.00E-06
20	5.00E-06	2.11E-04	7.06E-06	5.19E-06	5.00E-06
25	5.00E-06	2.51E-04	9.87E-06	5.41E-06	5.00E-06
30	5.00E-06	6.48E-04	1.86E-05	6.01E-06	5.00E-06
35	5.00E-06	1.18E-03	4.03E-05	6.95E-06	1.10E-04
40	5.00E-06	1.54E-03	6.48E-05	8.91E-06	1.60E-04
45	5.00E-06	2.92E-03	1.52E-04	1.21E-05	3.50E-04
50	5.00E-06	5.79E-03	2.57E-04	1.78E-05	6.20E-04
55	5.00E-06	6.27E-03	3.20E-04	2.20E-05	7.20E-04
60	5.00E-06	5.27E-03	3.43E-04	2.57E-05	7.10E-04
65	5.00E-06	4.25E-03	3.34E-04	2.97E-05	6.60E-04
70	5.00E-06	3.34E-03	3.10E-04	3.39E-05	5.80E-04
75	5.00E-06	2.58E-03	2.95E-04	4.36E-05	5.20E-04
80	5.00E-06	2.80E-03	3.44E-04	5.75E-05	5.90E-04
85	5.00E-06	7.73E-03	5.08E-04	6.69E-05	9.90E-04
90	5.00E-06	1.22E-02	7.11E-04	6.94E-05	1.50E-04
95	5.00E-06	1.51E-02	8.33E-04	6.87E-05	1.90E-03

Note: All concentrations are mg/L.
a Upper confidence limit on the mean concentration with 95% confidence as determined by ProUCL.

The summaries for the C-720 Building area fixed degradation scenario calculated within each time step are presented in Figs. F.61 to F.63. As shown in these plots, the peak mean and geometric mean at the plant boundary POE exceed the TCE MCL. The mean concentration at the plant boundary POE is predicted to be greater than the TCE MCL from about year 20 to year 60. The geometric mean at the plant boundary POE is predicted to be less than the TCE MCL. The mean concentration at the property boundary POE is predicted to be greater than the TCE MCL from about year 35 to year 70. The geometric mean at the property boundary POE is predicted to be less than the TCE MCL. The mean and geometric mean concentrations at the Ohio River POE are less than the TCE MCL. The peak 95% UCL concentration for the plant and property boundary POEs exceeds the TCE MCL; however, the peak 95% UCL concentration for the Ohio River POE is less than the TCE MCL.

Deleted: s

Risk and Hazard Results

Cancer risk and hazard results for each POE calculated using the peak predicted median and geometric mean TCE concentrations for the variable and fixed degradation scenarios are presented in Table F.49. As with earlier work, these cancer risk and hazard results were calculated using the risk-based no action screening values for a residential groundwater user contained in Appendix A of the Risk Methods Document. As shown in Table F.40, TCE statistical parameters based on maximum concentrations across all timesteps exceed the MCL for Table F.49. Cancer risk and hazard results[a,b] for the plant boundary, property boundary, and Ohio River POEs derived from peak predicted median and

Deleted: log normal
Deleted: 45
Deleted: 60
Deleted: 53
Deleted: 5
Deleted: 60
Deleted: log normal

Table F.49 Cancer risk and hazard results [a,b] for the plant boundary, property boundary, and Ohio River POEs derived from peak predicted median and geometric mean TCE concentrations derived using probabilistic SESOIL and AT123D modeling of sources at SWMU 1 and the C-720 Building area

Result	Peak Concentration (mg/L)[c]			Hazard Quotient			Cancer Risk		
	Plant Boundary	Property Boundary	Ohio River	Plant Boundary	Property Boundary	Ohio River	Plant Boundary	Property Boundary	Ohio River
SWMU 1- Variable Degradation Scenario									
Peak Median[d]	***2.50E-02***	9.50E-04	1.20E-08	1.56E+00	5.64E-02	<0.1	1.45E-05	5.49E-07	<1.00E-06
Peak Geometric Mean[e]	***1.50E-02***	5.50E-04	5.00E-06	8.74E-01	3.59E-02	<0.1	8.10E-06	3.18E-07	<1.00E-06
SWMU 1- Fixed Degradation Scenario									
Peak Median[f]	***6.69E-02***	***9.19E-03***	2.16E-04	4.18E+00	5.74E-01	1.26E-01	3.88E-05	5.31E-06	
Peak Geometric Mean[g]	***4.56E-02***	***6.27E-03***	1.19E-04	2.85E+00	3.92E-01	<0.1	2.64E-05	3.62E-06	<1.00E-06
C-720 Building Area – Variable Degradation Scenario									
Peak Median[h]	4.70E-04	7.30E-05	5.60E-10	2.99E-02	<0.1	<0.1	2.72E-07	<1.00E-06	<1.00E-06
Peak Geometric Mean[i]	2.90E-04	4.10E-05	5.00E-06	1.52E-02	<0.1	<0.1	1.74E-07	<1.00E-06	<1.00E-06
C-720 Building Area – Fixed Degradation Scenario									
Peak Median[j]	***5.42E-03***	2.10E-03	1.54E-04	3.39E-01	1.31E-01		3.13E-06	1.21E-06	
Peak Geometric Mean[k]	3.79E-03	1.64E-03	6.94E-05	2.37E-01	1.03E-01	<0.1	2.19E-06	9.48E-07	<1.00E-06

[a] Hazard quotients and cancer risks calculated using no action screening values from Appendix A of the Risk Methods Document. The screening values in mg/L for hazard at a target hazard of 0.1 and cancer risk at a target risk of 1.00E-06 are 1.60E-03 and 1.73E-03 mg/L.

[b] Contaminants with a hazard quotient (HQ) greater than 1 or a cancer risk greater than 1.00E-06 are considered contaminants of concern (COCs).

[c] Values in bold, italic font exceed the TCE MCL of 5.00E-03 mg/L.

[d]. Peak concentrations taken from Table F.41

[e]. Peak concentrations taken from Table F.43

[f]. Peak concentrations taken from Table F.45

[g]. Peak concentrations taken from Table F.47

[h]. Peak concentrations taken from Table F.42

[i]. Peak concentrations taken from Table F.44

[j]. Peak concentrations taken from Table F.46

[k]. Peak concentrations taken from Table F.48

Deleted: lognormal

Deleted: , SWMU 4,

Deleted: Log Normal

Deleted: *40E*

Deleted: 20E

Deleted: *SWMU 4* ... [20]

Deleted: Log Normal

Deleted: 3

Deleted: 00E

Deleted: 00E

geometric mean TCE concentrations derived using probabilistic SESOIL and AT123D modeling of sources at SWMU 1 and the C-720 Building area, regardless of the scenario (i.e., Variable versus Fixed Degradation Scenario). As shown in Table F.49, the hazard quotients for the variable degradation scenario estimated for SWMU 1 at the plant boundary POE exceed the EPA benchmark of 1, and the cancer risks estimated for the SWMU and the C-720 Building area are less than the upper end of EPA's acceptable risk range for site related exposure (i.e., 1.0E-04). Using the 95% UCL on the 75[th] percentile at the property boundary as a benchmark, TCE is not a COC (see Tables F.41 and F.41).

As shown in Table F.49, the hazard quotients for the fixed degradation scenario estimated for SWMU 1 at the plant and property boundary POE exceed the EPA benchmark of 1, and the cancer risks estimated for the SWMU and the C-720 Building area are less than the upper end of EPA's acceptable risk range for site related exposure (i.e., 1.0E-04). Using the 95% UCL on the 75[th] percentile at the property boundary as a benchmark, TCE is a COC.(see Tables F.47 and F.48).

F3.2.3 Uncertainty in Probabilistic Modeling of SWMU 1 and the C-720 Building Area

Because SESOIL and AT123D models were used for the investigation, it was necessary to include some simplifying assumptions. These assumptions resulted in modeling uncertainties. This section lists some of the key uncertainties and discusses their impacts upon the modeling results.

1. Source Term Development: The source term was developed using sampling results and considering SESOIL limitations. While the sampling results are appropriate for source identification, a denser sampling pattern would have allowed for more refined estimates of both the source zone volume and its TCE concentration. Additionally, due to SESOIL's need to use constant area sizes for each layer, the TCE concentrations of all layers needed to be normalized against the volume of the layer with the maximum estimated TCE concentration. These limitations in source term development increased the variability of the modeling results and resulted in the large range and 95% UCLs reported. It should be noted that there is no DNAPL ganglia at SWMU 1 or the C-720 Building area.

2. Potential Interaction of Sources: The simulations presented in this report for the C-720 Building and SWMU 1 are based on individual simulations of each source area. There is a small potential that the two source plumes could interact at the POEs to produce a cumulative affect. According to the flow paths presented in Fig. F.10, the flow paths from SWMU 1 and C-720 have separate centerlines, such that the maximum centerline plume concentrations presented in this report would not coincide. In addition, the time of the peak concentrations for each plume occur at different times at the POEs, resulting in little contribution to the peak concentrations of each source to the other.

3. Location of the POEs: The POEs used in the modeling were placed at locations on the plant boundary, property boundary, and Ohio River where the greatest TCE concentrations are expected in the future. By picking locations on the centerline of predicted contaminant plumes as the POEs, the modeling assumed that the hypothetical future resident would pick, by chance, the worst possible location to install a water supply well. To examine the effect of this uncertainty, several modeling runs for SWMU 1 were completed assuming that the hypothetical water supply well was moved off the plume centerline at the plant boundary. This modeling determined that the TCE concentration would be below the MCL at approximately 260 ft from the plume centerline. A reduction of 20% was attained at approximately 130 ft from the plume centerline. The location of the POEs, therefore, led to predicted TCE concentrations that are unlikely to be exceeded (i.e., are "conservative" estimates).

   Another uncertainty related to the location of POEs is using the Ohio River as a POE instead of a location on Little Bayou Creek near the Ohio River. The Ohio River was used for the POE because

Deleted: , SWMU 4,
Deleted: While
Deleted: s
Deleted: and 4
Deleted: it is notable that
Deleted: se two
Deleted: s
Deleted: UCL
Deleted: based on SWMU4 results only
Deleted: 5
Deleted: 1
Deleted: through
Deleted: 2
Deleted: 56
Deleted: , SWMU 4,
Deleted: b
Deleted: b
Deleted: ,
Deleted: ,
Deleted:
Deleted: be directly additive. Instead, the lateral dispersive edges of the plumes may interact to produce a plume concentration at the POEs that would be less than the summation of the centerline concentrations of both plumes.
Deleted: The location and areal dimensions of the secondary source in the RGA (only developed for SWMU 4) were assumed to approximate the main SWMU 4 pit. These assumptions are consistent with the location of the downgradient dissolved-phase contamination. The modeled soil contaminant levels within the secondary source were determined by a mass balance approach that also required assumptions regarding the DNAPL in the first order depletion rate.¶
Formatted: Bullets and Numbering

particle tracks predicted that the plume centerline would be at the Ohio River and not Little Bayou Creek. Generally, by selecting the Ohio River for the POE, conservative TCE estimates were derived.

4. Future Environmental Changes: Several future environmental changes at the PGDP could impact the accuracy of the modeling prediction. These changes include plant shutdown and dam operation on the Ohio River. In a previous modeling effort for a landfill at PGDP, several sensitivity analyses were performed (DOE 2003) to examine the impacts those changes may have on groundwater flow and contaminant transport. It was assumed in that sensitivity analysis that it can be expected that plant shutdown will lead to a changed recharge rate to the RGA through removal of ground cover (leading to increased recharge) and through reduced cooling water use (leading to decreased recharge); therefore, the sensitivity analysis of the groundwater travel time due to plant shutdown was studied by varying the recharge over a range of values. The results of the analysis indicated that a decrease in the recharge rate (i.e., plant shutdown conditions) resulted in an increase in the travel time to the receptor. Thus, chemicals that have short degradation half-lives would show a decrease in concentration due to plant shutdown, due to the additional time required to reach the POEs during which additional degradation would occur.

   The Olmstead Dam operation is expected to increase the stages (water level) in the Ohio River; therefore, a sensitivity analysis was conducted (DOE 2003) to assess changes in groundwater travel time in relation to dam operation, by increasing the river stage between 304.44 ft msl and 310.04 ft msl (the baseline river stage is 300.04 ft msl). The results of the analysis indicated that the travel times in the aquifer changed very little in relation to the Ohio River stage; therefore, an increase in water level that would result from dam operation would have little impact on the results shown in this report for SWUM 1 and C-720.

Deleted: ese

Deleted: Generally, these analyses concluded that contaminant migration following either plant shutdown or dam operation could be different from that predicted by SESOIL and AT123D modeling due to variations in groundwater flow. This indicates that additional predictive modeling may be needed if environmental conditions change in the future

Deleted: .

Deleted: T

Deleted: monotonic

Deleted: .

Deleted: T

Deleted: .

Deleted: T

Deleted: the dam operation would

Deleted: .

5. Limitations Due to Number of Runs: The Monte Carlo simulation for each source-POE combination was limited to 100 runs. Generally, 100 runs is the minimum number of runs necessary to develop a predictive TCE concentration data set for each POE. Generally, if the model is run a greater number of times, then better predictions of the "average" concentration is expected. Due to this limitation, it is believed that the median plots presented earlier provide the best information when making cleanup decisions. This may be further supported by stability plots presented in Attachment F.5 to this appendix.

6. Comparison of Modeling Results: Preliminary deterministic versus Probabilistic. Modeling results were compared between the probabilistic and preliminary modeling for the Southwest Plume source areas (e.g., SWMU 1 and C-720 area.) The comparisons for predicted TCE concentrations at the property boundary are shown in Table F.50. As can be seen in this table, the predicted concentrations based on probabilistic modeling are significantly lower (greater than an order of magnitude) than the concentrations obtained from preliminary modeling, applying the same codes (e.g., SADA, SESOIL, AT123D models). In order to evaluate this difference, the use of parameters in the preliminary model versus the parameter distribution in the probabilistic model were analyzed (see Attachment F.2 to this appendix). From this analysis, it was observed that the source term concentrations and the biodegradation rates are the two most important parameters that have produced the difference in concentrations. For example, the half-life in the preliminary modeling is 26.6 years as compared to the most likely value in the probabilistic modeling, 6 years. Similarly, the source term concentration at SWMU 1, Layer 2 is 110.8 mg/kg in the preliminary model whereas, the most likely value in the probabilistic model is 14.1 mg/kg, although the maximum value is 188 mg/kg.

Deleted: , SWMU 4,

Deleted: 46

Deleted: 1

   Comparison of the probabilistic variable and fixed degradation scenario with the preliminary modeling results indicates that degradation rate impacts the concentration of TCE seen at the POEs,

Deleted: the

with the fixed degradation scenario having higher concentrations. Therefore, the uncertainty in the degradation rate should be considered when making future decisions for the source areas at SWMU 1 and C-720 Building.

Deleted: factor represents the most important difference between the analyses. The probabilistic fixed degradation scenario results are near those predicted in the preliminary modeling.

Table F.50. Comparison of TCE Transport Modeling Results for Southwest Plume Sources at SWMU 1 and C-720 Area

Deleted: , SWMU 4,

Deleted: 46

Deleted: 1

TCE Concentrations Predicted for Exposure at the DOE Property Boundary				
		SADA/SESOIL/AT123D Modeling		
			Probabilistic Results[c]	
Source Area	MEPAS Modeling Results from RI[a]	Preliminary Results[b]	Median and (Interquartile Range)	Log Normal Mean and (95% UCL on Mean)
SWMU 1 Variable Degradation Scenario	3,400 µg/L Year 122	29.6 µg/L Year 20	1.8 (0.6 – 4.1) µg/L Year 20	1.5 (4.7) µg/L Year 20
SWMU 1 Fixed Degradation Scenario	3,400 µg/L Year 122	29.6 µg/L Year 20	16 (5.2 -34) µg/L Year 25	12 (34) µg/L Year 25
C-720 Variable Degradation Scenario	533 µg/L Year 82	5.5 µg/L Year 25	0.16 (0.04 – 0.55) µg/L Year 30	0.15 (0.76) µg/L Year 30
C-720 Fixed Degradation Scenario	533 µg/L Year 82	5.5 µg/L Year 25	4 (1.3 – 8.1) µg/L Year 30	3.4 (20) µg/L Year 30

Deleted: SWMU 4 ... [21]

[a] Results for SWMU 1 and C-720 Area are from the WAG 27 RI Report.
[b] Results calculated assuming a 26.6 year degradation half-life.
[c] Results (see Table F.40) calculated from 100 model iterations during which several input parameters were allowed to vary.

Deleted: Results from SWMU 4 are from the WAG 3 RI Report.

F3.3 VAPOR TRANSPORT MODELING

Vapor transport modeling was conducted to evaluate the potential air concentrations in a residential basement for soil and groundwater contamination at the SWMU 1 and C-720 areas and at the plant and property boundary POEs. The Johnson and Ettinger model (1991), coded into spreadsheets by EPA (1997), was used to assess the potential migration of VOCs into a residential basement.

Johnson and Ettinger (1991) introduced a screening-level model that incorporates both convective and diffusive mechanisms for estimating the transport of contaminant vapors emanating from either subsurface soils or groundwater into indoor spaces located directly above or in close proximity to the source of contamination. The Johnson and Ettinger model is a one-dimensional analytical solution to convective and diffusive vapor transport into indoor spaces and provides an estimated attenuation coefficient that relates the vapor concentration in the indoor space to the vapor concentration at the source of contamination.

Deleted: which

Since the Johnson and Ettinger model is a screening level model, the number of parameter inputs is minimized. Table F.51 provides the input parameter values used in the vapor transport analysis. The default chemical property library was used for all analyses. The contaminant source inventories for the soil layers beneath SWMU 1 were obtained from Table F.24 and for C-720 Building from F.25. The

Table F.51. Vapor transport model input parameter values

Parameter	**Value**	**Reference**
Average Soil Temperature (T_s)	15 ºC	Default value
Depth below grade to bottom of enclosed space floor (L_F)	200 cm	Default value
SCS soil type	Silty Clay	Table F.26
Soil dry bulk density (ρ_b)	1.46 g/cm^3	Table F.26
Soil total porosity (n)	0.45	Table F.26
Soil water-filled porosity (θ_w)	0.167	Default value
Soil organic carbon fraction (f_{oc})	0.08 (SWMU 1) 0.09 (C-720 Bldg)	Table F.26
Enclosed space floor thickness (L_{crack})	10 cm	Default value
Soil-building pressure differential (Δ_p)	40 g/cm-s^2	Default value
Enclosed space floor length (L_B)	1000 cm	Default value
Enclosed space floor width (W_B)	1000 cm	Default value
Enclosed space height (H_B)	366 cm	Default value
Floor-wall seam crack width (W)	0.1 cm	Default value
Indoor air exchange rate (ER)	0.5 hr^{-1}	Default value

groundwater concentrations beneath SWMU were taken from Section 5, Table 5.2. The groundwater concentrations at the plant and property boundaries were taken from Table F.29 for contaminants, except TCE. TCE groundwater concentrations for the plant and property boundaries were taken from Table F.49 for the peak median results for the fixed degradation probabilistic runs.

Deleted: ,

The resulting basement air concentrations, predicted by the model, are presented in Table F.52. These concentrations were used as the predicted household air concentrations for estimating excess lifetime cancer risk and hazard for the rural resident, as presented in Appendix G.

Table F.52. Basement air concentrations based on vapor transport modeling results for each source and POE

Source Area	Contaminant	On-Site	Plant boundary	Property boundary
		Air concentration (mg/m^3)	Air concentration (mg/m^3)	Air concentration (mg/m^3)
C-720 area	TCE	0.15	3.14E-07	4.45E-08
	cis-1,2-DCE	0.015	3.09E-05	2.60E-05
	trans-1,2-DCE	0.057	9.12E-05	1.66E-05
	Vinyl Chloride	0.008	2.66E-06	5.11E-07
SWMU 1	TCE	0.019	2.55E-08	1.02E-08
	cis-1,2-DCE	0.004	6.15E-06	4.16E-06
	trans-1,2-DCE	0.001	6.71E-07	3.23E-07
	Vinyl Chloride	0.0002	1.33E-06	6.82E-07

F.4. REFERENCES

BJC (Bechtel Jacobs Corporation LLC) 2003. *Contaminant Migration from SWMU 1 and the C-720 Area at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, BJC/PAD-506.

Bonazountas, M., and J. Wagner 1984. *SESOIL: A Seasonal Soil Compartment Model*, prepared for the U.S. Environmental Protection Agency, Office of Toxic Substances. Arthur D. Little, Inc., Cambridge, MA.

CH2M HILL 1991. *Results of the Site Investigation, Phase I, at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, KY/ER-4. December.

Deleted: .

CH2M HILL 1992. *Results of the Site Investigation, Phase II, at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, KY/SUB/13B-97777CP-03/1991/1, April.

Deleted: .

Deleted: .

Decisioneering, Inc. 2000. *Crystal Ball® 2000: A user friendly graphically oriented forecasting and risk analysis program*. 1515 Arapahoe Street, Denver, CO.

DOE 1995a. *Background Concentrations and Human Health Risk-Based Screening Criteria for Metals in Soil at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1417&D1.

Deleted: .

DOE 1998a. *Ground-Water Flow Model Recalibration and Transport Model Construction at the Paducah Gaseous Diffusion Plant, Paducah. Kentucky*, DOE/OR/07-1742&D0.

Deleted: .

DOE 1999a. *Remedial Investigation Report for WAG 27 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1777&D2.

DOE 2000a. *Remedial Investigation Report for Waste Area Grouping 3 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1895&D1.

DOE 2000b. *Methods for Conducting Risk Assessment and Risk Evaluations at the Paducah Gaseous Diffusion Plant. Paducah, Kentucky. Volume 1. Human Health,* DOE/OR/07-1506&D2.

Deleted: .

DOE 2000c. *Data Report for the Sitewide Remedial Evaluation for Source Areas Contributing to Off-Site Groundwater Contamination at the Paducah Gaseous Diffusion Plant,* DOE/07-1845&D2.

Deleted: .

DOE 2001a. *Feasibility Study for the Groundwater Operable Unit at Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/OR/07-1857&D2.

DOE 2003. *Risk and Performance Evaluation of the C-746-U Landfill at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/OR/07-2041&D2R1.

Deleted: .

DOE 2005. *User's Manual for RESRAD Version 6.0*. ANL/EAD-4. Accessible at http://web.ead.anl.gov/resrad/home2/.

EPA 1997. User's Guide for the Johnson and Ettinger (1991) Model for Subsurface Vapor Intrusion into Buildings. U.S. Environmental Protection Agency, Toxics Integration Branch (5202G), Washington, DC 20450, September.

Deleted: .

Deleted: .

Deleted: 1997.

EPA 1998. *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water*, EPA/600/R-98/128, U. S. Environmental Protection Agency, Washington DC, September.

Deleted: .

Deleted: .

EPA 2004. *ProUCL Version 3.0 User Guide*. EPA/600/R04/079.

GSC (General Sciences Corporation) 1996. *RISKPRO®'s SESOIL for Windows*, General Sciences Corporation, Laurel, MD.

GSC (General Sciences Corporation) 1998. *RISKPRO®'s* AT123D for Windows, Version 3.2. General Sciences Corporation, Laurel, MD.

Howard, P.H., R.S. Boethling, W.F. Jarvis, W.M. Meylan, and E.M. Michalenko, 1991. Environmental Degradation Rates, Lewis Publishers, Inc. Chelsea, MI.

Johnson, P.C., and R.A. Ettinger 1991. model for predicting the intrusion rate of contaminant vapors into buildings. Environ. Sci. Technology, 25:1445-1452.

Deleted: .

Deleted: Heuristic

Deleted: m

LMES (Lockheed Martin Energy Systems) 1997. *Evaluation of Natural Attenuation Processes for Trichloroethylene and Technetium-99 in the Northeast and Northwest Plumes at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, KY/EM-113, Lockheed Martin Energy Systems.

PNL (Pacific Northwest Laboratory) 1995. *Multimedia Environmental Pollutant Exposure Assessment System (MEPAS)*, Version 3.1. Pacific Northwest Laboratory, Battelle Memorial Institute, Richland WA.

PNL 2005. *Multimedia Environmental Pollutant Exposure Assessment System (MEPAS).* Accessible at http://mepas.pnl.gov/earth/mepasmain.html.

USGS (United States Geological Survey) 2005. *Summary of MODFLOW2000*. Accessible at http://water.usgs.gov/nrp/gwsoftware/modflow2000/modflow2000.html.

UT (University of Tennessee) 2002. Spatial *Analysis and Decision Assistance (SADA), Version 2.3, User Guide, January*. Accessible at http://www.tiem.utk.edu/~sada/.

Yeh, G. T., 1981. *AT123D: Analytical Transient One-, Two-, and Three-Dimensional Simulation of Waste Transport in the Aquifer System*, Environmental Sciences Division, Oak Ridge National Laboratory, Oak Ridge, TN, Publication No. 1439.

APPENDIX F
ATTACHMENT 1

SOURCE TERM DEVELOPMENT

THIS PAGE INTENTIONALLY LEFT BLANK.

APPENDIX F
ATTACHMENT 1

SOURCE TERM DEVELOPMENT

1. INTRODUCTION

This attachment presents the UCRS source term development for SWMU 1 and the C-720 area. The source term development considered TCE as the COC.

Deleted: , SWMU 4,

Deleted: . This attachment also presents the RGA source term development for the SWMU 4 area, a secondary source in the RGA that was noted for this area.

2. UCRS SOURCE TERM FOR SWMU 1

The UCRS source term for SWMU 1 was based upon observed data. Spatial analysis, specifically geospatial interpolation techniques in Spatial Analysis and Decision Assistance (SADA) (UT 2002), was used to characterize the source zone in the UCRS soil. The following sections discuss source term development using SADA.

2.1 SADA

SADA addresses common environmental assessment issues by integrating and streamlining methods from multiple fields as follows (SADA 2002).

- Data Exploration and Visualization
- Geographic Information System (GIS)
- Statistical Analysis
- Human Health Risk Assessment
- Ecological Risk Assessment
- Data Screening and Decision Criteria
- Geospatial Interpolation
- Uncertainty Analysis
- Decision Analysis
- Sample Design

While SADA was developed within the context of environmental analysis, many of its processes were broadly constructed to deal with a wide array of problems concerning spatially distributed information.

2.2 SOURCE TERM: MODEL SET-UP AND INTERPOLATION SELECTION

Figure F.1.1 shows a site map. Data from a selected area around the site were used for characterizing contaminant concentrations (Fig. F.1.2). This area covered approximately 525 ft × 225 ft, or 2.71 acres. The area was discretized using rows and columns with a uniform spacing of 25 ft. All soil below the area to a depth of 60 ft was vertically discretized into one layer. The discretized rows, columns, and layer defined the soil domain (volume). Observed data within the domain were compiled, and contaminant concentration in every cell of the domain was predicted using geospatial interpolation. Observed data were available at scattered locations in the domain, and the interpolation was expected to smooth the predicted concentrations over the domain. The complete characterization involved initial interpolation runs of the data within the domain, a visual inspection of the results of the interpolation runs, the selection of an acceptable interpolation, a final interpolation, and an analysis (post-processing) of the final interpolation. In this work, the average TCE concentration, planer area, and bulk mass of TCE within a lower and an upper concentration bounds (limits) were estimated. The upper bound was set at the maximum predicted TCE concentration.

The interpolation techniques in SADA are nearest neighbor, natural neighbor, inverse distance, ordinary kriging, and indicator kriging. Their applicability was assessed using a base scenario that utilized TCE concentrations in the UCRS. Figures F.1.3, F.1.4, and F.1.5 present the interpolation results developed using the nearest neighbor, inverse distance, and ordinary kriging techniques, respectively. The nearest neighbor interpolation yielded results that were most compatible with the conceptual site model of contaminant release presented in previous modeling for the WAG 6 RI Report (DOE 2000). In addition, nearest neighbor interpolation provided greater contrast in concentration and greater ease in source delineation through visual inspection. The inverse distance interpolation yielded results that showed no distinct bound to delineate the plume. The kriging interpolation yielded results that showed no distinct bound to delineate the plume parallel to the shorter width of the area. The kriging interpolations in SADA involve variogram modeling (Fig. F.1.6). Because observed semi-variogram values for the observed data were found not to follow a monotonically increasing trend, it was concluded that kriging interpolations were not suitable for the current area. Therefore, the nearest neighbor interpolation was selected for the study.

2.3 SOURCE TERM MODELING

The soil below the area to a depth of 60 ft was considered for the source term modeling. This depth was discretized into six layers to increase accuracy of the source term characterization. SADA uses uniform layer thickness; therefore, the depth was discretized with six 10 ft-thick layers. Concentration at each cell within the 60 ft-thick soil domain was estimated using the nearest neighbor interpolation. Figure F.1.7 shows the initial flood contours of the source zone in the UCRS developed using the interpolation methods on the original sample data. Figure F.1.8 shows the final flood contours of the source zone after focusing the analysis on the primary source zone using a visual interpretation of the initial results.

Data from the cells in the final contour were analyzed to estimate average concentration, area, and mass within a specified (lower bound) concentration line. The cells in the final contour with concentrations greater than or equal to the specified concentration were considered to estimate the average concentration, area, and mass for the specified concentration line.

Figure F.1.9a shows the average concentration, area, and mass as a function of the specified concentration for Layer 1. Figures F.1.9b through F.1.9f show the same for the remaining layers. The UCRS was considered to extend to a depth of 55 ft below the area; therefore, only the top 5 ft of Layer 6 was used in the volume and mass calculations for Layer 6 (Figure F.1.9f). Table F.1.1 shows a summary of the source characterization.

An example is provided here to clarify the development of the source term for input into the SESOIL model. The example is based on Layer 2 for TCE at SWMU 1.

The SADA output used to construct Figure F.1.8 provides average concentrations for 5 cells based on geostatistical interpolation of the sample data. Each cell is 25 ft by 25 ft wide and 10 ft deep in the SADA model (i.e., 1.77E+08 cm^3). The following data was obtained from SADA for the Layer 2 cells:

Cell	X (ft)	Y(ft)	Concentration (mg/kg)
1	-6900.49	1725.44	14
2	-6875.49	1725.44	439
3	-6850.49	1725.44	0.11
4	-6825.49	1725.44	87
5	-6900.49	1700.44	14

Knowing the cell volume (1.77E+08 cm^3), average concentration in the each cell, and a soil density of 1.46 g/cm^3, the total mass of the contaminant in Layer 2 was determined to be 143,177 grams. The mass of contaminant can alternatively be determined by using the average concentration based on all cells in Layer 2 (i.e., 110.8 mg/kg), total volume of Layer 2 (i.e., 8.849E+08 cm^3 based on five cells), and a soil density of 1.46 g/cm^3, which also results in a total mass in Layer 2 of 143,177 grams. The same calculations were performed for each of the remaining layers for input into the SESOIL model.

SESOIL assumes a uniform area for all the layers in a domain; therefore, the area of each layer needed to be normalized to a uniform area with equivalent concentration for SESOIL modeling. This normalization was performed using an area-based concentration factor (CF) for each layer. The CF adjusted the concentration needed for the area normalization based on mass conservation. The mass conservation may be expressed as

$$M = A\,H\,\rho_b\,C_s = A_*\,H\,\rho_b\,C_{s*} \qquad \text{(A.1)}$$

or

$$C_{s*} = \left(A / A_*\right) C_s = CF\,C_s \qquad \text{(A.2a)}$$

$$CF = A / A_* \qquad \text{(A.2b)}$$

where M = contaminant mass in a layer, A = actual contaminant area in the layer, H = contaminant thickness in the layer, ρ_b = soil bulk density of the layer, C_s = actual contaminant concentration in the layer, A_* = equivalent contaminant area in the layer, C_{s*} = equivalent contaminant concentration in the layer, and CF = concentration factor.

The area of the layer with maximum contaminant mass was selected as the equivalent area (A_*) for normalization, and the CF for each layer was estimated accordingly (Table F.1.1). The concentration for a layer (Table F.1.2) generated by Crystal Ball was multiplied by the CF (Table F.1.1) for the layer to obtain the equivalent concentration (Table F.4.1) needed for SESOIL modeling.

3. UCRS SOURCE TERM for C-720

An approach similar to that for SWMU 1 was followed. The soil below the area to a depth of 60 ft was considered for the source term modeling. This depth was discretized into six layers to increase accuracy of the source term characterization. Concentration at each cell within the 60 ft-thick soil domain

Deleted: The soil below the area to a depth of 60 ft was considered for the source term modeling. This depth was discretized into six layers to increase accuracy of the source term characterization. SADA uses uniform layer thickness; therefore, the depth was discretized with six 10 ft-thick layers. Concentration at each cell within the 60 ft-thick soil domain was estimated using the nearest neighbor interpolation. Figure F.1.7 shows the initial flood contours of the source zone in the UCRS developed using the interpolation. Figure F.1.8 shows the final flood contours of the source zone after focusing the analysis on the primary source zone using a visual interpretation of the initial results. The final contour was analyzed to estimate average concentration, area, and mass within a specified (lower bound) concentration line. The cells in the final contour with concentrations greater than or equal to the specified concentration were considered to estimate the average concentration, area, and mass for the specified concentration line. Figure F.1.9a shows the average concentration, area, and mass as a function of the specified concentration for Layer 1. Figures F.1.9b through F.1.9f show the same for the remaining layers. The UCRS was considered to extend to a depth of 55 ft below the area; therefore, only the top 5 ft of Layer 6 was us ... [1]

Deleted: . T

Deleted: 3. UCRS SOURCE TERM FOR SWMU 4¶ An approach similar to that for SWMU 1 was followed. The soil below the area to a depth of 60 ft was considered for the source term modeling. This depth ... [2]

Deleted: ignored

Deleted: . Figure F.1.11 shows the final flood contours of the source zone after focusing the analysis on the primary source zone using a visual interpretation of the initial results. Figure F.1.12 shows the average concentration, area, an ... [3]

Deleted: c

Deleted:), F is introduced to address the presence of DNAPL. The mass depletion rate in the presence of the DNAPL was expected to be much slower than the rate in the presence of a soil/liquid equilibrium condition. ... [4]

Deleted: c

Deleted:). Finally, the depletion rate was obtained substituting Eq. A.6 in Eq. A3a as:¶

$$\frac{dM}{dt} = -Q\,C_{w0}\,e^{-\alpha t} \qquad \text{(A.10)}$$ ... [5]

Deleted: 5

was estimated using the nearest neighbor interpolation. Figure F.1.10 shows the initial flood contours of the source zone in the UCRS developed using the interpolation. Two sources were observed in Layer 4. The contribution of the north source was predicted to be significantly less than that of the south source; therefore, the contribution from the north source was not included. Figure F.1.11 shows the final flood contours of the source zone after focusing the analysis on the primary source zone using a visual interpretation of the initial results. Figure F.1.12 shows the average concentration, area, and mass as a function of specified concentration for the layers. The UCRS was considered to extend at a depth of 60 ft below the area; therefore, the entire thickness of Layer 6 was included in the volume and mass calculations for Layer 6 (Figure F.1.12f). Table F.1.3 presents a summary of the source characterization. The specified concentration was selected close to zero for each layer. The close-to-zero concentration approach for a layer provided greater flexibility in selecting an average concentration, area, and mass assumed appropriate for the layer.

A normalization factor for each layer was estimated for SESOIL modeling (Table F.1.3). The concentration for a layer (Table F.1.4) generated by Crystal Ball was multiplied by the CF (Table F.1.3) for the layer to obtain the equivalent concentration (Table F.4.2) needed for SESOIL modeling.

Deleted: 13
Deleted: assumed
Deleted: ignored
Deleted: 14
Deleted: 15
Deleted: 5
Deleted: 9
Deleted: 9
Deleted: 10
Deleted: 9
Deleted: 3
Deleted: 6

4. REFERENCES

DOE (U.S. Department of Energy) 2000. *Remedial Investigation Report for Waste Area Grouping 6 at the Paducah Gaseous Diffusion Plant, Paducah, Kentuck*y.

UT (University of Tennessee) 2002. *Spatial Analysis and Decision Assistance (SADA*), Version 2.3, User Guide, January. Accessible at http://www.tiem.utk.edu/~sada/

ATTACHMENT F.1

TABLES

THIS PAGE INTENTIONALLY LEFT BLANK.

Table F.1.1. Concentration Factor (CF) for SESOIL Modeling of SWMU 1

		SADA				
Layer (#)	Depth ft bgs	Lower Bound on C (a) mg/kg	Average mg/kg	Area ft^2	Mass (b) g	CF
Layer 1	0-10	0.00	7.59	4375.00	13723.16	1.40
Layer 2	**10-20**	**0.00**	**110.82**	**3125.00**	**143177.16**	**1.00**
Layer 3	20-30	0.00	17.61	6250.00	45502.69	2.00
Layer 4	30-40	0.00	13.02	5625.00	30283.45	1.80
Layer 5	40-50	0.00	13.55	5625.00	31515.98	1.80
Layer 6	50-55	0.00	5.74	7500.00	8901.58	2.40

Bolded maximum mass.
[a] C = contaminant soil concentration.
[b] Used a bulk density of 1.46 g/cm^3 to estimate mass.

Table F.1.2. SWMU 1 Crystal Ball Generated Soil Concentration Used in Probabilistic Modeling

Run (#)	Layer 1 Conc. (mg/kg)	Layer 2 Conc. (mg/kg)	Layer 3 Conc. (mg/kg)	Layer 4 Conc. (mg/kg)	Layer 5 Conc. (mg/kg)	Layer 6 Conc. (mg/kg)
001	0.28	5.11	1.29	0.87	6.35	0.62
002	0.21	3.09	9.71	0.75	6.87	0.74
003	1.63	5.03	0.11	0.85	1.43	0.48
004	0.57	4.84	5.73	1.03	6.14	0.47
005	0.08	0.87	1.99	2.83	4.25	0.53
006	10.46	33.13	1.66	4.06	3.38	0.58
007	0.92	7.01	21.45	27.26	1.55	0.29
008	10.52	134.91	24.49	0.62	0.64	0.19
009	0.88	3.74	5.59	5.95	9.06	1.54
010	0.68	1.37	5.04	1.72	4.20	0.51
011	0.42	3.57	12.71	17.36	34.02	1.74
012	0.40	8.57	12.29	8.60	0.94	0.16
013	0.23	1.42	1.75	0.79	1.41	0.20
014	0.12	2.24	2.47	6.78	7.18	1.08
015	0.30	4.33	14.79	0.66	2.88	0.27
016	1.29	5.14	4.27	5.78	14.10	1.16
017	0.11	0.58	9.41	0.61	0.38	0.06
018	2.66	15.01	2.43	5.00	9.92	0.73
019	0.17	2.65	0.79	34.47	8.69	1.07
020	0.91	8.61	3.28	0.44	2.78	0.37
021	0.86	5.49	50.82	1.70	0.31	0.09
022	0.36	4.46	0.74	2.77	1.90	0.25
023	2.56	13.69	31.45	0.80	0.80	0.26
024	0.34	0.29	1.32	2.02	1.03	0.37
025	0.87	4.97	1.39	9.56	14.64	1.11
026	0.72	4.58	6.03	0.85	5.05	0.72
027	0.05	0.42	0.54	0.31	0.25	0.22
028	0.06	0.52	1.19	8.07	8.84	1.28
029	0.84	8.77	11.74	0.32	3.47	0.55
030	0.86	2.01	0.35	0.92	0.73	0.26

Table F.1.2. SWMU 1 Crystal Ball Generated Soil Concentration Used in Probabilistic Modeling

Run (#)	Layer 1 Conc. (mg/kg)	Layer 2 Conc. (mg/kg)	Layer 3 Conc. (mg/kg)	Layer 4 Conc. (mg/kg)	Layer 5 Conc. (mg/kg)	Layer 6 Conc. (mg/kg)
031	0.39	1.59	0.50	2.30	8.93	1.35
032	4.18	17.57	0.68	3.66	7.91	0.99
033	0.16	1.04	0.06	6.98	5.81	1.47
034	0.06	3.44	1.56	1.25	32.27	2.77
035	6.73	28.53	3.60	0.80	1.76	0.19
036	1.22	9.75	2.20	1.26	1.80	0.69
037	0.58	1.83	10.60	18.82	0.60	0.09
038	0.54	3.71	3.09	1.39	7.02	0.70
039	1.00	15.71	1.89	6.84	15.18	1.46
040	0.20	2.84	0.20	0.07	0.09	0.02
041	1.06	2.29	1.42	26.70	14.09	1.45
042	5.72	17.00	23.90	4.06	1.25	0.50
043	0.10	1.23	0.32	1.46	14.32	1.86
044	0.01	0.06	1.25	1.07	1.64	0.38
045	0.60	3.05	1.26	1.24	13.52	1.60
046	12.77	43.92	14.80	2.71	5.01	0.52
047	0.57	13.21	2.44	4.10	2.12	0.44
048	1.54	15.52	4.15	7.18	1.23	0.20
049	0.14	0.89	5.27	1.19	2.35	0.29
050	3.55	5.29	6.56	28.40	8.95	0.82
051	0.07	1.20	2.14	0.58	22.18	1.81
052	1.27	21.68	11.90	3.56	3.86	0.46
053	1.86	8.21	2.99	0.70	0.14	0.07
054	7.33	100.21	3.09	0.64	0.27	0.08
055	0.57	43.23	7.38	2.80	22.72	1.10
056	0.02	0.45	0.39	0.25	0.18	0.05
057	0.85	20.65	10.25	1.51	0.28	0.03
058	0.04	0.38	0.33	1.51	2.16	0.74
059	0.04	0.75	2.68	0.48	1.10	0.23
060	0.04	1.01	12.14	23.30	13.66	1.55
061	2.37	38.27	3.00	63.66	41.68	2.60
062	0.04	1.02	0.50	1.64	4.25	0.41
063	3.23	43.36	1.86	3.44	1.10	0.15
064	0.03	0.37	0.36	0.51	5.79	0.52
065	0.79	11.04	18.98	2.99	2.52	0.17
066	0.08	1.25	3.94	2.82	16.32	2.72
067	6.51	140.97	9.00	1.57	2.01	0.37
068	0.16	1.30	0.46	0.43	0.55	0.29
069	0.09	1.81	3.52	3.03	5.73	0.49
070	0.33	1.62	1.63	0.49	0.25	0.12
071	0.15	1.44	0.37	0.52	0.50	0.10
072	0.00	0.06	0.21	3.62	1.03	0.26
073	0.03	0.16	3.38	1.08	1.16	0.13
074	0.14	1.73	3.93	0.96	0.07	0.05
075	0.04	0.25	0.84	0.49	2.74	1.12
076	0.02	0.09	0.28	1.16	1.25	0.25
077	0.26	5.01	2.99	2.64	1.49	0.34
078	0.58	4.65	9.43	2.13	1.61	0.23
079	0.19	1.10	2.79	3.20	16.93	1.25
080	15.25	69.43	0.76	0.76	0.94	0.18

Table F.1.2. SWMU 1 Crystal Ball Generated Soil Concentration Used in Probabilistic Modeling

Run (#)	Layer 1 Conc. (mg/kg)	Layer 2 Conc. (mg/kg)	Layer 3 Conc. (mg/kg)	Layer 4 Conc. (mg/kg)	Layer 5 Conc. (mg/kg)	Layer 6 Conc. (mg/kg)
081	0.08	0.79	0.37	1.04	1.57	0.27
082	0.50	1.26	10.35	0.81	0.48	0.08
083	0.28	5.17	10.57	14.09	0.62	0.21
084	0.16	8.18	1.51	6.45	3.20	0.24
085	1.37	7.32	4.98	2.13	4.01	0.43
086	0.66	9.04	10.31	15.83	1.51	0.34
087	0.02	0.10	5.23	4.69	9.55	1.34
088	0.12	0.87	0.65	2.80	1.32	0.51
089	0.03	0.28	1.74	3.86	3.95	0.62
090	0.57	4.37	3.70	1.01	0.73	0.11
091	0.29	1.68	5.55	0.54	0.81	0.14
092	25.58	188.22	5.99	1.34	3.19	0.69
093	0.08	0.28	0.39	1.07	0.35	0.14
094	0.21	2.40	0.65	11.81	20.28	2.50
095	0.08	0.37	0.57	0.11	0.52	0.07
096	0.60	3.79	4.06	0.38	0.26	0.10
097	1.45	11.66	8.03	18.27	32.90	1.81
098	6.92	96.13	38.41	0.47	1.43	0.17
099	6.52	59.93	2.82	0.35	6.14	0.56
100	0.26	0.96	2.02	1.10	3.44	0.63

Table F.1.3. Concentration Factor (CF) for SESOIL Modeling of the C-720 area

		SADA				
Layer (#)	**Depth ft bgs**	**Lower Bound on C (a) mg/kg**	**Average mg/kg**	**Area ft^2**	**Mass (b) g**	**CF**
Layer 1	0-10	0.10	2.96	7500.00	9184.52	0.50
Layer 2	10-20	0.00	6.37	7500.00	19751.43	0.50
Layer 3	**20-30**	**0.00**	**11.92**	**15000.00**	**73899.89**	**1.00**
Layer 4	30-40	0.25	1.55	6875.00	4392.65	0.46
Layer 5	40-50	0.05	1.20	6875.00	3410.76	0.46
Layer 6	50-60	0.00	0.10	6875.00	282.16	0.46

Bolded maximum mass.
[a] C = contaminant soil concentration.
[b] Used a bulk density of 1.46 g/cm^3 to estimate mass.

Deleted: Table F.1.3. Concentration Factor (CF) for SESOIL Modeling of SWMU 4¶ ... [6]

Deleted: 9

Deleted: 10

Table F.1.4. C-720 Crystal Ball Generated Soil Concentration Used in Probabilistic Modeling

Run (#)	Layer 1 Conc (mg/kg)	Layer 2 Conc (mg/kg)	Layer 3 Conc (mg/kg)	Layer 4 Conc (mg/kg)	Layer 5 Conc (mg/kg)	Layer 6 Conc (mg/kg)
001	2.32	0.15	0.50	0.23	0.13	0.03
002	0.91	0.04	0.45	0.35	0.19	0.03
003	1.06	0.55	3.43	0.12	0.04	0.02
004	0.14	9.59	16.34	0.31	0.16	0.08
005	4.24	2.66	3.12	0.67	0.31	0.31
006	0.72	0.07	0.05	0.03	0.01	0.04
007	1.05	0.33	1.34	0.15	0.07	0.02
008	0.16	0.72	1.23	0.09	0.03	0.05
009	0.64	0.11	4.13	0.16	0.06	0.11
010	0.44	0.82	4.09	0.07	0.03	0.01
011	0.42	0.27	0.53	0.06	0.03	0.01
012	0.07	1.09	0.91	0.06	0.03	0.03
013	0.14	1.62	5.38	0.34	0.15	0.02
014	2.80	0.05	2.05	0.07	0.02	0.02
015	0.56	0.16	4.05	0.32	0.19	0.05
016	8.23	0.04	0.31	0.39	0.26	0.28
017	3.05	7.06	17.26	0.17	0.06	0.01
018	0.23	0.48	0.55	0.17	0.06	0.09
019	0.40	0.12	0.22	0.19	0.07	0.03
020	0.11	0.23	0.34	1.06	0.46	0.19
021	3.29	0.05	0.49	0.28	0.10	0.01
022	7.46	0.40	9.97	0.20	0.07	0.02
023	3.99	0.13	5.51	0.05	0.02	0.00
024	3.04	0.15	1.92	0.36	0.14	0.06
025	0.04	0.05	0.03	0.68	0.46	0.03
026	0.09	0.84	24.68	0.06	0.04	0.11
027	0.76	0.06	1.25	0.80	0.46	0.11
028	0.45	0.02	0.02	0.44	0.23	0.17
029	0.47	0.11	0.65	0.16	0.08	0.03
030	2.53	0.04	0.99	1.04	0.48	0.07
031	0.12	0.43	0.57	0.22	0.11	0.09
032	1.95	0.80	2.04	0.13	0.05	0.05
033	0.17	1.05	7.60	0.15	0.09	0.09
034	0.35	1.72	25.39	0.29	0.13	0.08
035	1.53	0.24	2.35	0.07	0.02	0.02
036	0.22	0.22	9.77	0.02	0.01	0.02
037	0.11	0.32	4.00	0.07	0.03	0.03
038	0.00	0.62	1.06	0.20	0.11	0.05
039	0.00	3.77	1.16	0.31	0.16	0.03
040	0.02	0.15	6.83	1.05	0.49	0.05
041	0.99	0.43	0.94	0.32	0.12	0.05
042	0.15	0.78	4.25	0.13	0.05	0.07
043	0.64	0.53	2.48	0.04	0.02	0.03
044	9.25	0.10	5.69	0.42	0.20	0.02
045	2.30	0.86	1.57	0.09	0.04	0.03
046	0.75	0.01	0.25	0.08	0.04	0.09
047	1.67	0.03	0.68	0.15	0.06	0.11
048	3.36	0.11	1.68	0.18	0.07	0.05
049	0.08	0.29	0.59	0.16	0.09	0.04

Deleted: 10

Table F.1.4. C-720 Crystal Ball Generated Soil Concentration Used in Probabilistic Modeling

Run (#)	Layer 1 Conc (mg/kg)	Layer 2 Conc (mg/kg)	Layer 3 Conc (mg/kg)	Layer 4 Conc (mg/kg)	Layer 5 Conc (mg/kg)	Layer 6 Conc (mg/kg)
050	0.63	0.87	0.98	0.15	0.06	0.03
051	0.87	0.15	1.61	0.43	0.18	0.03
052	2.04	1.27	1.31	0.05	0.02	0.02
053	0.04	2.05	1.11	0.38	0.23	0.20
054	1.69	0.07	0.61	0.03	0.01	0.00
055	0.19	1.79	1.66	0.10	0.05	0.09
056	7.62	0.17	0.80	0.18	0.06	0.02
057	0.01	6.68	16.81	0.14	0.05	0.04
058	0.10	2.22	2.62	0.81	0.36	0.18
059	0.69	0.06	9.34	1.29	0.88	0.05
060	0.13	1.76	2.34	0.38	0.17	0.32
061	0.12	0.52	27.19	0.04	0.01	0.01
062	0.46	0.52	1.64	0.07	0.04	0.01
063	8.47	0.02	0.15	0.89	0.47	0.27
064	2.15	1.69	2.59	0.02	0.01	0.02
065	0.04	9.97	2.07	0.03	0.01	0.05
066	0.54	0.04	0.08	0.03	0.01	0.03
067	0.05	5.50	48.25	1.08	0.47	0.20
068	1.46	0.26	1.33	0.05	0.02	0.04
069	0.10	2.03	3.81	0.09	0.04	0.06
070	0.05	0.40	8.23	0.05	0.02	0.02
071	8.26	0.04	0.45	0.17	0.08	0.02
072	0.02	0.96	0.77	0.05	0.02	0.01
073	0.99	0.06	0.39	0.16	0.06	0.03
074	0.49	0.01	1.39	0.51	0.20	0.22
075	0.09	2.69	6.84	0.12	0.05	0.11
076	0.81	0.60	4.67	0.34	0.17	0.04
077	0.58	0.49	0.88	0.20	0.10	0.23
078	2.06	0.07	0.58	0.05	0.02	0.04
079	0.15	0.79	45.04	0.47	0.28	0.12
080	0.87	0.43	2.25	0.32	0.16	0.09
081	0.05	0.30	2.63	0.12	0.06	0.02
082	0.29	3.62	30.72	0.12	0.05	0.00
083	0.01	9.54	18.65	0.21	0.10	0.03
084	0.05	11.60	19.27	0.09	0.05	0.03
085	4.37	0.16	2.67	0.41	0.19	0.10
086	0.21	0.75	12.81	0.38	0.19	0.06
087	0.62	1.27	1.56	0.01	0.00	0.05
088	4.01	0.47	8.02	0.19	0.10	0.04
089	0.48	0.02	0.43	0.47	0.26	0.07
090	0.38	0.26	1.86	0.16	0.09	0.11
091	0.18	0.03	0.85	0.24	0.13	0.42
092	0.06	0.48	1.67	0.51	0.23	0.03
093	1.02	0.17	5.77	0.22	0.10	0.06
094	0.24	0.30	0.56	0.12	0.05	0.02
095	0.05	1.87	1.59	0.40	0.22	0.08
096	0.06	0.45	3.70	0.44	0.25	0.03
097	0.85	0.59	2.91	0.11	0.03	0.03
098	0.51	1.30	1.44	0.46	0.25	0.15

Table F.1.4. C-720 Crystal Ball Generated Soil Concentration Used in Probabilistic Modeling

Deleted: 10

Run (#)	Layer 1 Conc (mg/kg)	Layer 2 Conc (mg/kg)	Layer 3 Conc (mg/kg)	Layer 4 Conc (mg/kg)	Layer 5 Conc (mg/kg)	Layer 6 Conc (mg/kg)
099	0.36	0.92	1.49	0.06	0.03	0.01
100	0.07	0.34	1.06	0.62	0.32	0.24

ATTACHMENT F.1

FIGURES

THIS PAGE INTENTIONALLY LEFT BLANK.

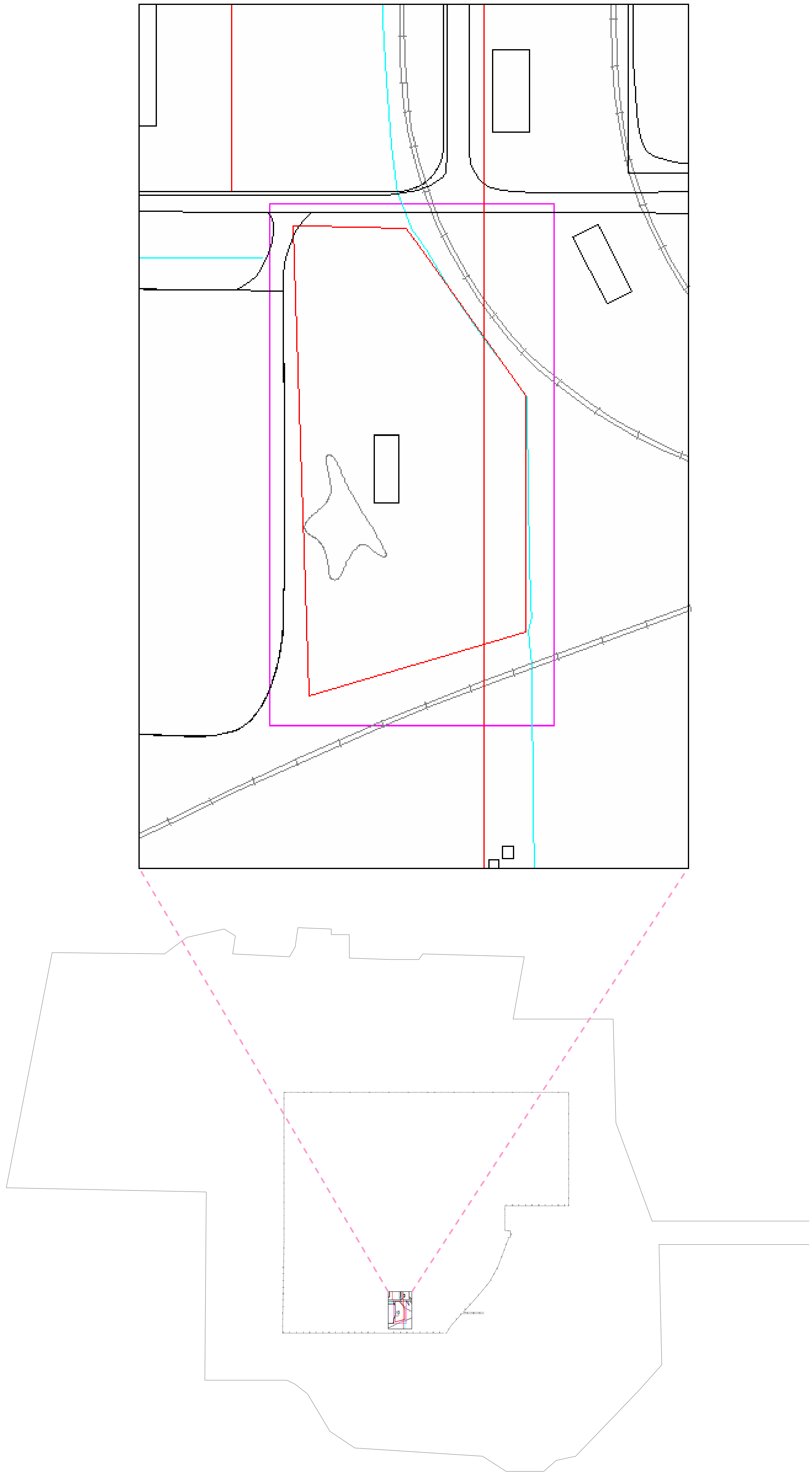


Fig. F.1.1. Site map for SWMU 1.

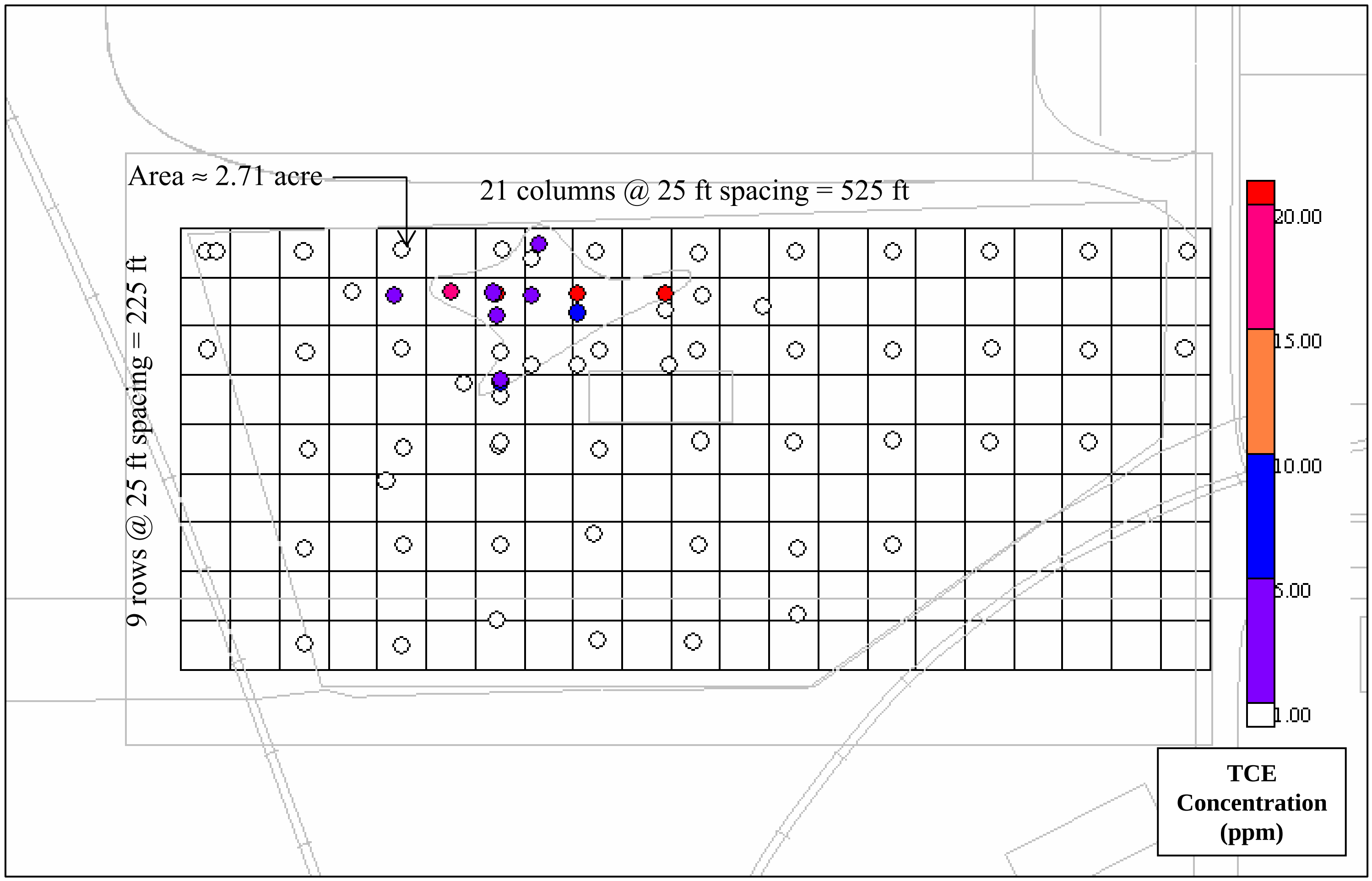


Fig. F.1.2. Discretization of planer area for SWMU 1.

21 x 9

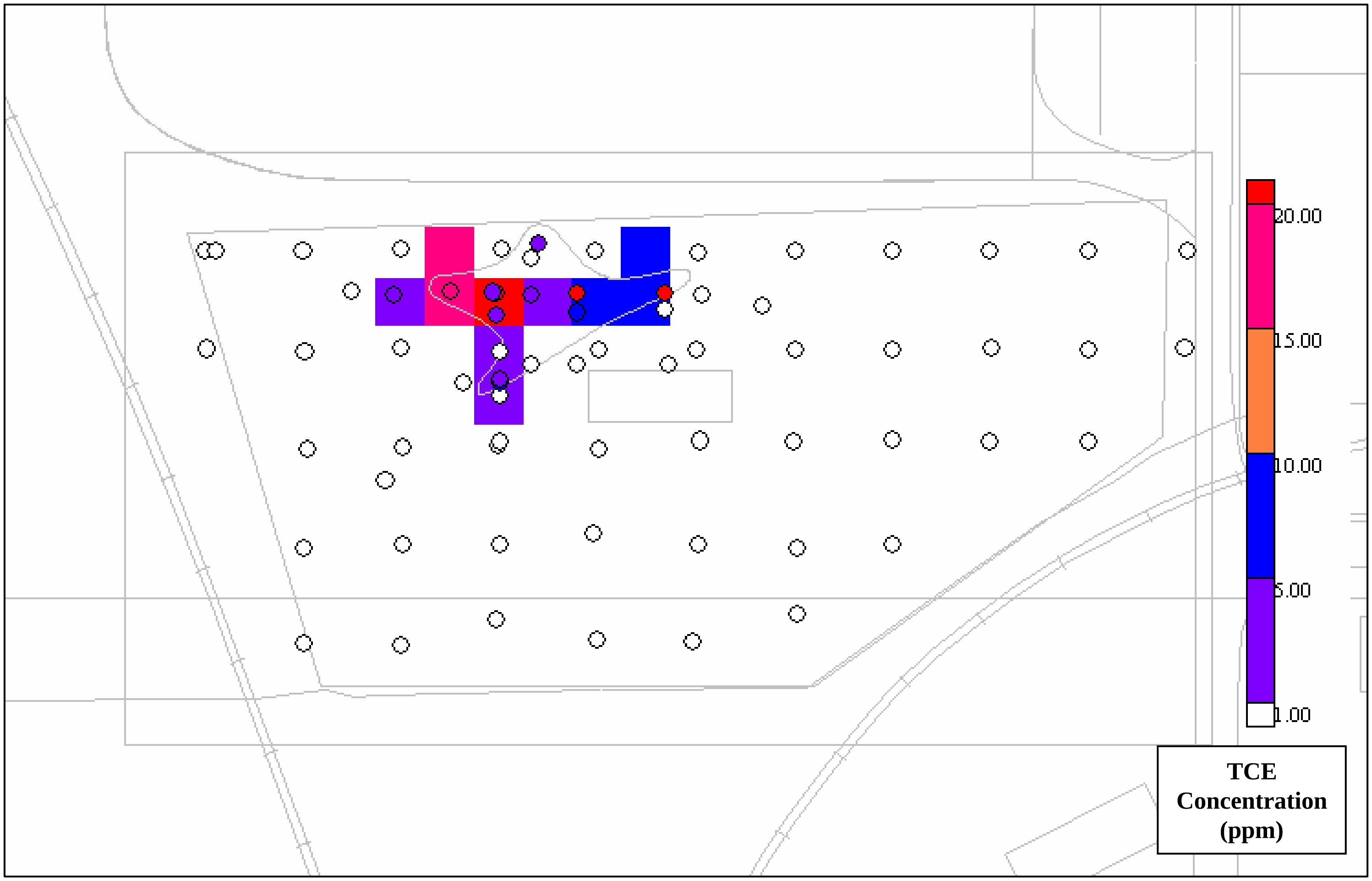


Fig. F.1.3. Interpolation – nearest neighbor for SWMU 1.

21 x 9

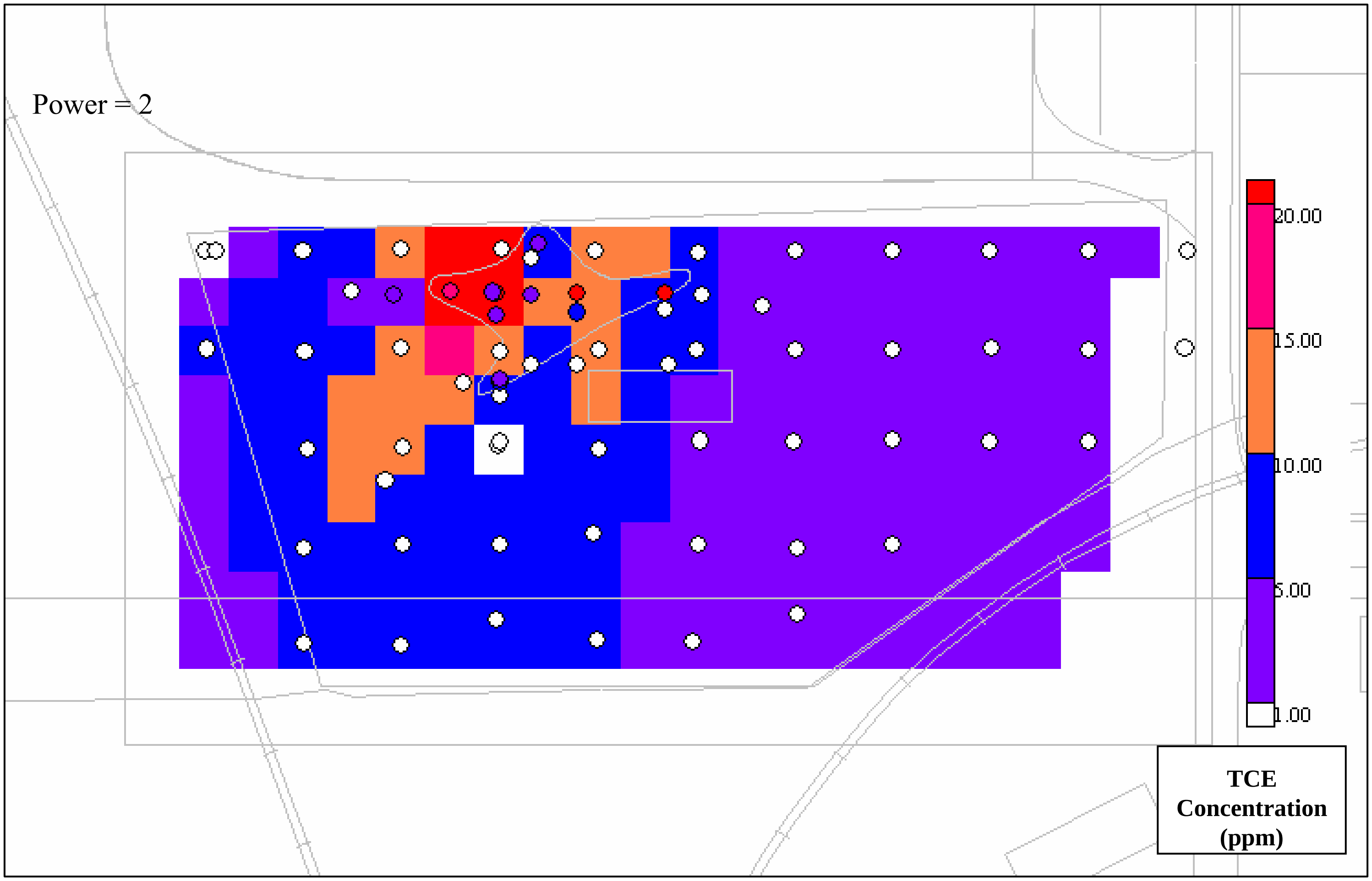


Fig. F.1.4. Interpolation – inverse distance.

21 x 9

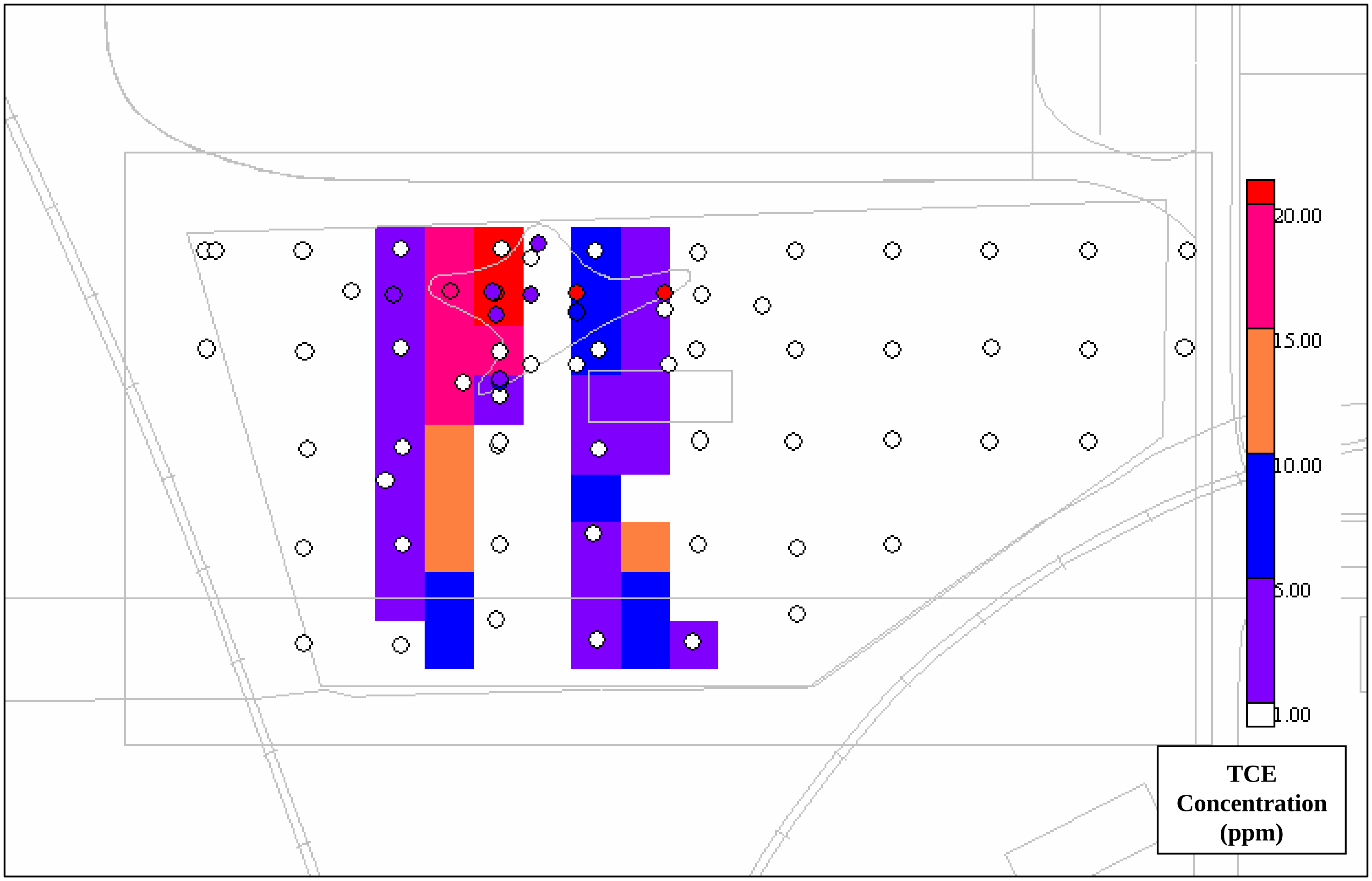


Fig. F.1.5. Interpolation – ordinary kriging for SWMU 1.

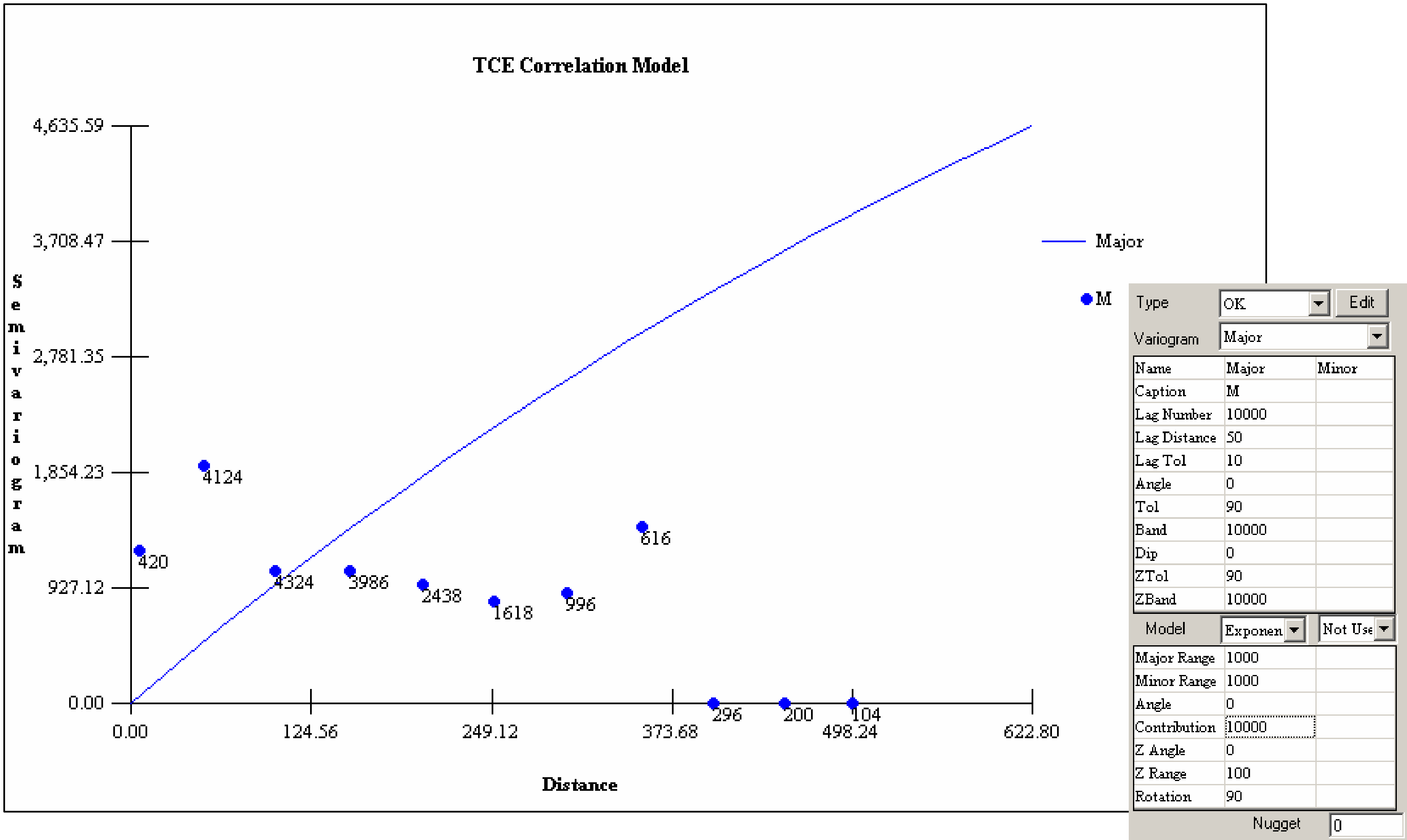


Fig. F.1.6. Ordinary kriging – semi-variogram for SWMU 1.

21 columns x 9 rows

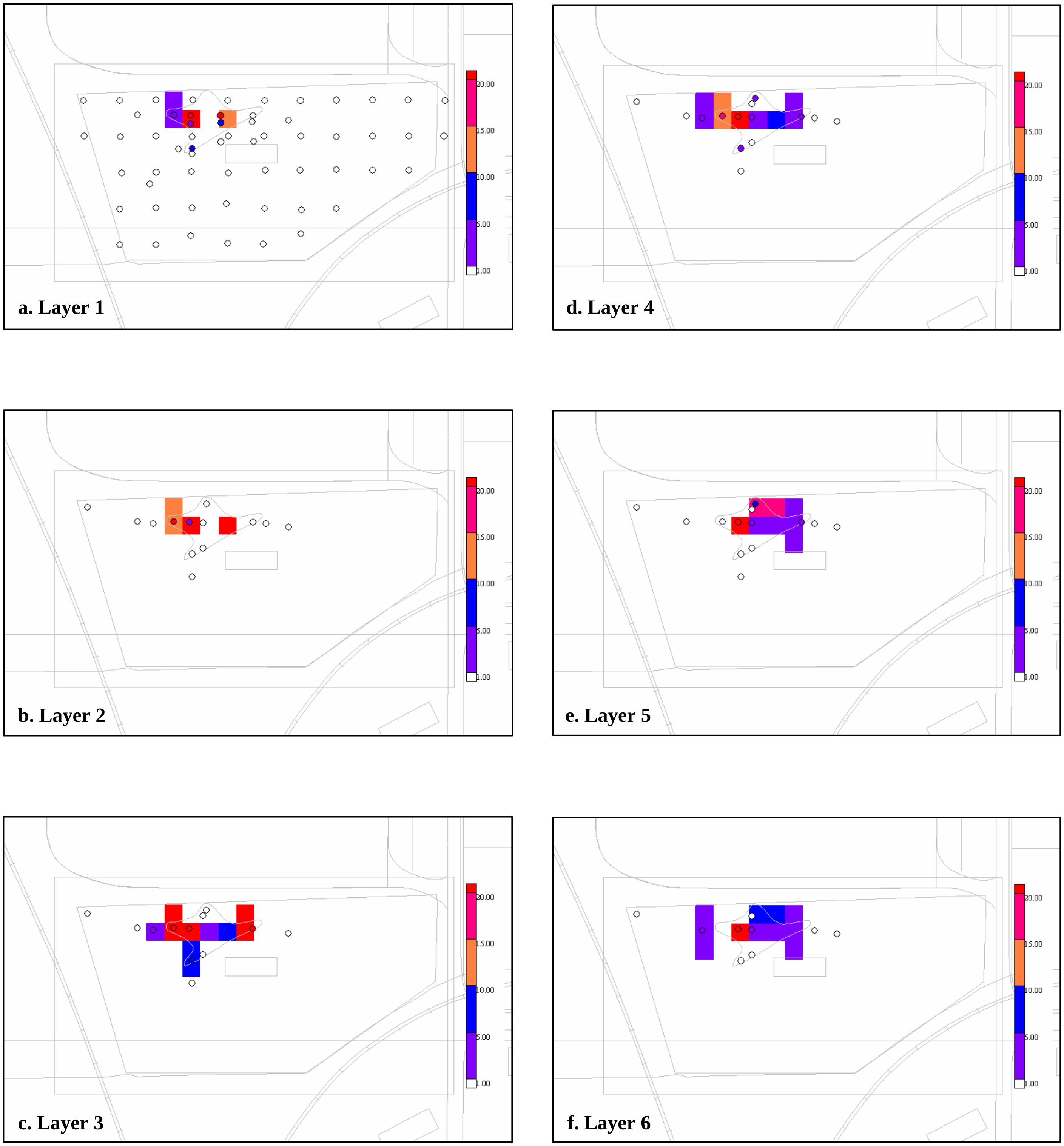


Fig. F.1.7. UCRS Soil concentration for SWMU 1.

21 columns x 9 rows

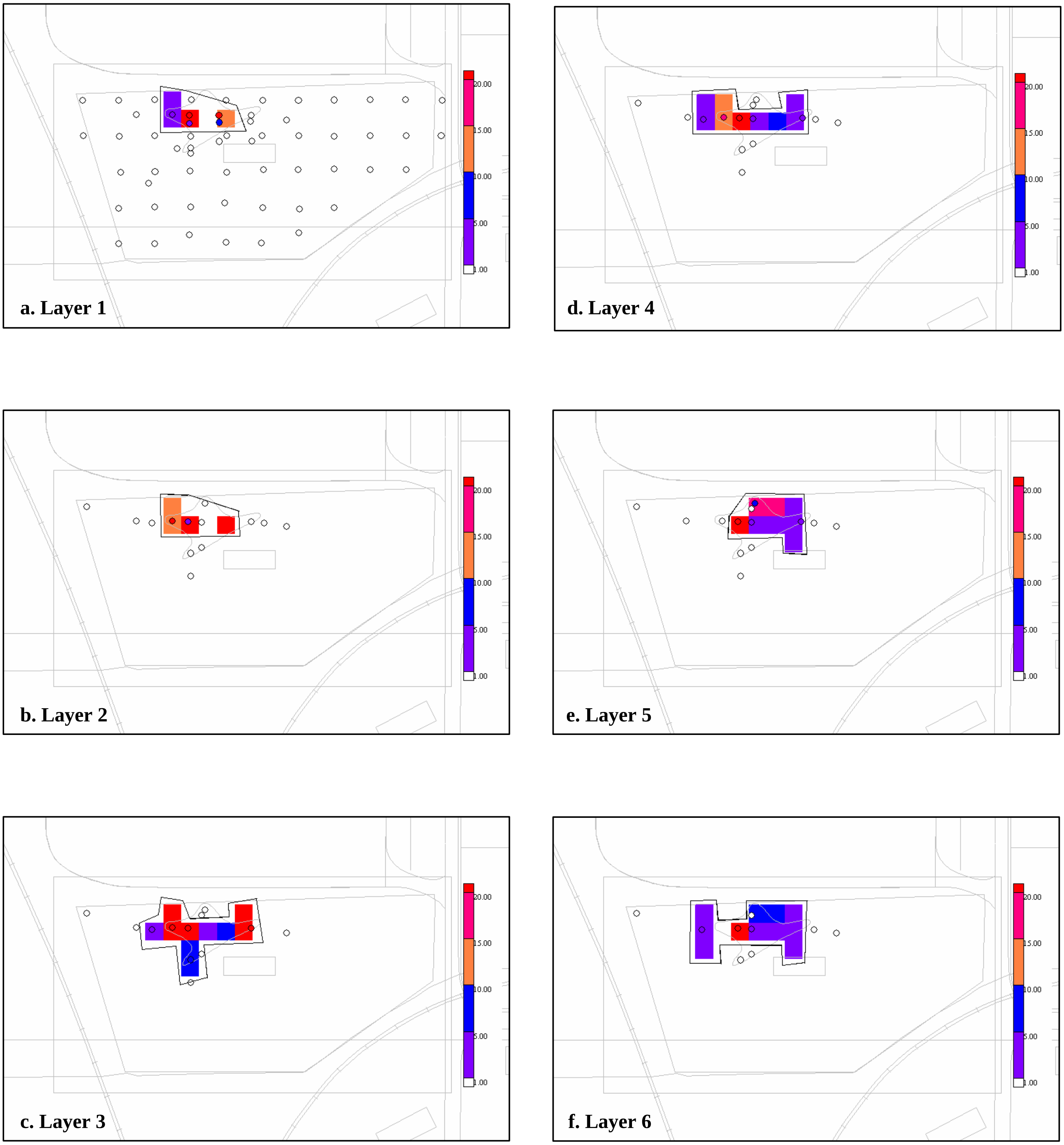
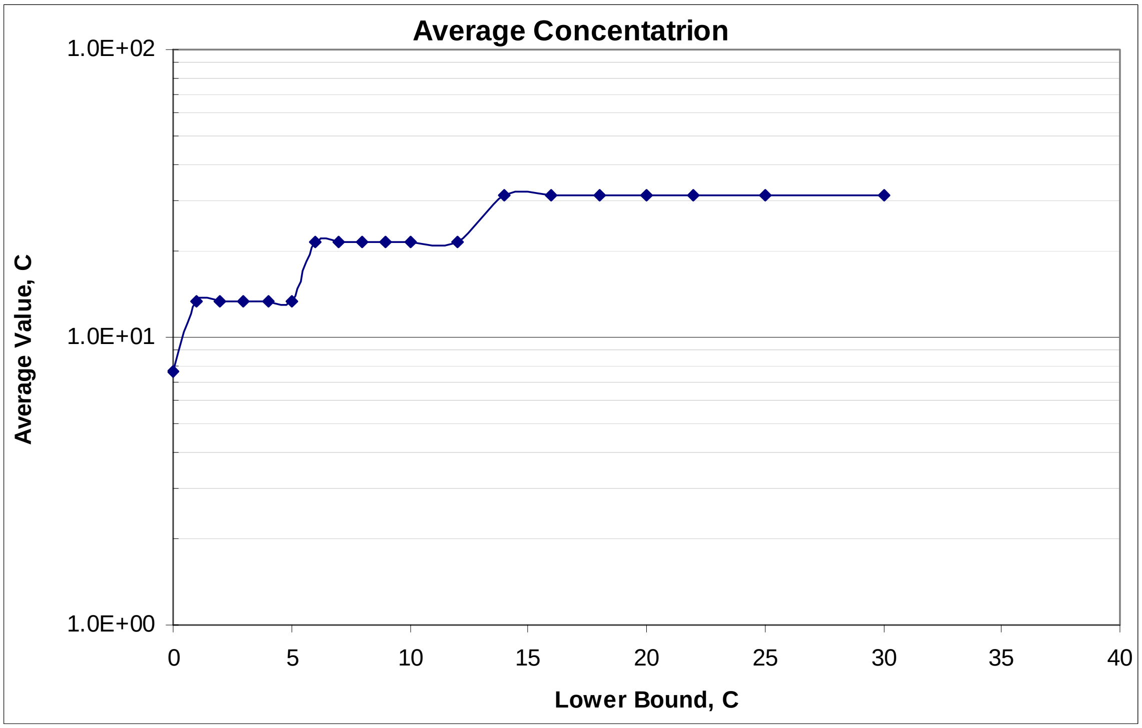
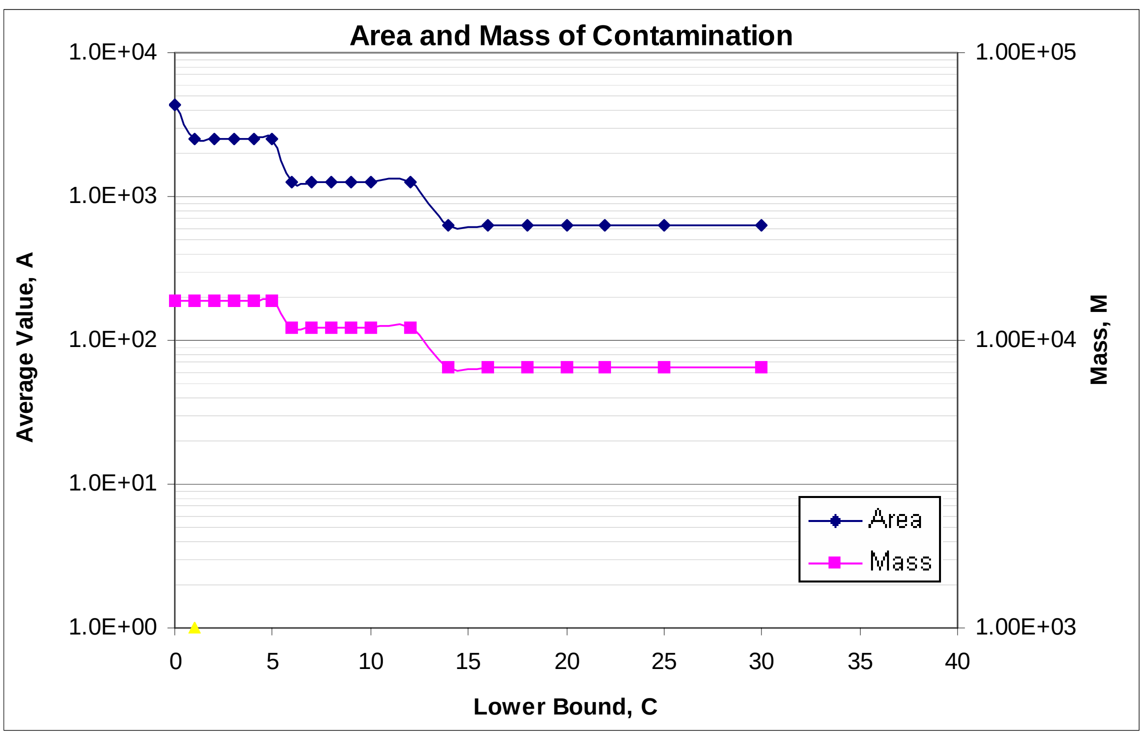


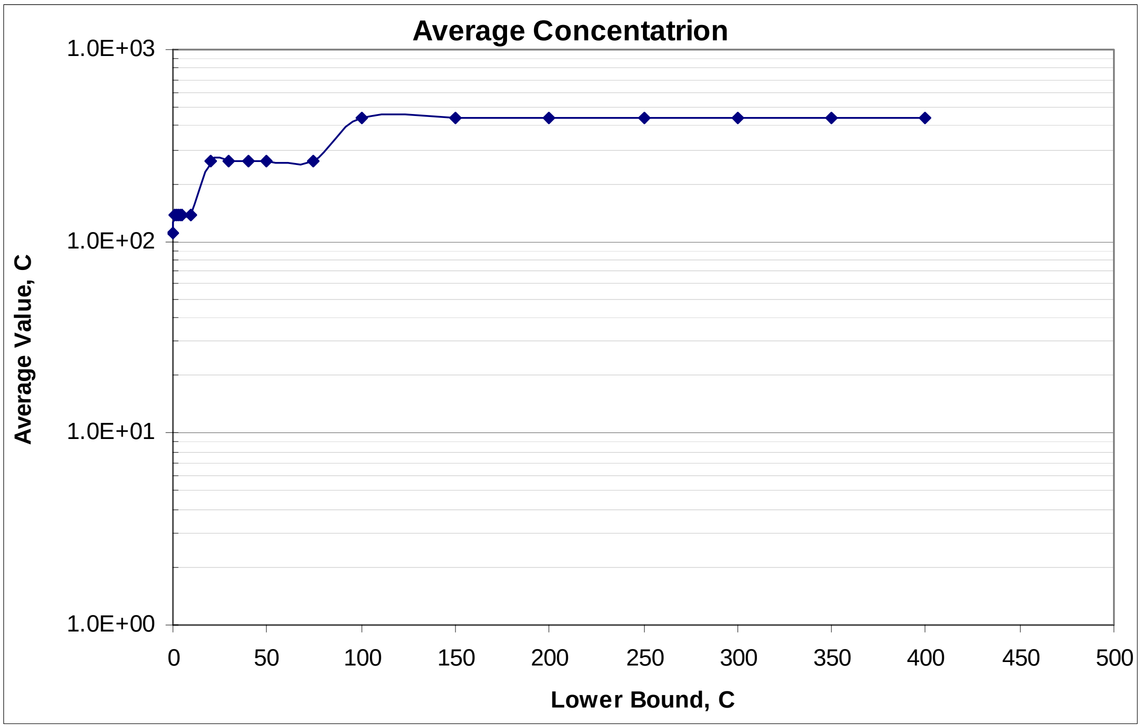
Fig. F.1.8. UCRS Source Delineation through Visual Inspection for SWMU 1.

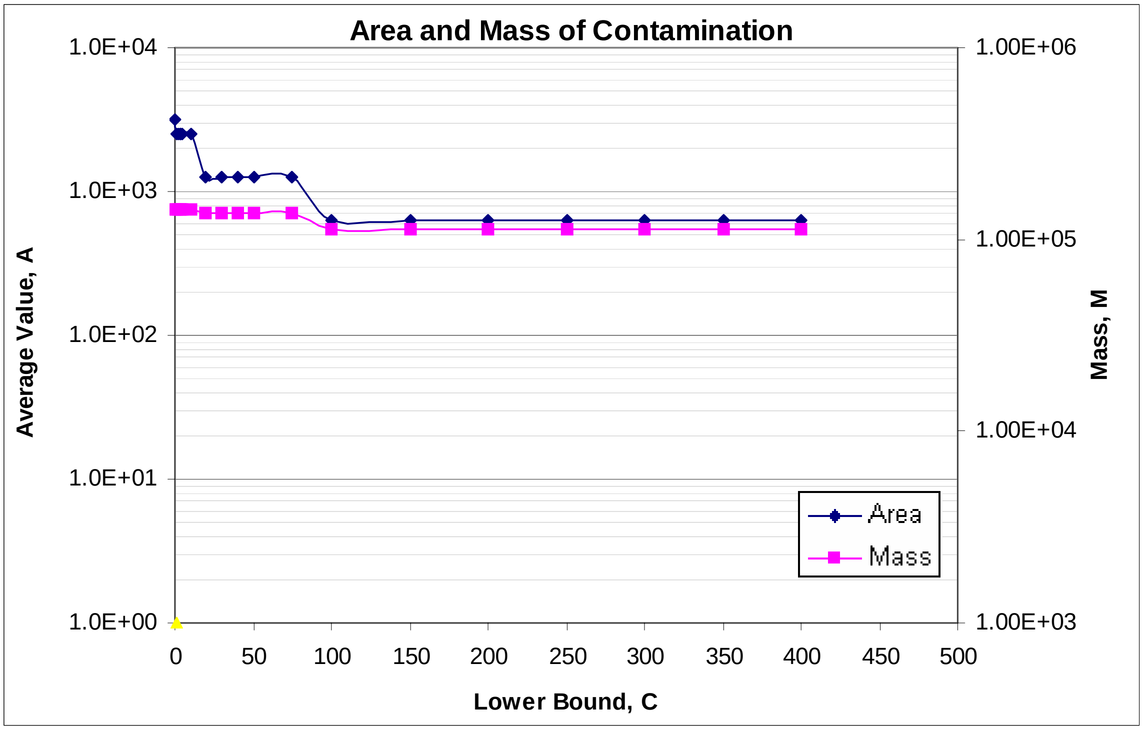




D ∈ [0, 10], V = 10 A
Unit: C (mg/kg), A (ft^2), M (gm), D (ft), V (ft^3)

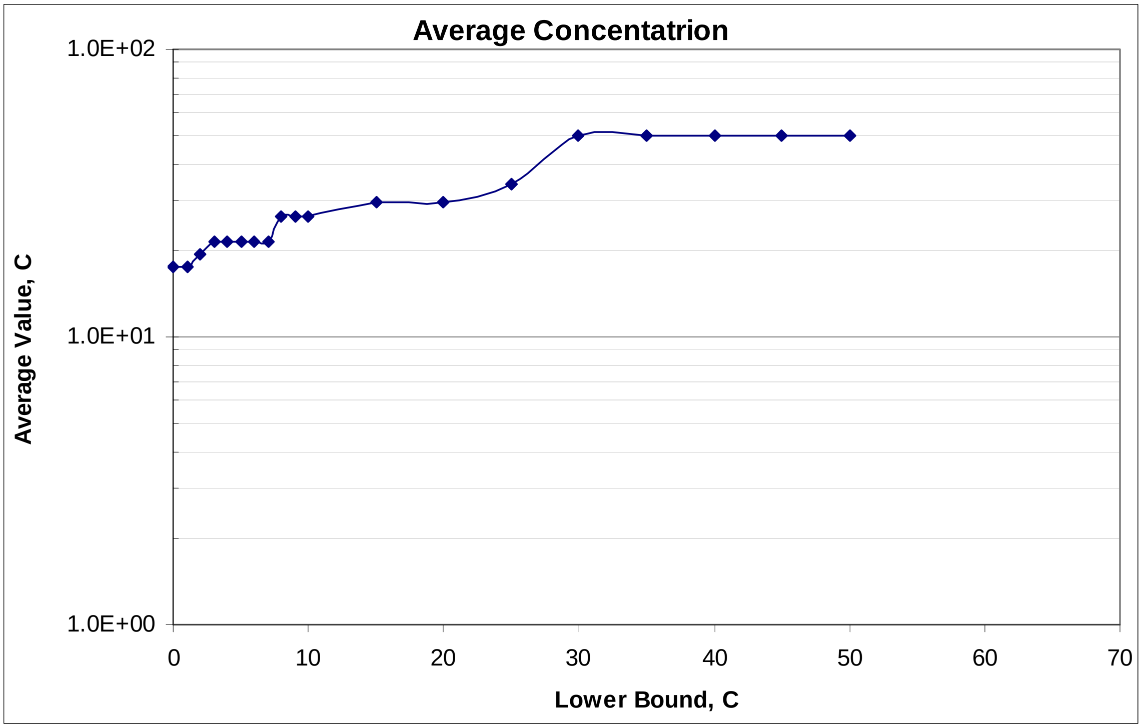
Fig. F.1.9a. UCRS Source for SWMU 1: Layer 1.

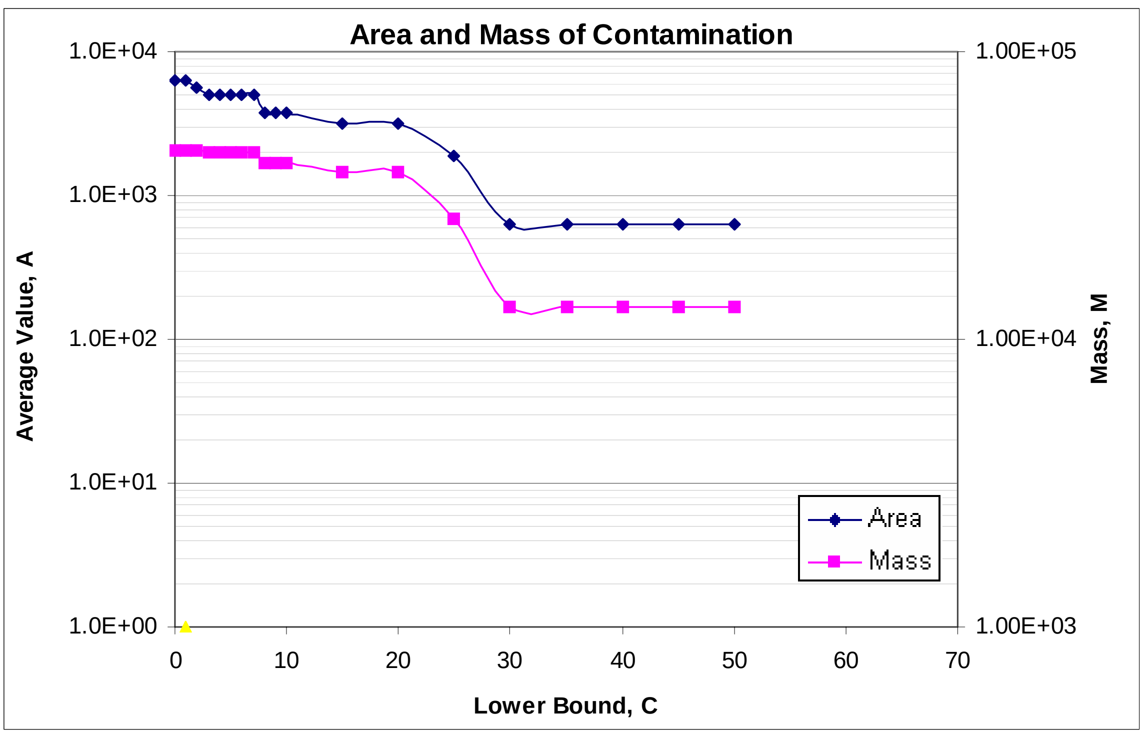




D ∈ [10, 20], V = 10 A
Unit: C (mg/kg), A (ft^2), M (gm), D (ft), V (ft^3)

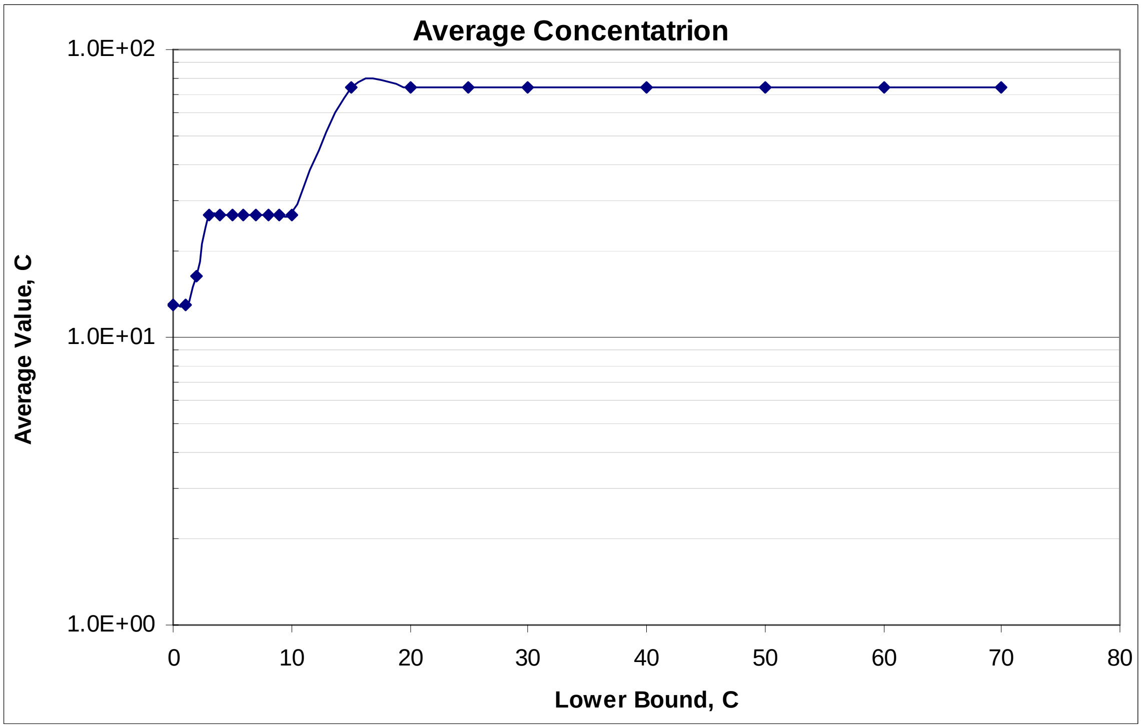
Fig. F.1.9b. UCRS Source for SWMU 1: Layer 2.

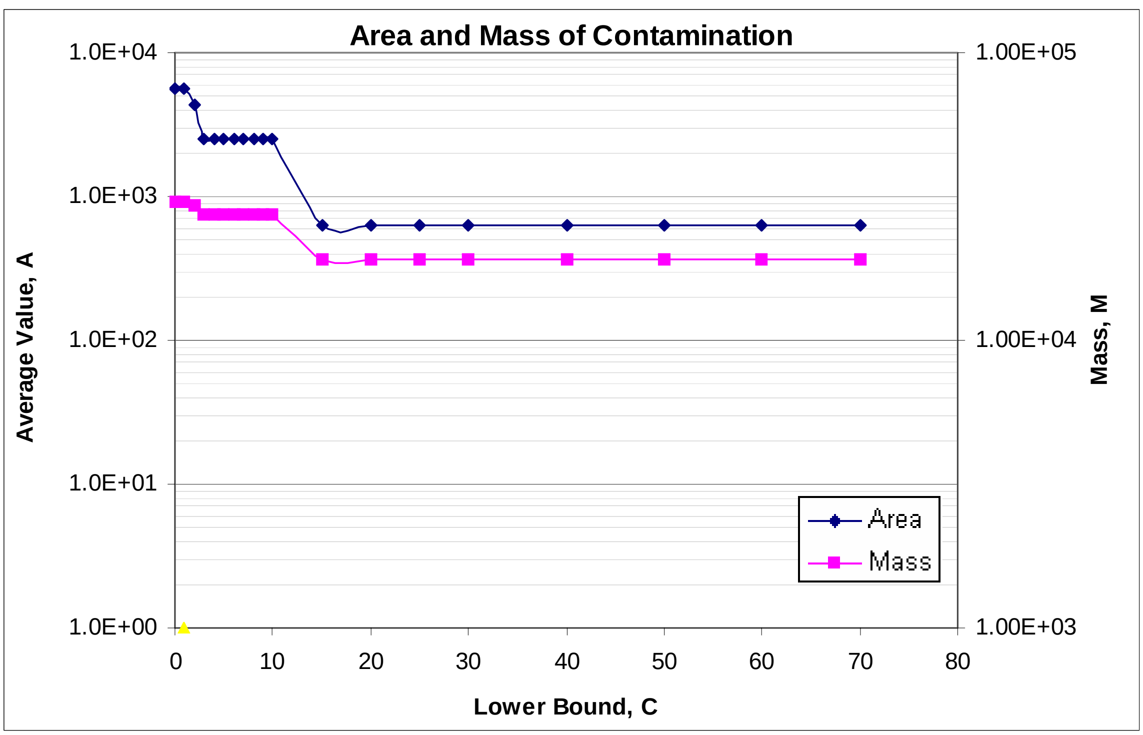




D ∈ [20, 30], V = 10 A
Unit: C (mg/kg), A (ft^2), M (gm), D (ft), V (ft^3)

Fig. F.1.9c. UCRS Source for SWMU 1: Layer 3.

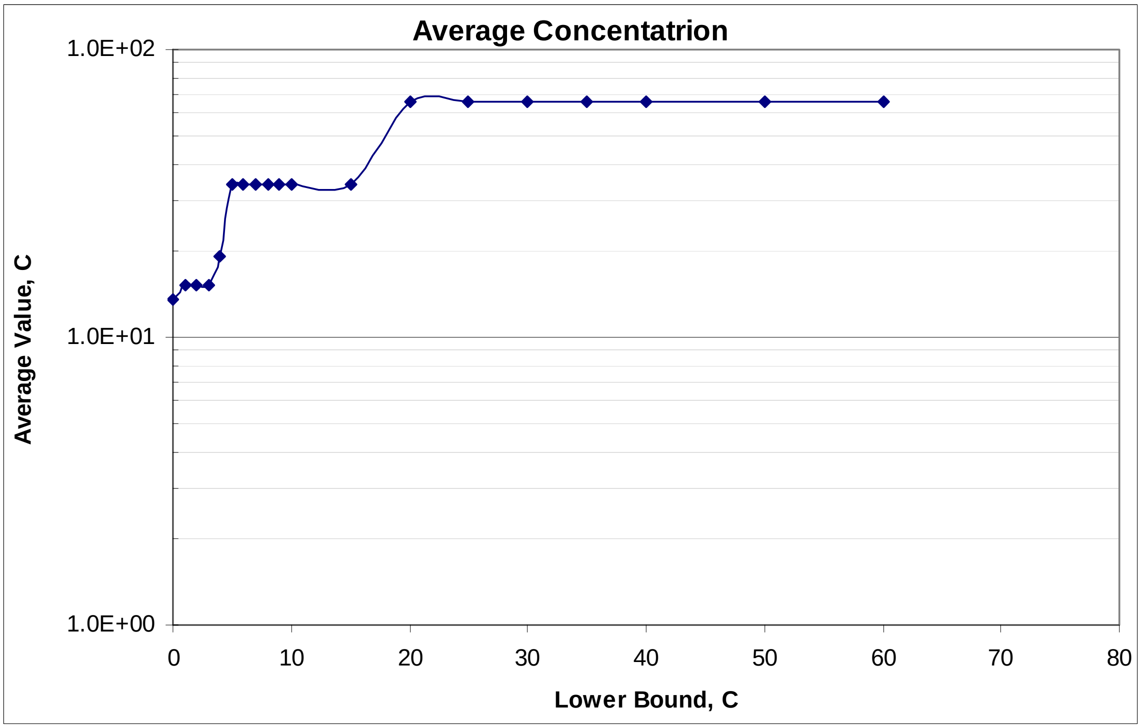


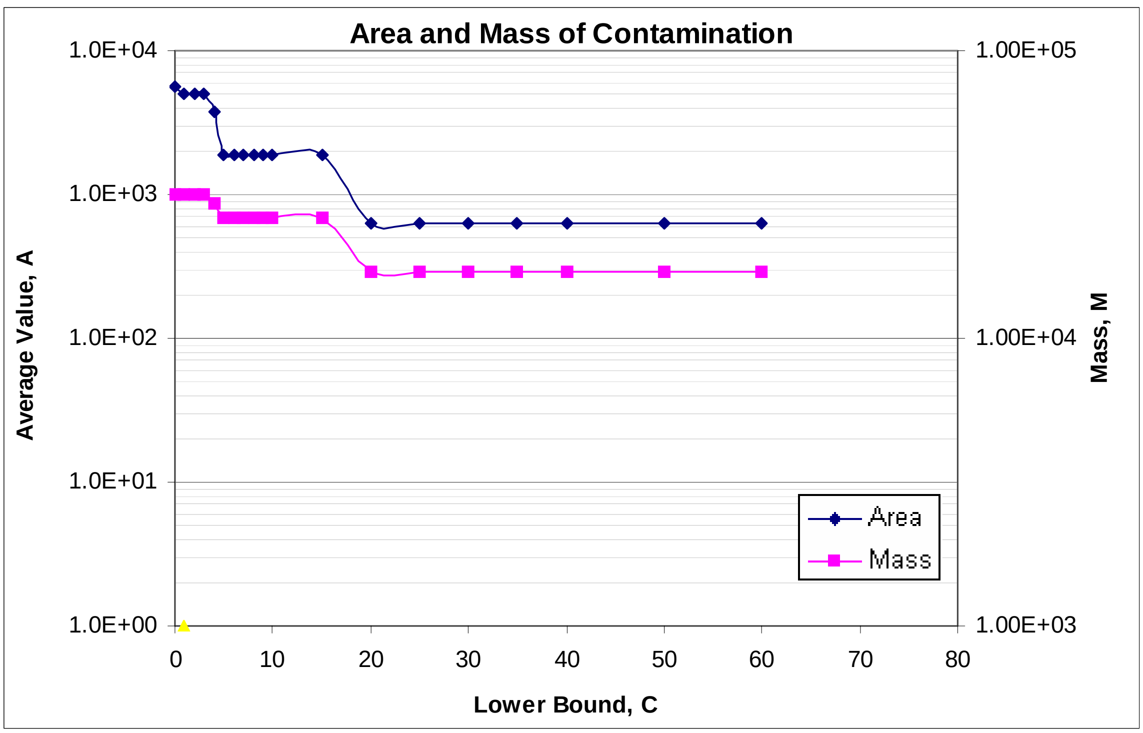


D ∈ [30, 40], V = 10 A

Unit: C (mg/kg), A (ft^2), M (gm), D (ft), V (ft^3)

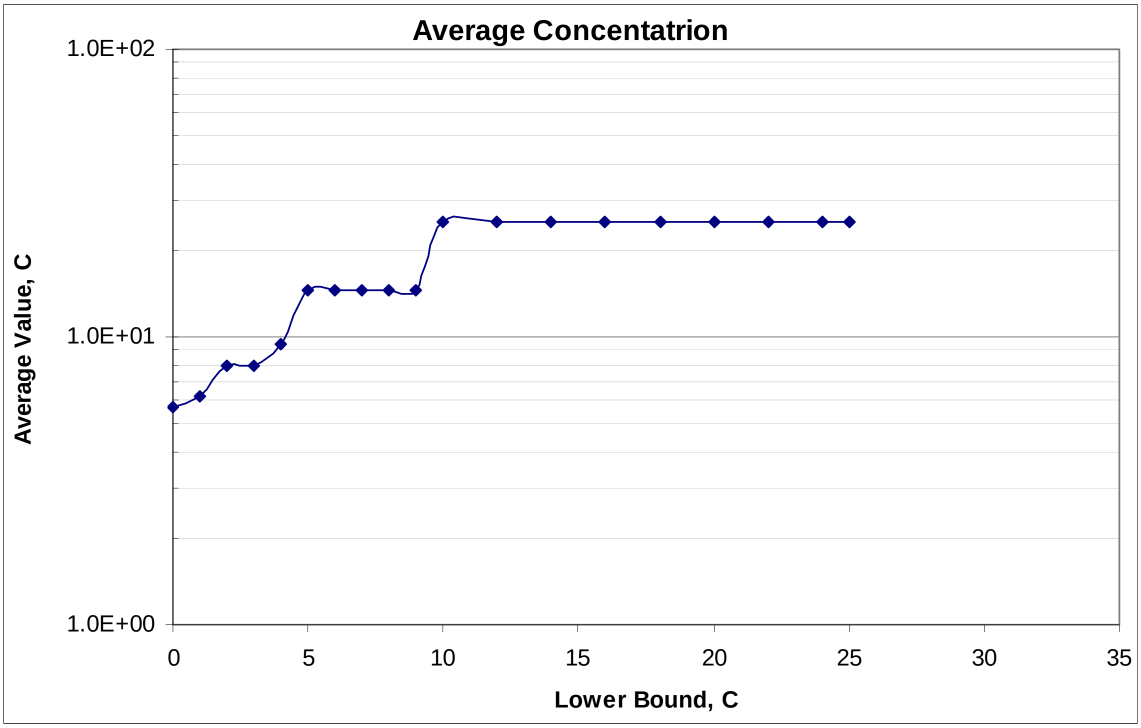
Fig. F.1.9d. UCRS Source for SWMU 1: Layer 4.

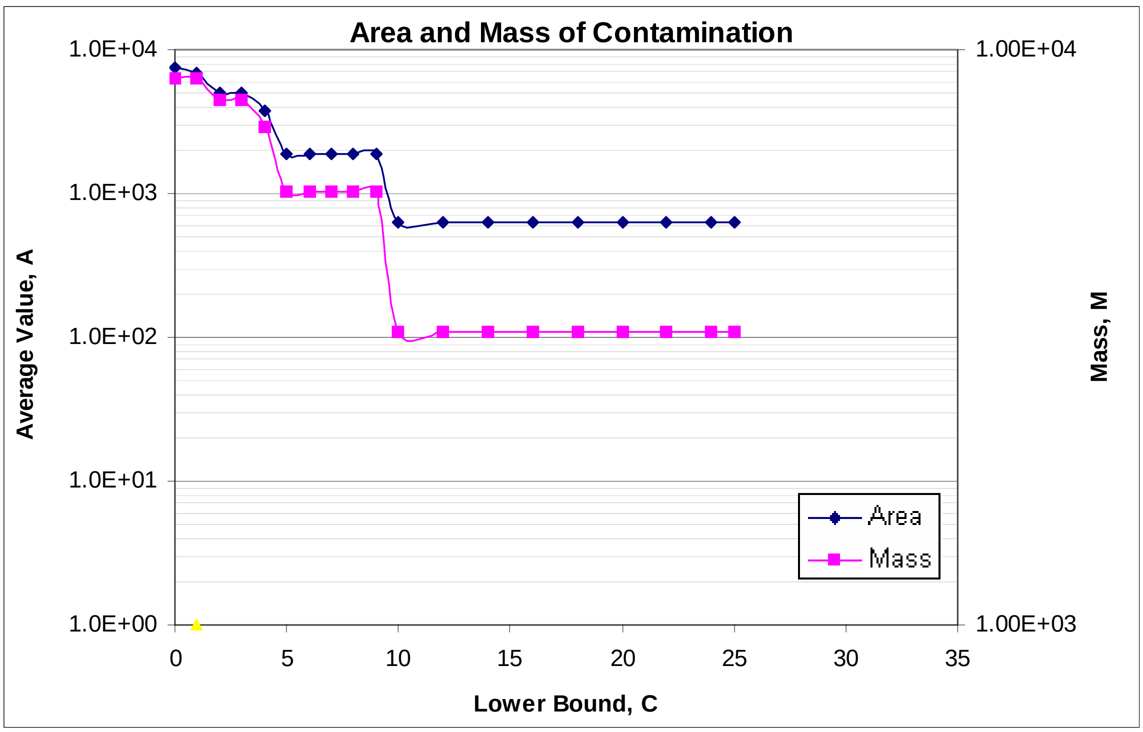




D ∈ [40, 50], V = 10 A
Unit: C (mg/kg), A (ft^2), M (gm), D (ft), V (ft^3)

Fig. F.1.9e. UCRS Source for SWMU 1: Layer 5.





D ∈ [50, 55], V = 5 A
Unit: C (mg/kg), A (ft^2), M (gm), D (ft), V (ft^3)

Fig. F.1.9f. UCRS Source for SWMU 1: Layer 6.

9 columns x 23 rows

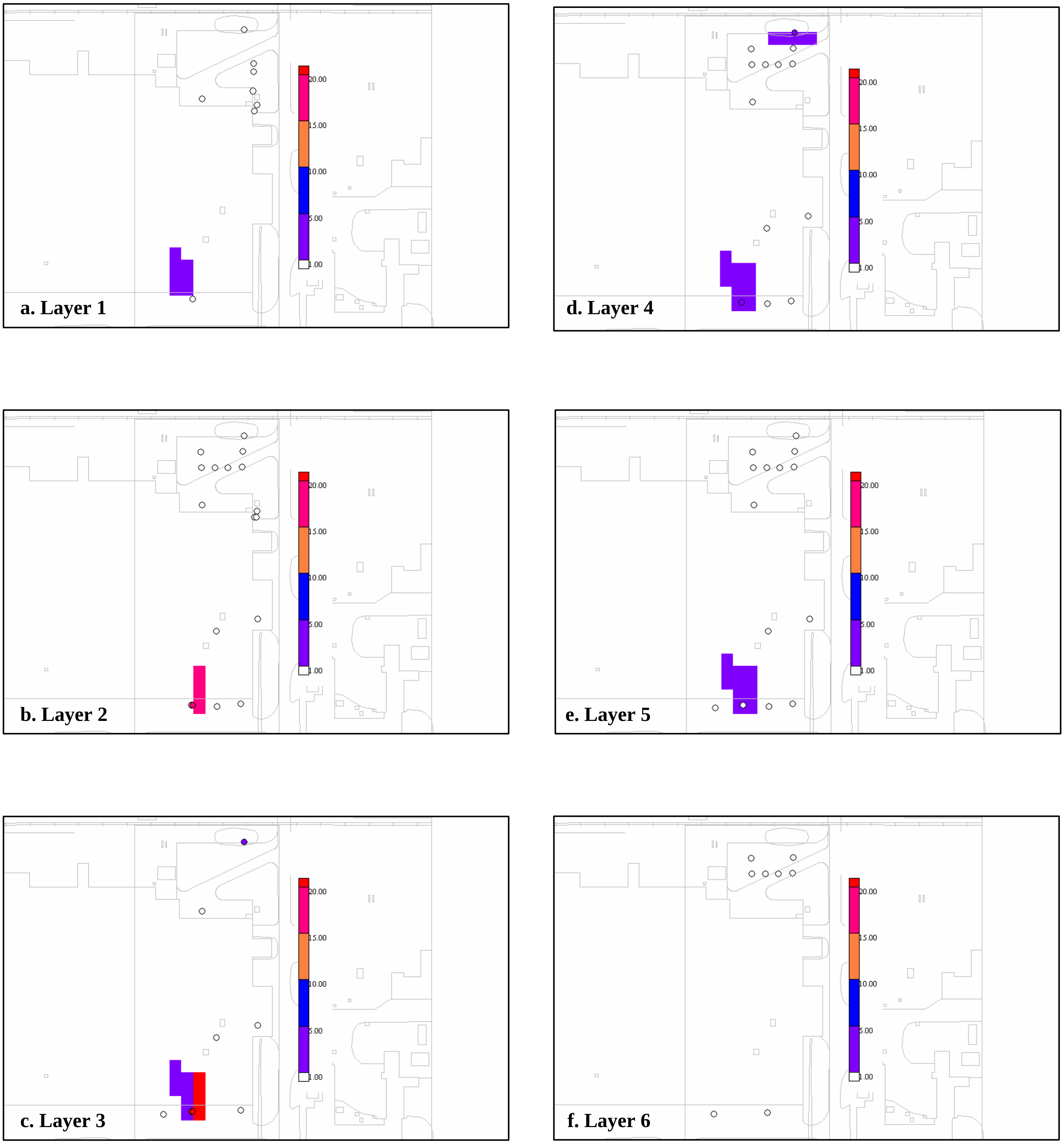


Fig. F.1.10. UCRS Soil concentration for C-720.

9 columns x 23 rows

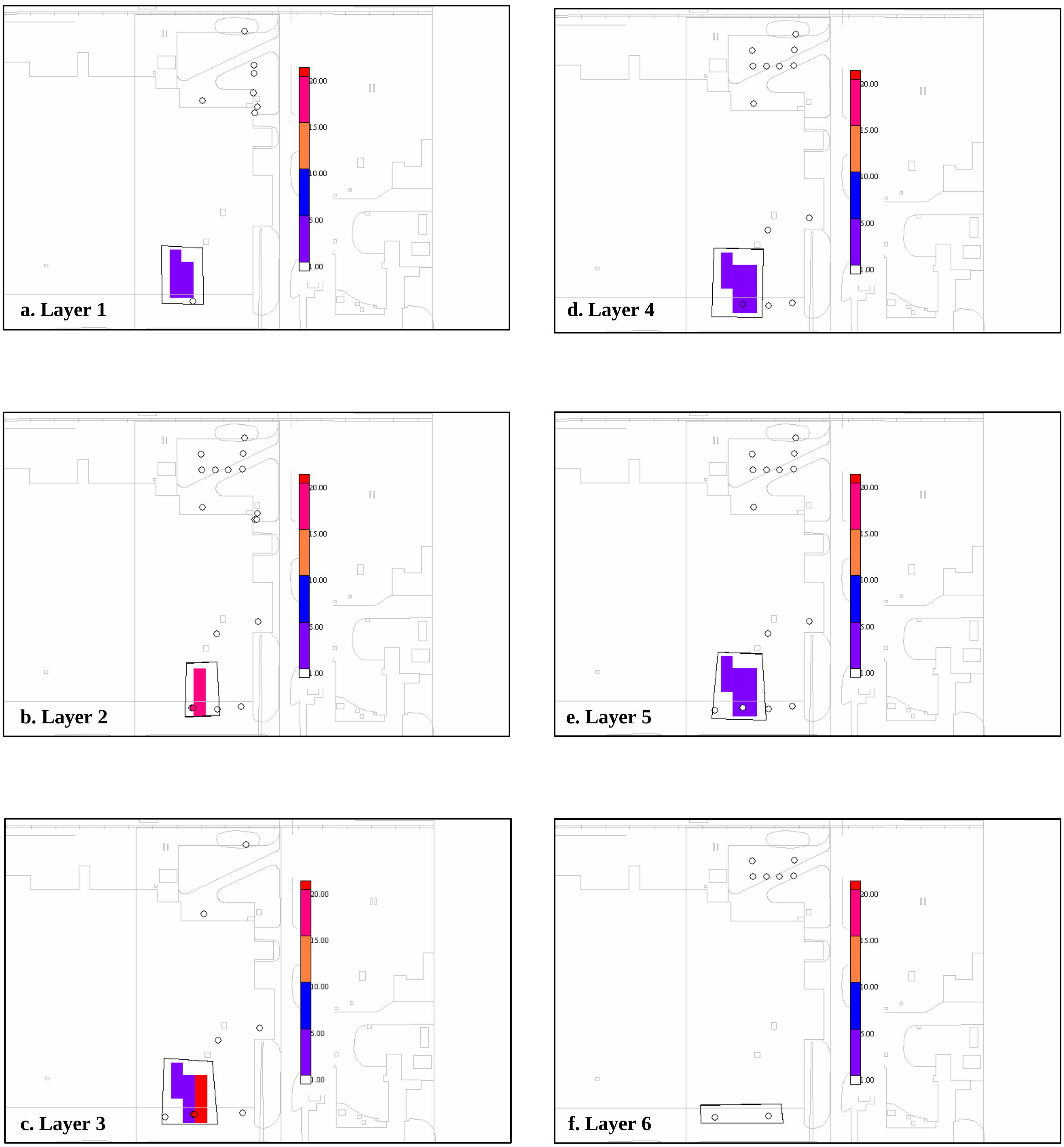
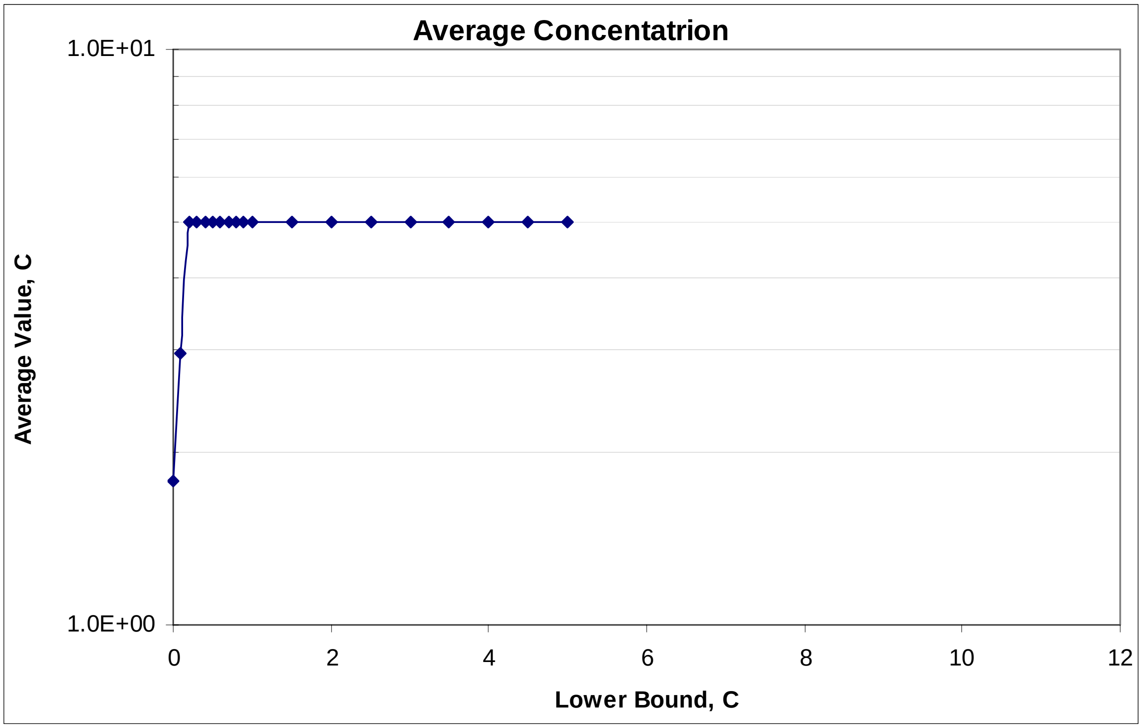
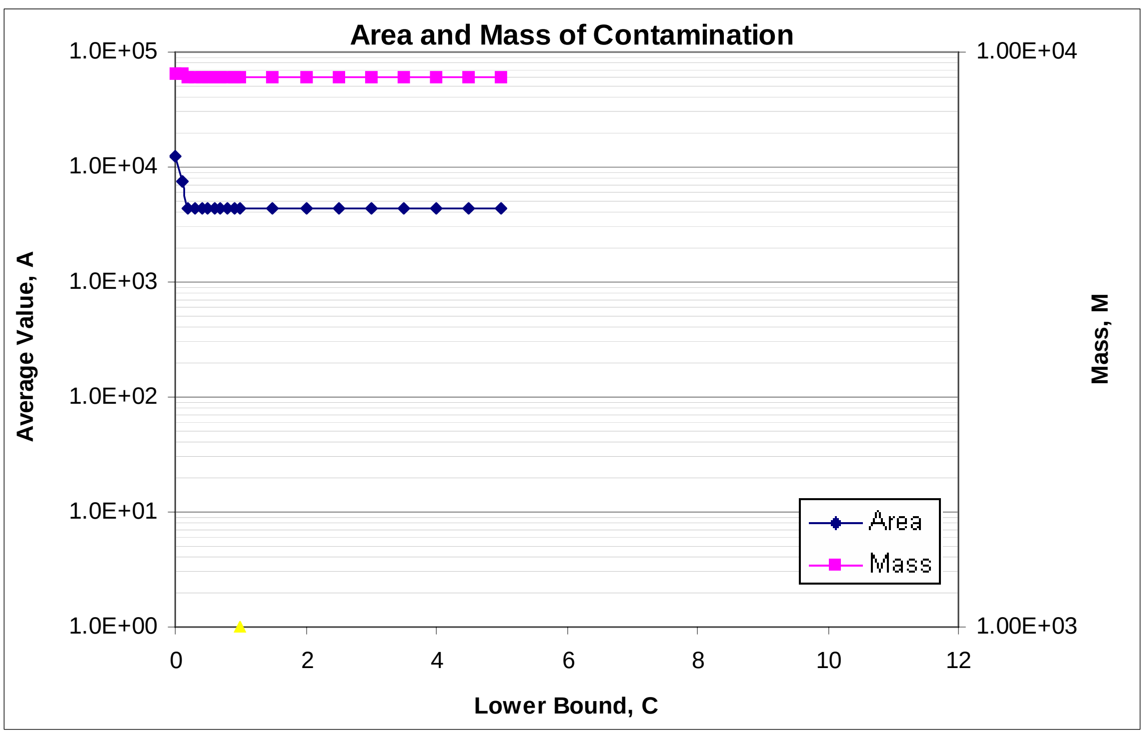


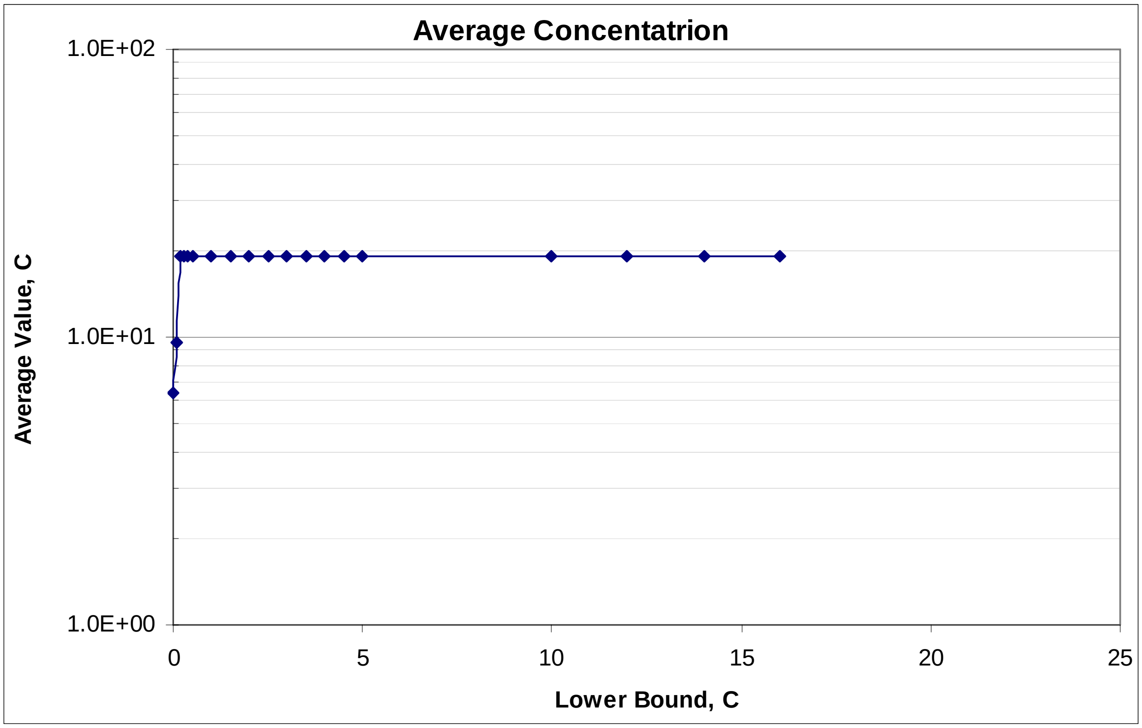
Fig. F.1.11. UCRS Source Delineation through Visual Inspection for C-720.

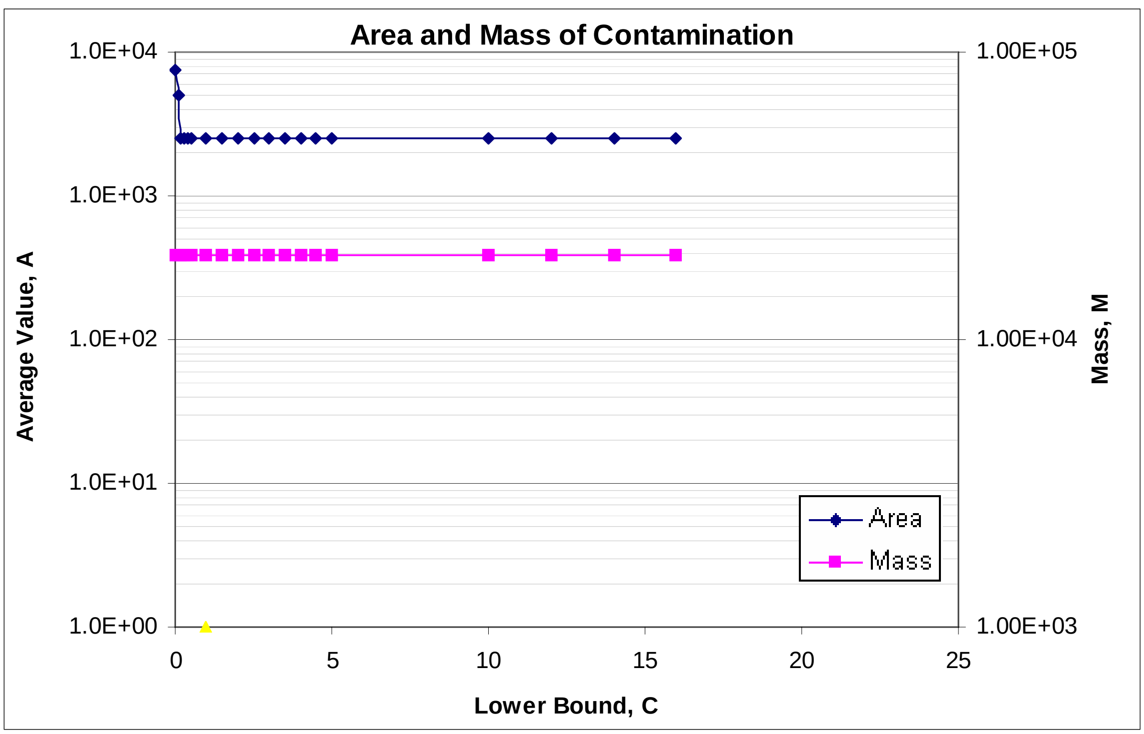




D ∈ [0, 10], V = 10 A
Unit: C (mg/kg), A (ft^2), M (gm), D (ft), V (ft^3)

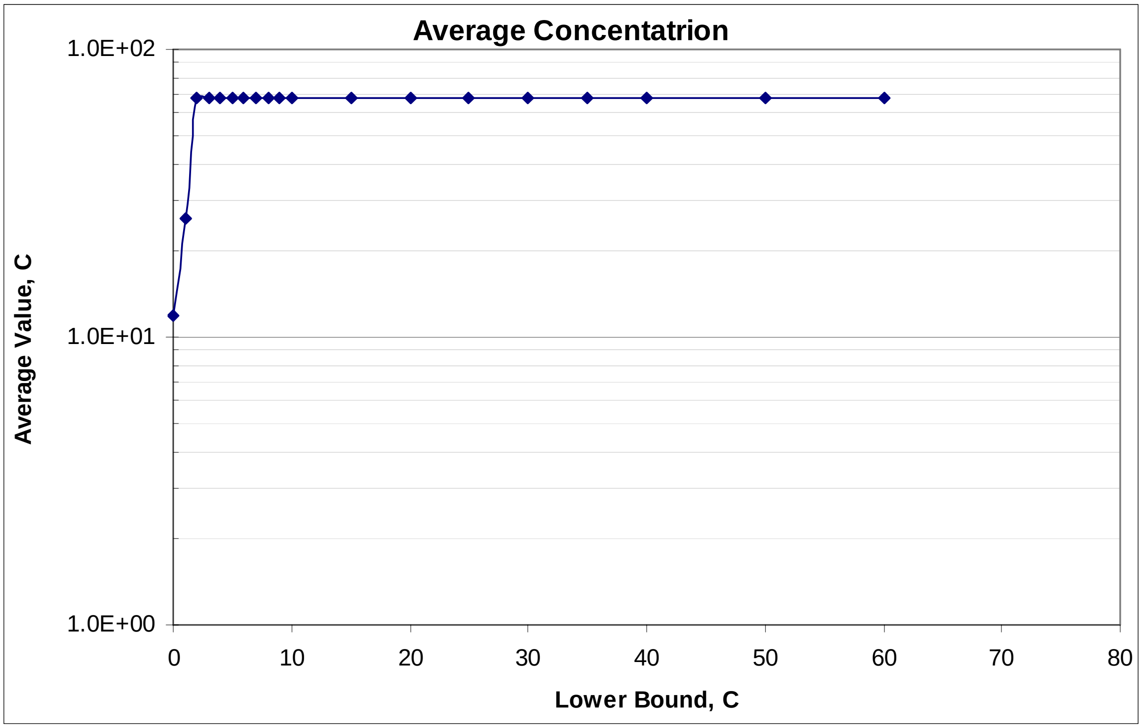
Fig. F.1.12a. UCRS Source for C-720: Layer 1.

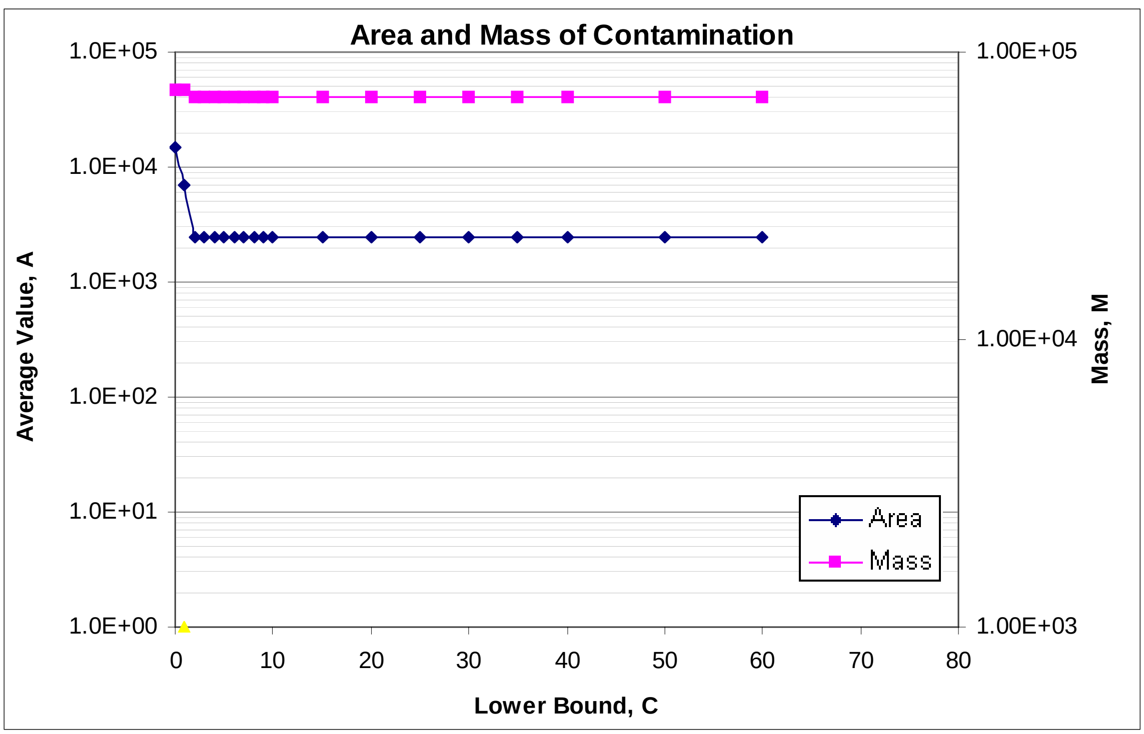




D $\in$ [10, 20], V = 10 A
Unit: C (mg/kg), A (ft^2), M (gm), D (ft), V (ft^3)

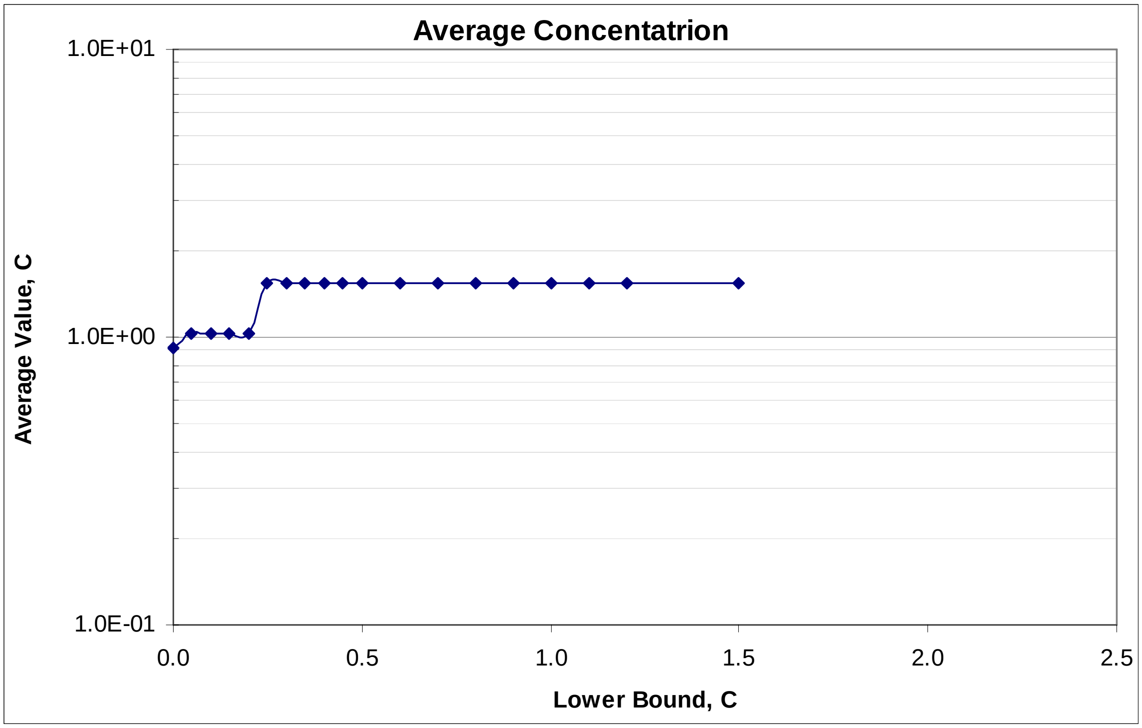
Fig. F.1.12b. UCRS Source for C-720: Layer 2.

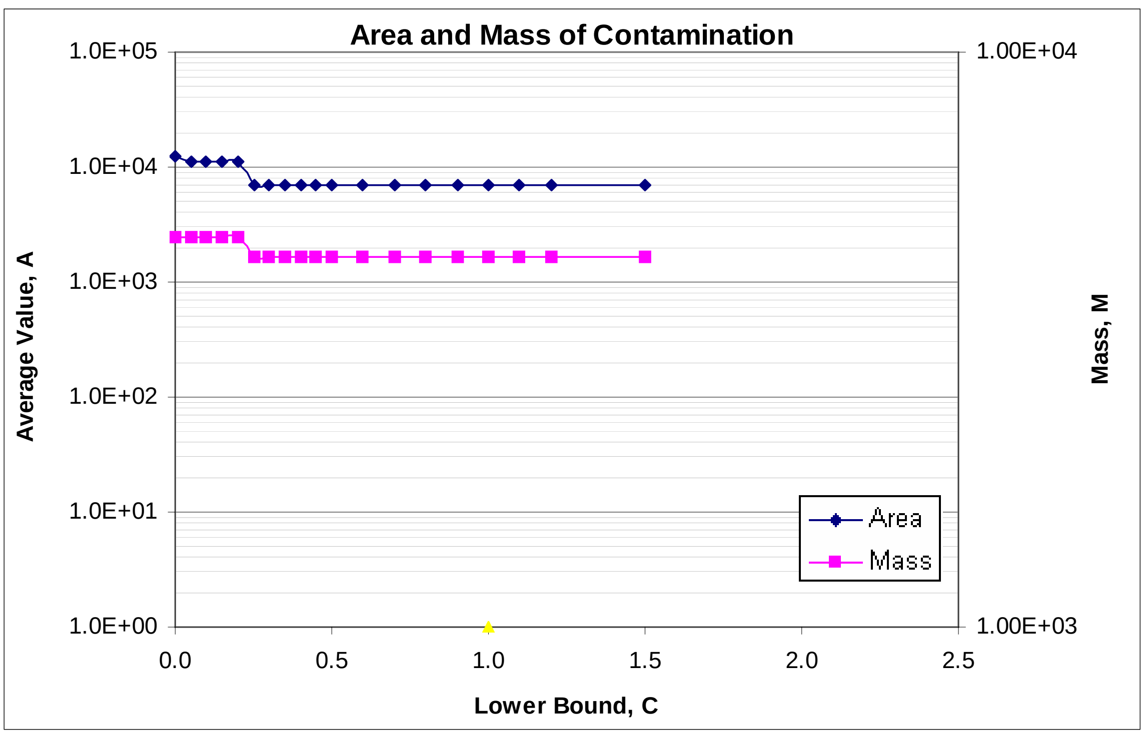




D ∈ [20, 30], V = 10 A
Unit: C (mg/kg), A (ft^2), M (gm), D (ft), V (ft^3)

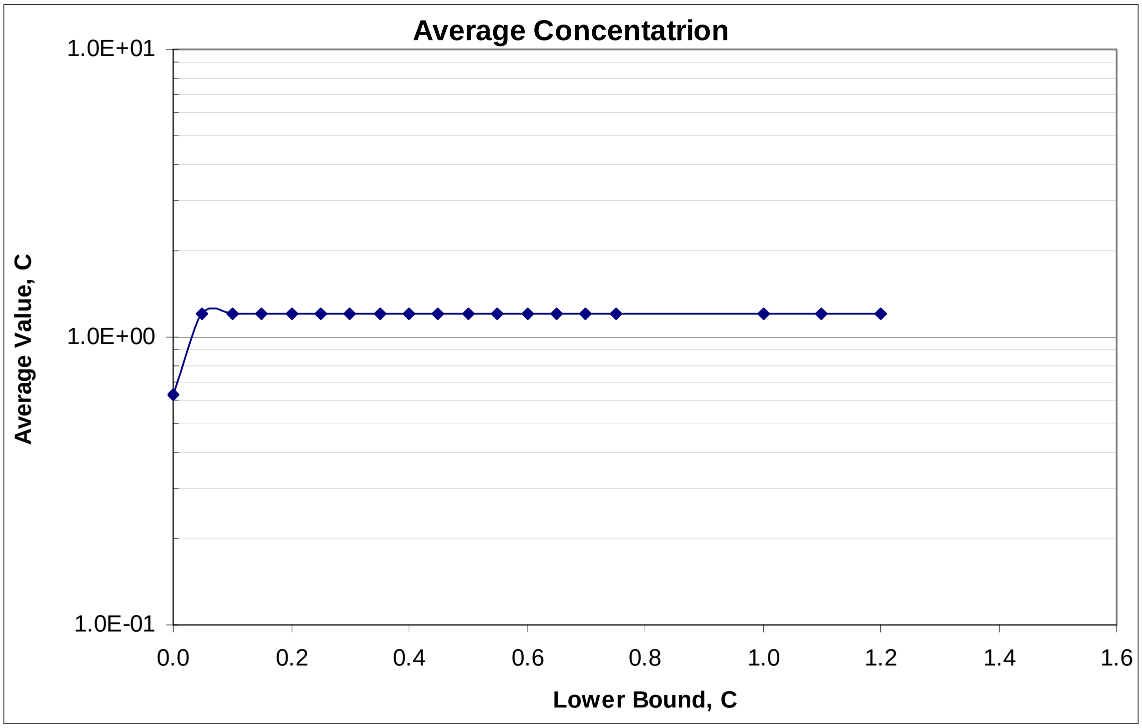
Fig. F.1.12c. UCRS Source for C-720: Layer 3.

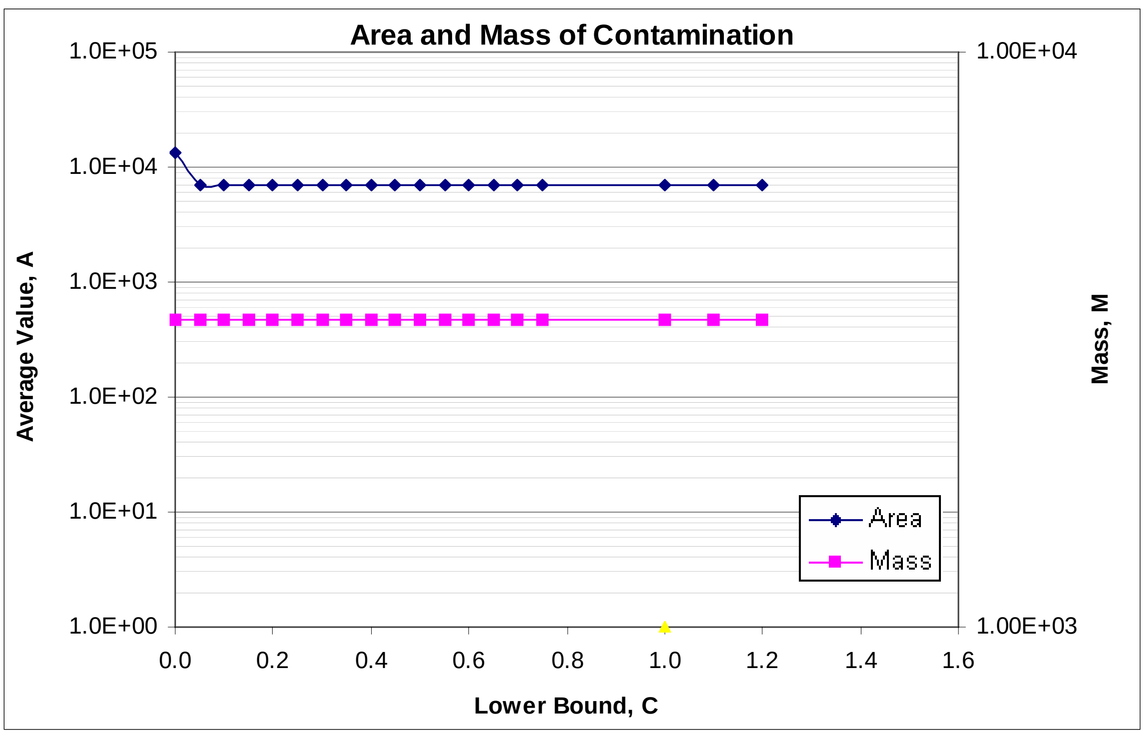




D ∈ [30, 40], V = 10 A
Unit: C (mg/kg), A (ft^2), M (gm), D (ft), V (ft^3)

Fig. F.1.12d. UCRS Source for C-720: Layer 4.

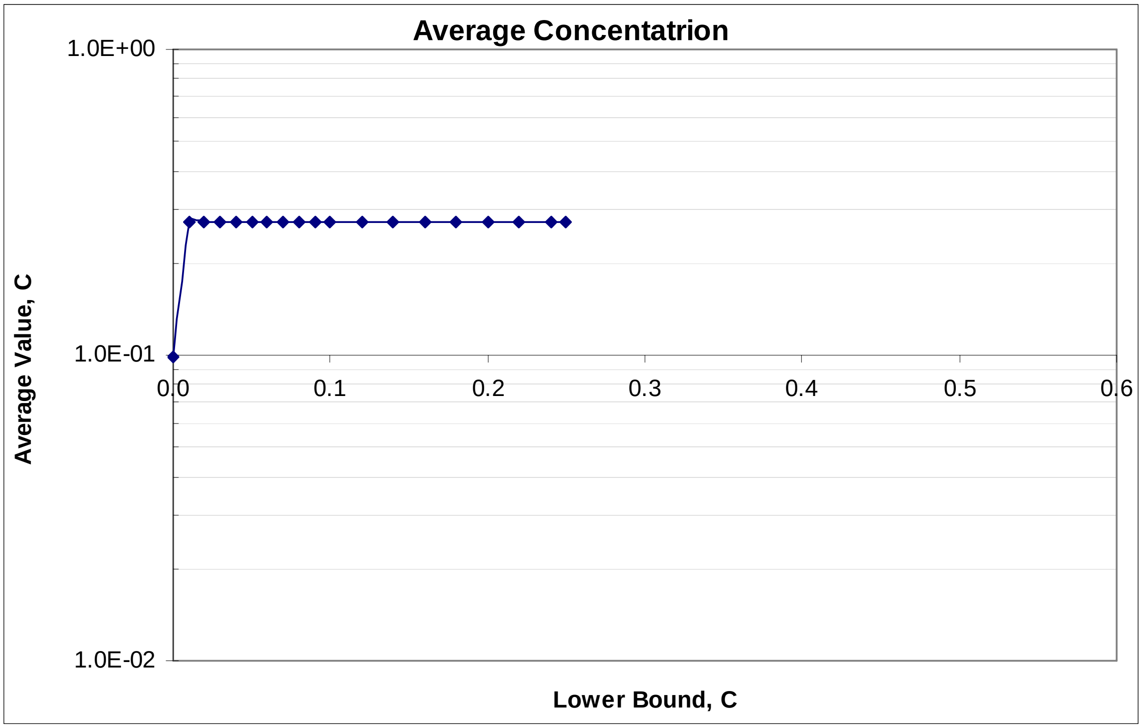


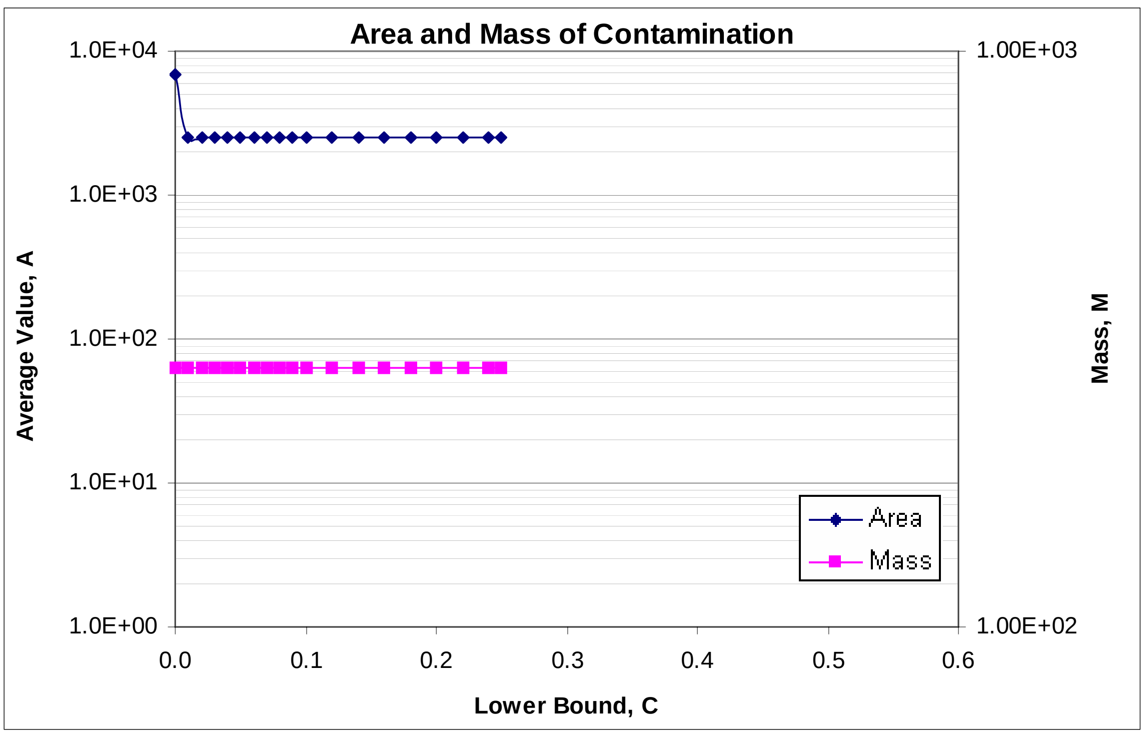


D ∈ [40, 50], V = 10 A

Unit: C (mg/kg), A (ft^2), M (gm), D (ft), V (ft^3)

Fig. F.1.12e. UCRS Source for C-720: Layer 5





D ∈ [50, 60], V = 10 A

Unit: C (mg/kg), A (ft^2), M (gm), D (ft), V (ft^3)

Fig. F.1.12f. UCRS Source for C-720: Layer 6.

APPENDIX F
ATTACHMENT 2

INPUT PARAMETERS FOR PROBABILISTIC MODELING

THIS PAGE INTENTIONALLY LEFT BLANK.

APPENDIX F
ATTACHMENT 2

INPUT PARAMETERS FOR PROBABILISTIC MODELING

1. INTRODUCTION

Probabilistic (stochastic) modeling was performed for the trichloroethene (TCE) sources at (Solid Waste Management Unit (SWMU) 1 and the C-720 Building areas in order to understand better the uncertainties in the transport modeling for these sources, to estimate the likely TCE concentrations at the points of exposure (POEs) using the most likely input parameters, and to determine the error bounds on the predicted TCE concentrations. This modeling was based upon the nature and extent discussion in the Site Investigation (SI) Report and the transport modeling results completed earlier.

Deleted: , SWMU 4,

The fate and transport modeling was performed using Spatial Analysis/Decision Assistance (SADA) software (UT 2002); Crystal Ball® (Decisioneering, Inc. 2000), an add-in to Microsoft Excel®; Seasonal Soil Compartment Model (SESOIL) (GSC 1996, Bonazountas and Wagner 1984); and Analytical Transient One-, Two-, and Three-Dimensional Simulation Model (AT123D) (GSC 1998, Yeh 1981). The key input parameters for the modeling were developed using SADA and Crystal Ball®, while the modeling itself was performed using SESOIL and AT123D.

2. INPUT PARAMETERS

The input parameters for the modeling were in two groups: fixed and variable. The values of the fixed parameters were from earlier work (DOE 2003). The values of the variable parameters were set considering earlier work and employing a probabilistic method. This was done by developing a distribution for each variable parameter and sampling the distribution using the Monte Carlo sampling technique provided in Crystal Ball®.

3. PARAMETER DISTRIBUTIONS

Several distributions were considered when selecting the best distribution for each of the variable input parameters. A general discussion of each distribution considered is provided below.

1. **Triangular Distribution:** This distribution is used to describe a variable with known minimum, maximum, and most likely values (Decisioneering, Inc. 2000). Three conditions underlying this distribution are as follows:

    - The minimum value of the variable is fixed.
    - The maximum value of the variable is fixed.

- The most likely value of the variable falls between the minimum and maximum values forming a triangular-shaped distribution and showing that values near the minimum and maximum are less likely to occur than those near the most likely values.

2. **Normal Distribution:** This is the most important distribution in the probability theory because it describes many natural phenomena (Decisioneering, Inc. 2000). Three conditions underlying this distribution are as follows:

   - Some value of the variable is the most likely (the mean of the distribution).
   - The value of the variable could as likely be below the mean as it could be above the mean (symmetrical about the mean).
   - The value of the variable is more likely to be near the mean than far away.

   Generally, if the coefficient of variability is less than 30%, a normal distribution is recommended. A skewness value between -0.5 and +0.5 indicates a fairly symmetrical distribution (Decisioneering, Inc. 2000).

3. **Log-Normal Distribution:** This distribution is widely used to describe a variable with values that are positively skewed (Decisioneering, Inc. 2000). The three conditions underlying this distribution are as follows:

   - The variable can increase without limits but cannot fall below zero.
   - The variable is positively skewed with most of the values near the lower limit.
   - The natural logarithm of the variable yields a normal distribution

   Generally, if the coefficient of variability is greater than 30%, a log-normal distribution is recommended. A skewness value less than -1 or greater than +1 indicates a highly skewed distribution (Decisioneering, Inc. 2000).

4. **Uniform Distribution:** This distribution is used to describe a variable when each value of the variable has the same probability of occurrence within a selected range. This distribution is often used when no information about variable's distribution is available. The three conditions underlying this distribution are as follows:

   - The minimum value of the variable is fixed.
   - The maximum value of the variable is fixed.
   - The probability of any value being selected within the range between the minimum and maximum values is equal.

4. SESOIL PARAMETERS

The SESOIL software was used to simulate contaminant transport through the Upper Continental Recharge System (UCRS) to the Regional Gravel Aquifer (RGA). The parameters used for SESOIL are listed in Tables F.2.1 and F.2.2. As mentioned earlier, there are two groups of parameters. Remarks for each parameter are provided in these tables to clarify the source of the value and the justification for its selected value. Additional remarks for each variable parameter, including the values input into Crystal Ball, are provided in Table F.2.3. Finally, summary statistics for each variable parameter output by

Crystal Ball are provided in Table F.2.4. Histograms of the values output by Crystal Ball for the variable parameters are in Figs. F.2.1 through F.2.18.

Deleted: 0

1. **Fixed Parameters:** These parameters are summarized in Tables F.2.1 and F.2.2.

- **Soil Type:** The upper portion of the UCRS is loam, while the bottom portion of it is silty clay (DOE 1999). The soil type was considered to be silty loam for each area.

- **Bulk Density:** The bulk density of the UCRS is 1.46 g/cm^3 (DOE 1999). The bulk density was set to this value for each area.

- **Disconnectedness Index:** The disconnected index was set to a site-specific approximate value of 10 used in earlier work. The value was estimated by calibrating the deterministic model to an average recharge of 11.38 cm/yr.

- **Porosity:** The porosity of the UCRS is 0.45 (DOE 1999). The porosity was set to this value for each area.

- **Depth to Water Table:** The depth to the water table was estimated for each area considering site-specific data. The depths were estimated as 16.76 m (55 ft) and 18.29 m (60 ft) for SWMU 1 and C-720 areas, respectively.

Deleted: , 16.76 m (55 ft)

Deleted: , SWMU 4,

- **Freundlich Equation Exponent:** The Freundlich equation exponent typically ranges from 0.9 to 1.4; the default value of 1.0 is recommended if the actual value is not known (GSC 1996). The exponent was set to 1 for each area.

- **Contaminant of Concern (COC):** The COC of interest was TCE.

- **Source Area:** The source area was developed analyzing site-specific data for each area. Soil concentration for the area was analyzed layer-by-layer using SADA. A limitation of SESOIL required that all layers have the same area. Source areas and the average soil concentration in each layer were estimated, and the source area with the maximum contaminant mass was identified and set as the "uniform area." Concentrations within each layer were then normalized against the "uniform area" (discussed later). The "uniform areas" used for SWMU 1 and the C-720 area were 324 m^2 and 1394 m^2, respectively.

Deleted: , SWMU 4,

Deleted: , 3699 m^2,

- **Molecular Weight:** The molecular weight was set to 131 g/gm-mol (EPA 1994).

- **Solubility in Water:** The solubility in water was set to 1100 mg/L (EPA 1996).

- **Diffusion in Air:** The diffusion in air was set to 0.08 cm^2/sec (EPA 1996).

- **Henry's Constant:** The Henry's constant was set to 0.0103 $atm\text{-}m^3/mol$ (EPA 1996).

- **Soil Organic Carbon/Water Partition coefficient (K_{oc}):** The K_{oc} was set to 94 L/kg (EPA 1996).

2. **Variable Parameters:** These parameters are summarized in Tables F.2.1 through F.2.4.

- **Intrinsic Permeability:** Site-specific data were available for the vertical hydraulic conductivity of the UCRS. Therefore, the intrinsic permeability was estimated from vertical hydraulic conductivity using the following equation.

$$K = k\frac{g}{\nu} \qquad (1)$$

where K = vertical hydraulic conductivity of soil, k = intrinsic permeability of soil, ν = kinematic viscosity of water, and g = gravitational acceleration (Bear 1979). Taking ν = 0.01 cm^2/sec and g = 981 cm/sec^2 (Mills et al. 1985), and substituting in Equation 1 leads to

$$k\left(cm^2\right) = \frac{K\left(cm/\sec\right)}{9.81\, x\, 10^4\left(1/cm - \sec\right)} \qquad (2)$$

The intrinsic permeability was estimated from the saturated vertical hydraulic conductivity using Equation 2.

The site-specific vertical hydraulic conductivities measured earlier were assumed to be representative of that expected in the UCRS at each area. Summary statistics for the site-specific data are in Table F.2.3. A set of 13 results was available (DOE 1997a, DOE 1997b). These results ranged from 1.00E-08 cm/sec to 2.00E-04 cm/sec with a likeliest (mean) value of 1.64E-05 cm/sec. The coefficient of variation was estimated as 336%, and the skewness was estimated as 3.6. Next, the statistics were studied. The maximum value, when used in SESOIL produced an unreasonable recharge; therefore, a second estimate of maximum was sought through calibration. The maximum was re-estimated as 3.20E-05 through calibration to a recharge of 22 cm/yr (DOE 2000). Given that a range and a most likely value could be determined from the site-specific data, a triangular distribution was assumed. The vertical hydraulic conductivity was assumed not correlated to any other parameter. The summary statistics for the values output by Crystal Ball are in Table F.2.4. Histograms for the output values for the resulting intrinsic permeabilities for each of the two source areas are in Figs. F.2.1 and F.2.2.

Deleted: hree
Deleted: , F.2.2,
Deleted: 3

- **Organic Carbon Content:** Site-specific data were available for the organic carbon content of the UCRS. The site-specific organic carbon contents measured earlier were assumed to representative of that expected in the UCRS at each source area. Summary statistics for the site-specific data are in Table F.2.3. A set of 138 results was available. The coefficient of variation was estimated as 66%, and the skewness was estimated as 4.3. Given the coefficient of variation and skewness, a log-normal distribution was assumed. The organic carbon content was assumed not correlated to any other parameter. The summary statistics for the values output by Crystal Ball are in Table F.2.4. Histograms for the output values for organic carbon content for each of the two source areas are in Figs. F.2.3 and F.2.4.

Deleted: three
Deleted: 4, F.2.5,
Deleted: 6

- **Soil Concentration:** Site-specific data were available for the TCE soil concentrations in each source area. Summary statistics for each layer are in Table F.2.3. For SWMU 1, a set of 135 results was available. The coefficient of variation for these results was estimated as 523%, and the skewness was estimated as 6.42. Given the coefficient of variation and skewness, a log-normal distribution was assumed. Using site-specific data, the correlation between Layers 1 and 2 soil concentrations was determined to be 0.92. (Please see Section 4.3 for additional discussion of correlations between layers.) Similar analyses led to choosing the log-normal distribution for Layer 1 at the C-720 area. The correlation coefficients between Layers 1 and 2 for the C-720 area were determined to be 0 and -0.50, respectively. Site-specific data were also available for the soil concentrations in Layer 2 through Layer 6. Summary statistics for each of these layers at each location are in Table F.2.3. For each layer at each location, a log-normal distribution was chosen, and correlations between layers were derived.

As mentioned earlier, a limitation of the SESOIL model required normalization of soil concentrations in each layer at each location to a "uniform area." To accomplish this, the layer with the maximum contaminant mass at each source was used as that source's "uniform area," and a simple ratio was used to normalize each layer's concentration to that of the "uniform area." The summary statistics for the value output by Crystal Ball are in Table F.2.4. Histograms for each layer at each location are in Figs. F.2.5 through F.2.16.

Deleted: SWMU 4 and

Deleted: SWMU 4 and t

Deleted: 7

Deleted: 24

- **Degradation Half-Life/Degradation Rate:** Site-specific data were limited for the degradation half-life of TCE in the UCRS; therefore, a range of half-lives estimated for the RGA (3.2 to 11.3 years) were selected with uniform distribution for the UCRS. (Please see Attachment F.3 of Appendix F for additional information on the estimation of degradation half-life of TCE in the RGA at PGDP.) The degradation half-life was assumed not correlated to any other parameter. Summary statistics for the values output by Crystal Ball are in Table F.2.4. Histograms of the output values for degradation rate for each of the two source areas are in Figs. F.2.17 and F.2.18. Note that only histograms of degradation rate are presented because the rate, and not the half-life, was the value input into SESOIL. Where, the degradation rate is derived from the degradation half-life using the following expression:

Deleted: three

Deleted: 25, F.2.26,

Deleted: 27

$$\lambda = \frac{\ln 2}{t_{1/2}} \qquad (3)$$

where λ = degradation rate (day^{-1}), and $t_{1/2}$ = degradation half-life (days).

An additional scenario termed the "fixed degradation scenario" was also assessed in the probabilistic analysis. The degradation half-life was set equal to 26.6 years for these runs, while the remaining parameters listed above were allowed to vary.

5. AT123D PARAMETERS AND SOURCE TERM MODELING PARAMETERS

Deleted: SECONDARY

The AT123D software was used to simulate contaminant transport from the source areas through the RGA to the POEs. The parameters used for AT123D modeling are listed in Tables F.2.5, F.2.6, and F.2.7. Remarks for each parameter are provided in the table to clarify the source and justification of selected values. Additional remarks for each variable parameter are provided in Table F.2.8. Finally, the summary

Deleted: , and mass balance modeling was used to develop the secondary source terms in the RGA at SWMU 4 (see the discussion in Attachment F.1 of Appendix F).

Deleted: and secondary source term

statistics for each variable parameter sampled output by Crystal Ball and used in the runs for AT123D and source term modeling are provided in Table F.2.9. Histograms of the values output by Crystal Ball for the variable parameters are in Figs. F.2.19 through F.2.24.

Deleted: 28

Deleted: 3

1. **Fixed Parameters:** These parameters are summarized in Tables F.2.5, F.2.6, and F.2.7.

   - **Dispersivity:** The longitudinal dispersivity was set to 1.5 m for each area (DOE 1999). Similarly, the transverse (lateral) dispersivity and the vertical dispersivity were set to 1.5 m and 0.03 m, respectively, for the area.

   - **Bulk Density:** The bulk density of the RGA is 1670 kg/m^3 (DOE 1999). The bulk density was set to this value for each area.

   - **Density of Water:** The density of water was set to 1000 kg/m^3 (Mills et al. 1985).

   - **COC:** As mentioned earlier, the COC was TCE.

   - **Source Area:** The area used in AT123D modeling for each source was the "uniform area" developed for the source in SESOIL modeling.

   - **Diffusion in Water:** The diffusion in water was set to 3.28E-6 m^2/hr (EPA 1996).

   - **K_{oc}:** As mentioned earlier, the K_{oc} was set to 94 L/kg (EPA 1996).

   - **Distance to POEs:** The distance from the center of each source area to the POEs was estimated from plant maps. Each of the POEs was placed at the centerline of the estimated path of contaminant migration.

2. **Variable Parameter:** These parameters are summarized in Tables F.2.5 through F.2.9.

   - **Aquifer Depth (Thickness):** The aquifer depth was allowed to vary in order to account for changes in the thickness of RGA as a contaminant migrates from a source area to the Ohio River. Site-specific data were available from field measurements, and these data were assumed to be applicable to the RGA at each source area and along the estimated contaminant flow paths. A set of 24 results was available. The coefficient of variation was estimated as 31%, and the skewness was estimated as -0.61. Given the coefficient of variation and skewness, the distribution was assumed to be normal. The aquifer depth was assumed not correlated to any other parameter. Summary statistics for the values output by Crystal Ball® and used in runs for AT123D modeling are provided in Table F.2.9. A histogram of the output values for aquifer depth is in Fig. F.2.19. (Note that each source area used the same set of parameters in AT123D modeling; therefore, only one histogram is presented for each of the AT123D variable parameters.)

     Deleted: 28

   - Hydraulic Conductivity: Site specific data were available for the hydraulic conductivity of the RGA, and these data were assumed to be applicable to the RGA at each source area and along the contaminant flow paths. A set of 62 results was available. The data ranged from 1.00E-04 ft/day to 8.50E+05 ft/day with a likeliest value of 1.93E+04 ft/day. The coefficient of variation was estimated as 563%, and the skewness was estimated as 7.53. A value of 1500 ft/day was used in DOE 1999. During model set-up, the range was judged to be too variable given the site-specific soil condition, and a second estimate was

     Deleted: **Hydraulic Conductivity:** Site-

     Formatted: Space After: 12 pt, Bulleted + Level: 2 + Aligned at: 0.75" + Tab after: 1" + Indent at: 1", Adjust space between Latin and Asian text, Adjust space between Asian text and numbers

     Deleted: t

sought from the PGDP groundwater flow model. This estimate was developed using an analysis based upon a plan area from the PGDP site-wide groundwater model and the path of contaminant migration from the source areas to the Ohio River (please see Fig.5.1 of the main report). Based upon this analysis, the minimum, maximum, and most likely values chosen were 75, 1500, and 967 ft/day, respectively. The coefficient of variation was estimated as 65%, and the skewness was estimated as -0.35. Subsequently, the selected most likely value was determined to be inconsistent with probable site conditions, and after consultation with site experts these value was changed to 350 ft/day (i.e., the geometric mean of the minimum and maximum in the plan area). The standard deviation was assumed equal to the likeliest value yielding a coefficient of variation of 100%. Given this coefficient of variation and the skewness from the earlier analyses (i.e., that related to site-specific data and plan area), a log-normal distribution was assumed. In addition, the hydraulic conductivity was assumed correlated to the hydraulic gradient and the porosity. The correlation coefficients selected by site experts were -0.50 and 0.20 for correlating the hydraulic conductivity to the hydraulic gradient and to the porosity, respectively. Summary statistics for the values output by Crystal Ball® and used in runs for AT123D modeling are provided in Table F.2.9. A histogram of the output values for hydraulic conductivity is in Fig. F.2.20.

Formatted: Not Superscript/ Subscript

Deleted: 9

Formatted: Font: Bold

Deleted: H

Hydraulic Gradient: Site-specific data were available for the hydraulic gradient of the RGA, and these data were assumed applicable to the RGA at each source area and along the contaminant flow paths. A set of 12 results was available. The coefficient of variation was estimated as 111%, and the skewness was estimated as 1.95. Given the coefficient of variation and skewness, a log-normal distribution was assumed with minimum, maximum, and most likely values of 1.00E-04, 4.00E-03, and 1.01E-03 m/m, respectively. The standard deviation was set at 1.12E-03 m/m. Additionally, the hydraulic gradient was assumed correlated to the hydraulic conductivity and the porosity. The correlation coefficients were assumed as -0.50 and -0.20 for correlating the hydraulic gradient to the hydraulic conductivity and to the porosity, respectively. Summary statistics for the values output by Crystal Ball® and used in runs for AT123D modeling are provided in Table F.2.9. A histogram of the output values for hydraulic gradient is in Fig. F.2.21.

Deleted: 30

Effective Porosity: Site-specific data were available for the porosity of the RGA; therefore, the effective porosity was estimated from the porosity using a conversion value of 81% taken from DOE 1999. [In that report, an effective porosity of 0.30 and a porosity of 0.37 were reported (i.e., 0.30/0.37 = 0.81 or 81%).] The data were assumed applicable to the RGA at each source area and along the contaminant flow paths. A set of 28 results was available. The minimum, maximum, and most likely values selected for porosity were 27, 54, and 39%. The coefficient of variation was estimated as 15%, and the skewness was estimated as 0.43. Given the coefficient of variation and skewness, a normal distribution was assumed. Additionally, the porosity was assumed correlated to the hydraulic conductivity and the hydraulic gradient. The correlation coefficients were assumed as 0.20 and -0.20 for correlating the porosity to the hydraulic conductivity and to the hydraulic gradient, respectively. Summary statistics for the values output by Crystal Ball® and the resulting effective porosity values used in runs for AT123D modeling are provided in Table F.2.9. A histogram of the effective porosity values is in Fig. F.2.22[1]. Note that only a histogram of effective porosity is presented because effective porosity and not porosity was the value input into AT123D.

Deleted: 31

[1] Future groundwater modeling efforts at PGDP will utilize 35% as a practical upper-bound for effective porosity values.

- **Organic Carbon Content:** Site-specific data were available for the organic carbon content of the RGA, and these data were assumed applicable to the RGA at each source area and along the contaminant flow paths. A set of 38 results was available. The minimum, maximum, and most likely values selected were 3.0E-03, 2.53E-01, and 3.5E-02%, respectively. The coefficient of variation was estimated as 1.05%, and the skewness was estimated as 4.0. Given the coefficient of variation and skewness, a log-normal distribution was assumed. The organic carbon content was assumed not correlated to any other parameter. Summary statistics for the values output by Crystal Ball® and used in runs for AT123D modeling are provided in Table F.2.9. A histogram of the output values for organic carbon content is in Fig. F.2.23.

- **Degradation Half-Life:** Recently, as part of response actions, the U.S. Department of Energy (DOE) has developed revised biodegradation rates that were incorporated into the SI modeling. Attachment F.3 to this appendix presents a detailed discussion of the derivation of the degradation rates. Additionally, the degradation half-life was observed to be correlated with groundwater flow which is a direct function of hydraulic conductivity and hydraulic gradient. However, for this analysis the degradation half-life was assumed 100% correlated to the hydraulic gradient. Summary statistics for the values output by Crystal Ball® and used in runs for AT123D modeling are provided in Table F.2.9. A histogram of the output values for degradation rate is in Fig. F.2.24. Note that only histograms of degradation rate are presented because the rate, and not the half-life, was the value input into AT123D. It should be noted here that although hydraulic gradient assumed a normal distribution, Crystal Ball output for degradation rate presented in Fig. F2.24 does not appear to be normally distributed. An additional scenario termed the "fixed degradation scenario" was also assessed in the probabilistic analysis. No degradation was assumed for these runs, while the remaining parameters listed above were allowed to vary.

6. CORRELATION MATRIX

As mentioned earlier, the soil concentration in each layer was assumed correlated to the adjacent layers for a given area. To estimate the correlation coefficient between two adjacent layers, sets of ordered pairs of concentrations were analyzed. Because data were sparse, ordered pairs were difficult to establish using the sampling date; therefore, the source developed using SADA was used for the estimation. For SADA data, the size and shape of the source areas in the adjacent layers differed; therefore, an ordered pair was formed only in the parts of the source where two layers overlapped.

The correlation values are presented in Table F.2.3.

Formatted: Indent: Left: 0.75"

Deleted: O

Formatted: Bulleted + Level: 2 + Aligned at: 0.75" + Tab after: 1" + Indent at: 1"

Deleted: 2

Deleted: 33

Deleted: 33

Deleted: The degradation half-life was set equal to 0 years

Deleted: <#>**Groundwater Concentration in the RGA**: This parameter was only used for secondary source term modeling for SWMU 4. Site-specific data from SWMU 4 were used to determine groundwater concentrations in the RGA. A set of 99 results was available. The coefficient of variation was estimated as 4.3%, and the skewness was estimated as 9.15. Given the coefficient of variation and skewness, a log-normal distribution was assumed with minimum, maximum, and most likely values of 0.0, 6.7E+4, and 1585 µg/L, respectively. Summary statistics for the values output by Crystal Ball® and used in Monte Carlo runs for AT123D modeling are provided in Table F.2.9. A histogram of the output values for groundwater concentration is in Fig. F.2.34. A discussion on how these groundwater concentrations were used in the development of the secondary source term has already been presented in Attachment F.1 of Appendix F.¶
¶

7. SENSITIVITY ANALYSIS

Although there was not any sensitivity analysis performed under this task to select the parameters that were allowed to vary, previous groundwater modeling efforts at the PGDP have included sensitivity analyses of several of the parameters input into SESOIL and AT123D in order to understand some of the modeling uncertainties. The analyses are included in these documents:

- U-Landfill Design and Analysis (DOE 2002)
- K_d-Sensitivity Analysis (SAIC 2002)
- Northeast and Northwest Plume Groundwater Modeling (BJC 2003)
- Recharge- and Ohio River Stage-Sensitivity Analysis (DOE 2002)

Based on these analyses, the following parameters were determined to be the most sensitive parameters for fate and transport modeling using SESOIL and AT123D:

- Contaminant's concentration in the soil/source term,
- Contaminant's degradation half-life,
- Contaminant's distribution coefficient (K_d) (i.e., directly related to the organic carbon content of source soils for organic compounds)
- Percolation rate (controlled by source vertical permeability)
- Saturated hydraulic conductivity,
- Hydraulic gradient,
- Effective porosity, and
- Aquifer thickness

The contaminant concentration in the source term is one of the most sensitive parameters; increasing the source term concentration increases the predicted groundwater concentration at the POE by increasing contaminant flux and lengthening the time required for depletion of contaminant in the source. The percolation rate is also a very sensitive parameter; increasing the percolation rate results in increased contaminant flux to the RGA and, potentially, a greater peak concentration at the POE. An increased percolation rate, however, is related to faster depletion of contaminant in the source. The contaminant's distribution coefficient, K_d, is a very sensitive parameter for the SESOIL and AT123D models and may rank only behind contaminant concentration in terms of importance. Sensitivity analyses have shown that increasing the K_d of any layer included in the SESOIL model or of the RGA included in the AT123D model decreases contaminant concentrations at the POE because of retardation and attenuation due to sorption. Therefore, with higher K_d's the rate of source depletion is slowed, and the time required for source depletion is increased. Degradation half-life is also important if the time taken for source depletion or required for contaminant migration from the source to the POE is long relative to the contaminant's degradation half-life (i.e., 3 or more times half-life). This is the case because, under this condition, the rate of contaminant degradation in the source or as the contaminant migrates from the source to the POE results in markedly lower contaminant concentrations at the POE.

For AT123D modeling, the earlier sensitivity analyses have identified three additional input parameters. These parameters are hydraulic conductivity, hydraulic gradient, and effective porosity. In the AT123D model, hydraulic conductivity, hydraulic gradient, and effective porosity work together to control seepage velocity (i.e., seepage velocity equals hydraulic conductivity times hydraulic gradient divided by effective porosity), and an increase in seepage velocity increases the rate of contaminant migration to the POE. The values chosen for the Southwest Plume model indicates that the hydraulic gradient varies over a relatively narrow range in the RGA. Therefore, the impact of hydraulic gradient on seepage velocity is expected to be relatively smaller than that of hydraulic conductivity. Table 2.10

presents an overall summary of qualitative sensitivity of modeling results to input parameters for this analysis.

8. REFERENCES

BJC (Bechtel Jacobs Company, LLC) 2003. *Quarterly Modeling Report for the Second Quarter Calendar Year 2003 for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, BJC/PAD-559.

BJC 2001a. C-746-U Solid Waste Landfill Groundwater Monitoring Plan Paducah Gaseous Diffusion Plant Paducah, Kentucky, BJC/PAD-205/R1, December.

BJC 2001b. Groundwater Monitoring Plan for the C-746-S Residential Landfill, Paducah Gaseous Diffusion Plant, Paducah, Kentucky, BJC/PAD-268/R1, December.

Bonazountas, M., and J. Wagner 1984. SESOIL: *A Seasonal Soil Compartment Model*, prepared for the U.S. Environmental Protection Agency, Office of Toxic Substances. Arthur D. Little, Inc., Cambridge, MA.

Decisioneering, Inc. 2000. Crystal Ball® 2000: A user friendly graphically oriented forecasting and risk analysis program. 1515 Arapahoe Street, Denver, CO.

DOE (U.S. Department of Energy) 1995. *Northeast Plume Preliminary Characterization Summary Report*, DOE/OR/07-1339/V2&D2, July.

DOE, 1997a. *Ground-Water Conceptual Model for the Paducah Gaseous Diffusion Plant Paducah, Kentucky*, DOE/OR/06-1628&D0, August.

DOE, 1997b. *Data Summary and Interpretation Report for Interim Remedial Design at Solid Waste Management Unit 2 of Waste Area Grouping 22 at the PGDP Paducah, Kentucky*, DOE/OR/07-1549&D1, February.

DOE 1999. *Remedial Investigation Report for Waste Area Grouping 27 at the Paducah Gaseous Diffusion Plant Paducah, Kentucky*, DOE/OR/07-1777/V4&D2, U.S. Department of Energy, June.

DOE 1999a. *Remedial Investigation Report for Waste Area Grouping 6 at Paducah Gaseous Diffusion Plant Paducah, Kentucky*, DOE/OR/07-1727V1&D2, May.

DOE 1999b. *Remedial Investigation Report for Waste Area Grouping 27 at Paducah Gaseous Diffusion Plant Paducah, Kentucky*, DOE/OR/07-1777V1&D2, June.

DOE 1999c. *Remedial Investigation Report for Waste Area Grouping 6 at Paducah Gaseous Diffusion Plant Paducah, Kentucky*, DOE/OR/07-1727V2&D2, May.

DOE 2000. *Feasibility Study for the Groundwater Operable Unit at Paducah Gaseous Diffusion Plant Paducah, Kentucky*, DOE/OR/07-1857&D1, July.

Deleted: ¶ Bear, J. 1979. *Hydraulics of Groundwater*, McGraw-Hill, New York.¶

Deleted: -

Deleted: rporation

Deleted: (U. S. Department of Energy)

Deleted: , Bechtel Jacobs Company LLC.

Deleted: , Bechtel Jacobs Company LLC.

DOE 2000a. *Data Report for the Sitewide Remedial Evaluation for Source Areas Contributing to Off-Site Groundwater Contamination at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1845/D1, January.

DOE 2000b. *Remedial Investigation Report for Waste Area Grouping 3 at the Paducah Gaseous Diffusion Plan, Paducah, Kentucky*, DOE/OR/07-1895/V2&D1, September.

DOE 2002. *Risk and Performance Evaluation of the C-746-U Landfill at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-2041&D2.

DOE 2003. *Risk and Performance Evaluation of the C-746-U Landfill at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*. DOE/OR/07-2041&D2R1.

DOE 2004. *Site Investigation Report for the Southwest Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-2180&D0, October.

EPA (Environmental Protection Agency) 1994. Risk Reduction Engineering Laboratory (RREL) Treatability Database, ver. 5.0, Office of Research and Development, Cincinnati, OH.

EPA 1996. *Soil Screening Guidance: Technical Background Document*, Office of Solid Waste and Emergency Response, Washington, DC.

GSC (General Sciences Corporation) 1996. RISKPRO®'s SESOIL for Windows, General Sciences Corporation, Laurel, MD.

GSC 1998. RISKPRO®'s AT123D for Windows, Version 3.2. General Sciences Corporation, Laurel, MD.

Howard, P.H., R.S. Boethling, W.F. Jarvis, W.M. Meylan, and E.M. Michalenko, 1991. *Environmental Degradation Rates*, Lewis Publishers, Inc., Chelsea, MI.

KY 1992a. *Report of the Paducah Gaseous Diffusion Plan Groundwater Investigation Phase III*, KY/E-150, November 25.

KY 1992b. *Results of the Site Investigation, Phase II, at the Paducah Gaseous Diffusion Plant*, KY/SUB/13B-97777C P-03/1991/1, April.

KY 1997. *Analysis and Interpretation of Water Levels in Observations Wells at the Paducah Gaseous Diffusion Plant 1990-1997*, KY/EM-210, June 30.

LMES (Lockheed Martin Energy Systems) 1997. *Evaluation of Natural Attenuation Processes for Trichloroethylene and Technetium-99 in the Northeast and Northwest Plumes at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, KY/EM-113, Lockheed Martin Energy Systems.

Mills, W. B., D. B. Porcella, M. J. Ungs, S.A. Gherini, K. V. Summers, Lingfung Mok, G. L. Rupp, G. L. Bowie, and D. A. Hadith 1985. *Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants*, Parts II, EPA-600/6-85/002b, September, U. S. Environmental Protection Agency, Environmental Research Laboratory, Office of Research and Development, Athens, GA.

Deleted: ,

SAIC (Science Applications International Corporation) 2002. Final White Paper on *Sensitivity Analysis on Distribution Coefficient (K_d) Values for TCE and Tc-99 with the Regional Flow and Transport Model at the Paducah Gaseous Diffusion Plant*, submitted to BJC on June 2002.

UT (University of Tennessee) 2002. Spatial Analysis and Decision Assistance (SADA), Version 2.3, User Guide, January. Accessible at http://www.tiem.utk.edu/~sada/.

Yeh, G. T. 1981. *AT123D: Analytical Transient One-, Two-, and Three-Dimensional Simulation of Waste Transport in the Aquifer System*, Environmental Sciences Division, Oak Ridge National Laboratory, Oak Ridge, TN, Publication No. 1439.

Table F.2.1. Sil-specific parameters for SESOIL modeling (see Table F.46a)

Input Parameter	Unit	SWMU 1	C-720 Building	Remark
Soil Type	-	Silty Loam	Silty Loam	DOE 1999
Bulk Density	g/cm^3	1.46	1.46	DOE 1999
Intrinsic Permeability	cm^2	Variable	Variable	Probabilistic method
Disconnectedness Index	-	10	10	Site-specific (to PGDP) approximate value used in earlier work
Porosity	-	0.45	0.45	DOE 1999
Depth to Water Table	m	16.76	18.29	Site-specific (to RGA) field data
Organic Carbon Content	%	Variable	Variable	Probabilistic method
Freundlich Equation Exponent	-	1	1	Default

DOE 1999. *Remedial Investigation Report for Waste Area Grouping 27 at the Paducah Gaseous Diffusion Plant Paducah, Kentucky*, DOE/OR/07-1777/V4&D2, June.
DOE 2000. *Feasibility Study for the Groundwater Operable Unit at Paducah Gaseous Diffusion Plant Paducah, Kentucky*, DOE/OR/07-1857&D1, July.

Deleted: o
Deleted: SWMU 4
Deleted: Silty Loam
Deleted: 1.46
Deleted: Variable
Deleted: 10
Deleted: 0.45
Deleted: 16.76
Deleted: Variable
Deleted: 1

Table F.2.2. Chemical-specific parameters for SESOIL modeling (see Table F.46b)

Input Parameter	Unit	SWMU 1	C-720 Building	Remark
Contaminant of Concern	-	Trichloroethene	Trichloroethene	
Source Area	m^2	324	1394	Site-specific (to TCE) SADA analysis
Soil Concentration - Layer 1	mg/kg	Variable	Variable	Probabilistic method
Soil Concentration - Layer 2	mg/kg	Variable	Variable	Probabilistic method
Soil Concentration - Layer 3	mg/kg	Variable	Variable	Probabilistic method
Soil Concentration - Layer 4	mg/kg	Variable	Variable	Probabilistic method
Soil Concentration - Layer 5	mg/kg	Variable	Variable	Probabilistic method
Soil Concentration - Layer 6	mg/kg	Variable	Variable	Probabilistic method
Molecular Weight	g/gmol	131	131	EPA 1994
Solubility in Water	mg/L	1100	1100	EPA 1996
Diffusion in Air	cm^2/s	0.08	0.08	EPA 1996
Henry's Constant	$atm.m^3/mol$	0.0103	0.0103	EPA 1996
Koc	L/kg	94	94	EPA 1996
Degradation Rate	day^{-1}	Variable	Variable	Probabilistic method

DOE 1999. *Remedial Investigation Report for Waste Area Grouping 27 at the Paducah Gaseous Diffusion Plant Paducah, Kentucky*, DOE/OR/07-1777/V4&D2, June.
EPA 1994. Risk Reduction Engineering Laboratory (RREL) Treatability Database, ver. 5.0, Office of Research and Development, Cincinnati, OH.
EPA 1996. *Soil Screening Guidance: Technical Background Document*, Office of Solid Waste and Emergency Response, Washington, DC.

Deleted: SWMU 4
Deleted: Trichloroethene
Deleted: 3699
Deleted: Variable
Deleted: Variable
Deleted: Variable
Deleted: Variable
Deleted: Variable
Deleted: Variable
Deleted: 131
Deleted: 1100
Deleted: 0.08
Deleted: 0.0103
Deleted: 94
Deleted: Variable

Table F.2.3. Statistics of variable inputs used in Monte Carlo sampling for SESOIL modeling (see Table F.45)

Input Parameter	Statistics	Unit	SWMU 1	C-720 Building	Remark
Vertical Hydraulic Conductivity[a]	Minimum	cm/sec	1.00E-08	1.00E-08	DOE 1997a, DOE 1997b
	Likeliest	cm/sec	1.64E-05	1.64E-05	DOE 1997a, DOE 1997b
	Maximum	cm/sec	2.00E-04	2.00E-04	[b]DOE 1997a, DOE 1997b
	Standard Deviation	cm/sec	5.52E-05	5.52E-05	DOE 1997a, DOE 1997b
	Count	#	13	13	DOE 1997a, DOE 1997b
	Coefficient of Variation	%	336.49	336.49	DOE 1997a, DOE 1997b
	Skew	-	3.60	3.60	DOE 1997a, DOE 1997b
	Maximum	cm/sec	3.20E-05	3.20E-05	[c,d]Recharge-specific (to RGA) calibration
	Distribution	-	Triangular	Triangular	See Section 4.0, Intrinsic Permeability
	Correlation Pair	-	None	None	None
	Correlation Coefficient	-	NA	NA	NA
Organic Carbon Content	Minimum	%	2.48E-02	2.48E-02	Site-specific (to PGDP) field data
	Likeliest	%	8.01E-02	8.01E-02	Site-specific (to PGDP) field data
	Maximum	%	4.55E-01	4.55E-01	Site-specific (to PGDP) field data
	Standard Deviation	%	5.27E-02	5.27E-02	Site-specific (to PGDP) field data
	Count	#	138	138	Site-specific (to PGDP) field data
	Coefficient of Variation	%	65.82	65.82	Site-specific (to PGDP) field data
	Skew	-	4.30	4.30	Site-specific (to PGDP) field data
	Distribution	-	Log normal	Log normal	Site-specific (to PGDP) field data
	Correlation Pair	-	None	None	See Section 4.0, Organic Carbon Content
	Correlation Coefficient	-	NA	NA	NA
Soil Concentration - Layer 1	Minimum	mg/kg	0.00E+00	0.00E+00	Site-specific (to PGDP) field data
	Likeliest	mg/kg	2.14E+00	1.56E+00	Site-specific (to PGDP) field data
	Maximum	mg/kg	8.70E+01	1.70E+01	Site-specific (to PGDP) field data
	Standard Deviation	mg/kg	1.12E+01	5.12E+00	Site-specific (to PGDP) field data
	Count	#	135	11	Site-specific (to PGDP) field data
	Coefficient of Variation	%	522.90	328.48	Site-specific (to PGDP) field data
	Skew	-	6.42	3.32	Site-specific (to PGDP) field data
	Distribution	-	Log normal	Log normal	Site-specific (to PGDP) field data
	Correlation Pair	-	see Layer 2	see Layer 2	Site-specific (to TCE) SADA analysis
	Correlation Coefficient	-	see Layer 2	see Layer 2	Site-specific (to TCE) SADA analysis

Deleted: SWMU 4
Deleted: 1.00E-08
Deleted: 1.64E-05
Deleted: 2.00E-04
Deleted: 5.52E-05
Deleted: 13
Deleted: 336.49
Deleted: 3.60
Deleted: 3.20E-05
Deleted: Triangular
Deleted: None
Deleted: NA
Deleted: 2.48E-02
Deleted: 8.01E-02
Deleted: 4.55E-01
Deleted: 5.27E-02
Deleted: 138
Deleted: 65.82
Deleted: 4.30
Deleted: Log normal
Deleted: None
Deleted: NA
Deleted: 0.00E+00
Deleted: 1.00E-02
Deleted: 1.20E+00
Deleted: 1.10E-01
Deleted: 135
Deleted: 1100.00
Deleted: 9.70
Deleted: Log normal
Deleted: see Layer 2
Deleted: see Layer 2

Table F.2.3. Statistics of variable inputs used in Monte Carlo sampling for SESOIL modeling (see Table F.45) (continued)

Input Parameter	Statistics	Unit	SWMU 1	C-720 Building	Remark
Soil Concentration - Layer 2	Minimum	mg/kg	0.00E+00	0.00E+00	Site-specific (to PGDP) field data
	Likeliest	mg/kg	1.59E+01	1.22E+00	Site-specific (to PGDP) field data
	Maximum	mg/kg	4.39E+02	1.90E+01	Site-specific (to PGDP) field data
	Standard Deviation	mg/kg	7.87E+01	4.23E+00	Site-specific (to PGDP) field data
	Count	#	31	36	Site-specific (to PGDP) field data
	Coefficient of Variation	%	494.84	347.17	Site-specific (to PGDP) field data
	Skew	-	5.53	3.81	Site-specific (to PGDP) field data
	Distribution	-	Log normal	Log normal	Site-specific (to PGDP) field data
	Correlation Pair	-	Layer 1 and Layer 2	Layer 1 with Layer 2	Site-specific (to TCE) SADA analysis
	Correlation Coefficient	-	9.20E-01	-5.00E-01	Site-specific (to TCE) SADA analysis
Soil Concentration - Layer 3	Minimum	mg/kg	0.00E+00	0.00E+00	Site-specific (to PGDP) field data
	Likeliest	mg/kg	7.60E+00	5.94E+00	Site-specific (to PGDP) field data
	Maximum	mg/kg	8.50E+01	6.80E+01	Site-specific (to PGDP) field data
	Standard Deviation	mg/kg	1.82E+01	1.54E+01	Site-specific (to PGDP) field data
	Count	#	32	23	Site-specific (to PGDP) field data
	Coefficient of Variation	%	238.82	258.66	Site-specific (to PGDP) field data
	Skew	-	3.15	3.49	Site-specific (to PGDP) field data
	Distribution	-	Log normal	Log normal	Site-specific (to PGDP) field data
	Correlation Pair	-	Layer 2 and Layer 3	Layer 2 with Layer 3	Site-specific (to TCE) SADA analysis
	Correlation Coefficient	-	3.50E-01	5.90E-01	Site-specific (to TCE) SADA analysis
Soil Concentration - Layer 4	Minimum	mg/kg	0.00E+00	0.00E+00	Site-specific (to PGDP) field data
	Likeliest	mg/kg	5.12E+00	3.87E-01	Site-specific (to PGDP) field data
	Maximum	mg/kg	7.40E+01	1.80E+00	Site-specific (to PGDP) field data
	Standard Deviation	mg/kg	1.46E+01	6.50E-01	Site-specific (to PGDP) field data
	Count	#	27	33	Site-specific (to PGDP) field data
	Coefficient of Variation	%	285.55	168.18	Site-specific (to PGDP) field data
	Skew	-	4.37	1.44	Site-specific (to PGDP) field data
	Distribution	-	Log normal	Log normal	Site-specific (to PGDP) field data
	Correlation Pair	-	Layer 3 and Layer 4	Layer 3 with Layer 4	Site-specific (to TCE) SADA analysis
	Correlation Coefficient	-	2.10E-01	1.60E-01	Site-specific (to TCE) SADA analysis

Deleted: SWMU 4
Deleted: 0.00E+00
Deleted: 4.80E-03
Deleted: 4.00E-01
Deleted: 3.49E-02
Deleted: 140
Deleted: 727.08
Deleted: 10.70
Deleted: Log normal
Deleted: Layer 1 with Layer 2
Deleted: 0.00E+00
Deleted: 0.00E+00
Deleted: 2.30E-01
Deleted: 9.03E+00
Deleted: 1.23E+00
Deleted: 87
Deleted: 534.78
Deleted: 6.43
Deleted: Log normal
Deleted: Layer 2 with Layer 3
Deleted: 0.00E+00
Deleted: 0.00E+00
Deleted: 1.36E+00
Deleted: 4.10E+01
Deleted: 6.41E+00
Deleted: 42
Deleted: 471.32
Deleted: 6.08
Deleted: Log normal
Deleted: Layer 3 with Layer 4
Deleted: 3.60E-01

Table F.2.3. Statistics of variable inputs used in Monte Carlo sampling for SESOIL modeling (see Table F.45) (continued)

Input Parameter	Statistics	Unit	SWMU 1	C-720 Building	Remark
Soil Concentration - Layer 5	Minimum	mg/kg	0.00E+00	0.00E+00	Site-specific (to PGDP) field data
	Likeliest	mg/kg	5.95E+00	2.00E-01	Site-specific (to PGDP) field data
	Maximum	mg/kg	6.60E+01	1.30E+00	Site-specific (to PGDP) field data
	Standard Deviation	mg/kg	1.42E+01	3.69E-01	Site-specific (to PGDP) field data
	Count	#	33	30	Site-specific (to PGDP) field data
	Coefficient of Variation	%	238.99	184.61	Site-specific (to PGDP) field data
	Skew	-	3.24	2.04	Site-specific (to PGDP) field data
	Distribution	-	Log normal	Log normal	Site-specific (to PGDP) field data
	Correlation Pair	-	Layer 4 with Layer 5	Layer 4 with Layer 5	Site-specific (to TCE) SADA analysis
	Correlation Coefficient	-	4.00E-01	9.90E-01	Site-specific (to TCE) SADA analysis
Soil Concentration - Layer 6	Minimum	mg/kg	0.00E+00	0.00E+00	Site-specific (to PGDP) field data
	Likeliest	mg/kg	7.20E-01	1.17E-01	Site-specific (to PGDP) field data
	Maximum	mg/kg	3.40E+00	6.30E-01	Site-specific (to PGDP) field data
	Standard Deviation	mg/kg	1.07E+00	2.04E-01	Site-specific (to PGDP) field data
	Count	#	12	16	Site-specific (to PGDP) field data
	Coefficient of Variation	%	148.61	174.34	Site-specific (to PGDP) field data
	Skew	-	1.71	1.61	Site-specific (to PGDP) field data
	Distribution	-	Log normal	Log normal	Site-specific (to PGDP) field data
	Correlation Pair	-	Layer 5 with Layer 6	Layer 5 with Layer 6	Site-specific (to TCE) SADA analysis
	Correlation Coefficient	-	9.20E-01	5.00E-01	Site-specific (to TCE) SADA analysis
Degradation Half-life	Minimum	yr	3.20E+00	3.20E+00	See Attachment F.3
	Likeliest	yr	NA	NA	NA
	Maximum	yr	1.13E+01	1.13E+01	See Attachment F.3
	Standard Deviation	yr	NA	NA	NA
	Distribution	-	Uniform	Uniform	See Section 4.0, Degradation Half-Life
	Correlation Pair	-	None	None	See Section 4.0, Degradation Half-Life
	Correlation Coefficient	-	NA	NA	NA

Deleted: SWMU 4
Deleted: 0.00E+00
Deleted: 7.40E-01
Deleted: 9.20E+00
Deleted: 2.06E+00
Deleted: 59
Deleted: 278.38
Deleted: 3.11
Deleted: Log normal
Deleted: Layer 4 with Layer 5
Deleted: 3.30E-01
Deleted: 0.00E+00
Deleted: 6.29E+00
Deleted: 1.89E+01
Deleted: 1.09E+01
Deleted: 3
Deleted: 173.13
Deleted: 1.73
Deleted: Log normal
Deleted: Layer 5 with Layer 6
Deleted: 1.00E+00
Deleted: 3.20E+00
Deleted: NA
Deleted: 1.13E+01
Deleted: NA
Deleted: Uniform
Deleted: None
Deleted: NA

Table F.2.3. Statistics of variable inputs used in Monte Carlo sampling for SESOIL modeling (see Table F.45) (continued)

[a] Field observation was available for vertical hydraulic conductivity. Therefore, intrinsic permeability was estimated from vertical hydraulic conductivity.
[b] The maximum from DOE 1997a and DOE 1997b was judged to be high and was re-estimated through calibration.
[c] The maximum was estimated through calibration to a recharge of 22 cm/yr (DOE 2000).
[d] The value selected for probabilistic method.

Howard, P.H., R.S. Boethling, W.F. Jarvis, W.M. Meylan, and E.M. Michalenko, *Environmental Degradation Rates*, Lewis Publishers, Inc. Chelsea, MI, 1991.

LMES (Lockheed Martin Energy Systems) 1997. *Evaluation of Natural Attenuation Processes for Trichloroethylene and Technetium-99 in the Northeast and Northwest Plumes at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, KY/EM-113.

DOE, 1997a. *Ground-Water Conceptual Model for the Paducah Gaseous Diffusion Plant Paducah, Kentucky,* DOE/OR/06-1628&D0, August.

DOE, 1997b. *Data Summary and Interpretation Report for Interim Remedial Design at Solid Waste Management Unit 2 of Waste Area Grouping 22 at the PGDP Paducah, Kentucky,* DOE/OR/07-1549&D1, February.

DOE 2000. *Feasibility Study for the Groundwater Operable Unit at Paducah Gaseous Diffusion Plant Paducah, Kentucky,* DOE/OR/07-1857&D1, July.

Table F.2.4. Statistics of variable inputs used in Monte Carlo runs for SESOIL modeling (see Table F.47)

Input Parameter	Statistics	Unit	SWMU 1	C-720 Building
Vertical Hydraulic Conductivity[a]	Minimum	cm/sec	2.75E-06	2.75E-06
	Median	cm/sec	1.64E-05	1.64E-05
	Maximum	cm/sec	2.82E-05	2.83E-05
	Arithmetic Mean	cm/sec	1.60E-05	1.58E-05
	Standard Deviation	cm/sec	6.57E-06	6.73E-06
Intrinsic Permeability[a]	Minimum	cm^2	2.80E-11	2.80E-11
	Median	cm^2	1.67E-10	1.67E-10
	Maximum	cm^2	2.87E-10	2.89E-10
	Arithmetic Mean	cm^2	1.63E-10	1.61E-10
	Standard Deviation	cm^2	6.70E-11	6.86E-11
Organic Carbon Content[b]	Minimum	mg/kg	2.53E+02	2.67E+02
	Median	mg/kg	6.76E+02	6.86E+02
	Maximum	mg/kg	2.78E+03	3.47E+03
	Arithmetic Mean	mg/kg	7.90E+02	8.37E+02
	Standard Deviation	mg/kg	4.71E+02	5.14E+02
Organic Carbon Content (%)[b]	Minimum	%	2.53E-02	2.67E-02
	Median	%	6.76E-02	6.86E-02
	Maximum	%	2.78E-01	3.47E-01
	Arithmetic Mean	%	7.90E-02	8.37E-02
	Standard Deviation	%	4.71E-02	5.14E-02
Soil Concentration - Layer 1[c]	Minimum	mg/kg	2.86E-03	2.33E-03
	Median	mg/kg	5.73E-01	2.37E-01
	Maximum	mg/kg	3.58E+01	4.63E+00
	Arithmetic Mean	mg/kg	2.37E+00	6.46E-01
	Standard Deviation	mg/kg	5.15E+00	1.03E+00
Soil Concentration - Layer 2[c]	Minimum	mg/kg	6.03E-02	5.20E-03
	Median	mg/kg	3.64E+00	2.14E-01
	Maximum	mg/kg	1.88E+02	5.80E+00
	Arithmetic Mean	mg/kg	1.41E+01	5.95E-01
	Standard Deviation	mg/kg	3.09E+01	1.12E+00
Soil Concentration - Layer 3[c]	Minimum	mg/kg	1.28E-01	2.34E-02
	Median	mg/kg	5.80E+00	1.67E+00
	Maximum	mg/kg	1.02E+02	4.82E+01
	Arithmetic Mean	mg/kg	1.14E+01	5.08E+00
	Standard Deviation	mg/kg	1.63E+01	8.66E+00
Soil Concentration - Layer 4[c]	Minimum	mg/kg	1.28E-01	5.11E-03
	Median	mg/kg	2.78E+00	7.76E-02
	Maximum	mg/kg	1.15E+02	5.91E-01
	Arithmetic Mean	mg/kg	8.93E+00	1.24E-01
	Standard Deviation	mg/kg	1.62E+01	1.23E-01
Soil Concentration - Layer 5[c]	Minimum	mg/kg	1.26E-01	1.01E-03
	Median	mg/kg	4.39E+00	3.56E-02
	Maximum	mg/kg	7.50E+01	4.01E-01
	Arithmetic Mean	mg/kg	1.04E+01	6.09E-02
	Standard Deviation	mg/kg	1.44E+01	6.68E-02

Deleted: SWMU 4
Deleted: 2.75E-06
Deleted: 1.59E-05
Deleted: 2.94E-05
Deleted: 1.58E-05
Deleted: 6.41E-06
Deleted: 2.80E-11
Deleted: 1.62E-10
Deleted: 2.99E-10
Deleted: 1.61E-10
Deleted: 6.53E-11
Deleted: 2.62E+02
Deleted: 6.78E+02
Deleted: 4.11E+03
Deleted: 8.21E+02
Deleted: 5.79E+02
Deleted: 2.62E-02
Deleted: 6.78E-02
Deleted: 4.11E-01
Deleted: 8.21E-02
Deleted: 5.79E-02
Deleted: 1.36E-06
Deleted: 1.02E-03
Deleted: 1.14E+00
Deleted: 2.50E-02
Deleted: 1.18E-01
Deleted: 8.58E-06
Deleted: 7.50E-04
Deleted: 6.68E-02
Deleted: 4.44E-03
Deleted: 1.02E-02
Deleted: 1.75E-04
Deleted: 2.71E-02
Deleted: 4.65E+00
Deleted: 1.86E-01
Deleted: 5.39E-01
Deleted: 5.32E-03
Deleted: 2.30E-01
Deleted: 2.13E+01
Deleted: 1.05E+00
Deleted: 2.53E+00
Deleted: 3.86E-03
Deleted: 3.25E-01
Deleted: 1.21E+01
Deleted: 1.08E+00
Deleted: 2.02E+00

Table F.2.4. Statistics of variable inputs used in Monte Carlo runs for SESOIL modeling (see Table F.47) (continued)

Input Parameter	Statistics	Unit	SWMU 1	C-720 Building
Soil Concentration - Layer 6[c]	Minimum	mg/kg	5.30E-02	7.50E-04
	Median	mg/kg	1.04E+00	1.95E-02
	Maximum	mg/kg	6.65E+00	1.92E-01
	Arithmetic Mean	mg/kg	1.55E+00	3.31E-02
	Standard Deviation	mg/kg	1.53E+00	3.63E-02
Degradation Half-Life[d]	Minimum	yr	3.2	3.2
	Median	yr	4.9	4.9
	Maximum	yr	11.3	11.3
	Arithmetic Mean	yr	4.9	4.9
	Standard Deviation	yr	NA	NA
Degradation Rate[d]	Minimum	/hr	7.13E-06	7.21e-06
	Median	/hr	1.22E-05	1.13E-05
	Maximum	/hr	2.43E-05	2.43E-05
	Arithmetic Mean	/hr	1.32E-05	1.30E-05
	Standard Deviation	/hr	NA	NA

[a] Intrinsic permeability (cm^2) was estimated from the vertical hydraulic conductivity (cm/sec) using a conversion factor of 1.019E-5.
[b] Organic carbon content (%) was estimated from organic carbon content (mg/kg) using a conversion factor of 1E-4.
[c] Soil concentrations are normalized using the volume of the layer with the largest mass.
[d] Degradation rate was estimated from degradation half-life in units of days using the formula: rate = [(ln 2)/degradation half-life].

Deleted: SWMU 4
Deleted: 3.66E-01
Deleted: 5.35E+00
Deleted: 3.20E+01
Deleted: 8.65E+00
Deleted: 8.14E+00
Deleted: 3.2
Deleted: 4.9
Deleted: 11.3
Deleted: 4.9
Deleted: NA
Deleted: 7.13E-06
Deleted: 1.20E-05
Deleted: 2.43E-05
Deleted: 1.30E-05
Deleted: NA

Table F.2.5. Hydrogeology-specific parameters for AT123D modeling (see Table F.49)

Input Parameter	Unit	SWMU 1	C-720 Building	Remark
Aquifer Thickness	m	Variable	Variable	Probabilistic method
Hydraulic Conductivity	m/hr	Variable	Variable	Probabilistic method
Hydraulic Gradient	m/m	Variable	Variable	Probabilistic method
Effective Porosity	-	Variable	Variable	Probabilistic method
Organic Carbon Content	%	Variable	Variable	Probabilistic method
Dispersivity - Longitudinal	m	15	15	DOE 1999
Dispersivity - Transverse	m	1.5	5	DOE 1999
Dispersivity - Vertical	m	0.03	5	DOE 1999
Bulk Density	kg/m^3	1670	1670	DOE 1999
Density of Water	kg/m^3	1000	1000	Mills et al. 1985

Deleted: SWMU 4
Deleted: Variable
Deleted: Variable
Deleted: Variable
Deleted: Variable
Deleted: Variable
Deleted: 15
Deleted: 5
Deleted: 5
Deleted: 1670
Deleted: 1000

DOE 1999. *Remedial Investigation Report for Waste Area Grouping 27 at the Paducah Gaseous Diffusion Plant Paducah, Kentucky*, DOE/OR/07-1777/V4&D2, June.

Mills, W. B., D. B. Porcella, M. J. Ungs, S. A. Gherini, K. V. Summers, Lingfung Mok, G. L. Rupp, G. L. Bowie, and D. A. Hadith, 1985. *Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants, Parts II*, EPA-600/6-85/002b, September, U.S. Environmental Protection Agency, Environmental Research Laboratory, Office of Research and Development, Athens, GA.

Table F.2.6. Chemical-specific parameters for AT123D modeling (see Table F.49)

Input Parameter	Unit	SWMU 1	C-720 Building	Remark
Contaminant of Concern	-	Trichloroethene	Trichloroethene	Selected for analysis
Source Area	m^2	324	1394	Site-specific (to TCE) SADA analysis
Diffusion in Water	m^2/hr	3.28E-06	3.28E-06	EPA 1996
Koc	L/kg	94	94	EPA 1996
Degradation Rate (half-life)[a]	hr^{-1} (year)	Variable	Variable	Attachment F.3

Deleted: SWMU 4
Deleted: Trichloroethene
Deleted: 3699
Deleted: 3.28E-06
Deleted: 94
Deleted: Variable

[a] Degradation rate was estimated from degradation half-life (see text).

EPA 1996. *Soil Screening Guidance: Technical Background Document*, Office of Solid Waste and Emergency Response, Washington, D.C.

Table F.2.7. POE-specific parameters for AT123D modeling (see Table F.51)

Input Parameter	Unit	SWMU 1	C-720 Area	Remark
Distance to Plant Boundary	m (ft)	170 (558)	762 (2500)	See Fig. F.20
Distance to Property Boundary	m (ft)	915 (3000)	1460 (4789)	See Fig. F.20
Distance to Ohio River	m (ft)	7317 (24000)	7927 (26000)	See Fig. F.20

Deleted: SWMU 4
Deleted: 300 (984)
Deleted: 915 (3000)
Deleted: 7012 (23000)

Table F.2.8. Statistics of variable inputs used in Monte Carlo sampling for AT123D modeling (see Table F.48)

Input Parameter	Statistics	SWMU 1 and C-720 Building				Remark
		Crystal Ball	Unit	AT123D	Unit	
Aquifer Thickness	Minimum Value	10.00	ft	3.05	m	DOE 1995, DOE 1997a, DOE 1997b, DOE 2000a, DOE 2000b, DOE 2004, KY 1992b
	Likeliest Value	38.71	ft	11.80	m	DOE 1995, DOE 1997a, DOE 1997b, DOE 2000a, DOE 2000b, DOE 2004, KY 1992b
	Maximum Value	63.50	ft	19.36	m	DOE 1995, DOE 1997a, DOE 1997b, DOE 2000a, DOE 2000b, DOE 2004, KY 1992b
	Standard deviation	11.84	ft	3.61	m	DOE 1995, DOE 1997a, DOE 1997b, DOE 2000a, DOE 2000b, DOE 2004, KY 1992b
	Count	24	#	24	#	DOE 1995, DOE 1997a, DOE 1997b, DOE 2000a, DOE 2000b, DOE 2004, KY 1992b
	Coefficient of Variation	30.59	%	30.59	%	DOE 1995, DOE 1997a, DOE 1997b, DOE 2000a, DOE 2000b, DOE 2004, KY 1992b
	Skew	-0.61	-	-0.61	-	DOE 1995, DOE 1997a, DOE 1997b, DOE 2000a, DOE 2000b, DOE 2004, KY 1992b
	Distribution	Normal	-	Normal	-	DOE 1995, DOE 1997a, DOE 1997b, DOE 2000a, DOE 2000b, DOE 2004, KY 1992b
	Correlation pair	None	-	None	-	Assumed none
	Correlation coefficient	NA	-	NA	-	NA
Hydraulic Conductivity	Minimum Value	1.00E-04	ft/day	1.27E-06	m/hr	[a] BJC 2001a, BJC 2001b, DOE 1997a, DOE 1997b, DOE 1999a, DOE 1999b, DOE 1999c, KY 1992a
	Likeliest Value	1.93E+04	ft/day	2.46E+02	m/hr	[a] BJC 2001a, BJC 2001b, DOE 1997a, DOE 1997b, DOE 1999a, DOE 1999b, DOE 1999c, KY 1992a
	Maximum Value	8.50E+05	ft/day	1.08E+04	m/hr	[a] BJC 2001a, BJC 2001b, DOE 1997a, DOE 1997b, DOE 1999a, DOE 1999b, DOE 1999c, KY 1992a
	Standard deviation	1.09E+05	ft/day	1.38E+03	m/hr	[a] BJC 2001a, BJC 2001b, DOE 1997a, DOE 1997b, DOE 1999a, DOE 1999b, DOE 1999c, KY 1992a
	Count	62	#	62	#	[a] BJC 2001a, BJC 2001b, DOE 1997a, DOE 1997b, DOE 1999a, DOE 1999b, DOE 1999c, KY 1992a
	Coefficient of Variation	563.17	%	563.17	%	[a] BJC 2001a, BJC 2001b, DOE 1997a, DOE 1997b, DOE 1999a, DOE 1999b, DOE 1999c, KY 1992a
	Skew	7.53	-	7.53	-	[a] BJC 2001a, BJC 2001b, DOE 1997a, DOE 1997b, DOE 1999a, DOE 1999b, DOE 1999c, KY 1992a

Deleted: , SWMU 4,

Table F.2.8. Statistics of variable inputs used in Monte Carlo sampling for AT123D modeling (see Table F.48) (continued)

Deleted: , SWMU 4,

		SWMU 1 and C-720 Building				
Input Parameter	**Statistics**	**Crystal Ball**	**Unit**	**AT123D**	**Unit**	**Remark**
Hydraulic Conductivity	Minimum Value	75.00	ft/day	0.95	m/hr	[a] PGDP Groundwater flow model
	Likeliest Value	966.85	ft/day	12.28	m/hr	[a] PGDP Groundwater flow model
	Maximum Value	1500.00	ft/day	19.05	m/hr	[a] PGDP Groundwater flow model
	Standard deviation	628.74	ft/day	7.99	m/hr	[a] PGDP Groundwater flow model
	Count	12166	#	12166	#	[a] PGDP Groundwater flow model
	Coefficient of Variation	65.03	%	65.03	%	[a] PGDP Groundwater flow model
	Skew	-0.35	-	-0.35	-	[a] PGDP Groundwater flow model
Hydraulic Conductivity	Minimum Value	75.00	ft/day	0.95	m/hr	[a,b] Minimum of the site-specific (to PGDP) groundwater flow model
	Likeliest Value	350.00	ft/day	4.45	m/hr	[a,b] Assumed approximate geomean of the minimum and maximum of the site-specific (to PGDP) groundwater flow model
	Maximum Value	1500.00	ft/day	19.05	m/hr	[a,b] Maximum of the site-specific (to PGDP) groundwater flow model
	Standard deviation	350.00	ft/day	4.45	m/hr	[a,b] Assumed equal to likeliest value
	Coefficient of Variation	100.00	%	100.00	%	[a,b] Assumed equal to likeliest value
	Distribution	Log normal	-	Log normal	-	BJC 2001a, BJC 2001b, DOE 1997a, DOE 1997b, DOE 1999a, DOE 1999b, DOE 1999c, KY 1992a
	Correlation pair	Hydraulic Conductivity and Porosity	-	Hydraulic Conductivity and Porosity	-	Assumed
	Correlation coefficient	NA	-	NA	-	NA
Hydraulic Gradient	Minimum Value	1.00E-04	ft/ft	1.00E-04	m/m	BJC 2001a, DOE 1997a, DOE 1997b, DOE 1997, KY 1992a, KY 1997
	Likeliest Value	1.01E-03	ft/ft	1.01E-03	m/m	BJC 2001a, DOE 1997a, DOE 1997b, DOE 1997, KY 1992a, KY 1997
	Maximum Value	4.00E-03	ft/ft	4.00E-03	m/m	BJC 2001a, DOE 1997a, DOE 1997b, DOE 1997, KY 1992a, KY 1997
	Standard deviation	1.12E-03	ft/ft	1.12E-03	m/m	BJC 2001a, DOE 1997a, DOE 1997b, DOE 1997, KY 1992a, KY 1997
	Count	12	#	12	#	BJC 2001a, DOE 1997a, DOE 1997b, DOE 1997, KY 1992a, KY 1997
	Coefficient of Variation	110.89	%	110.89	%	BJC 2001a, DOE 1997a, DOE 1997b, DOE 1997, KY 1992a, KY 1997
	Skew	1.95	-	1.95	-	BJC 2001a, DOE 1997a, DOE 1997b, DOE 1997, KY 1992a, KY 1997
	Distribution	Normal	-	Normal	-	BJC 2001a, DOE 1997a, DOE 1997b, DOE 1997, KY 1992a, KY 1997
Hydraulic Gradient	Correlation pair	Hydraulic Conductivity and Hydraulic Gradient	-	Hydraulic Conductivity and Hydraulic Gradient	-	Assumed

Table F.2.8. Statistics of variable inputs used in Monte Carlo sampling for AT123D modeling (see Table F.48) (continued)

Input Parameter	Statistics	SWMU 1 and C-720 Building				Remark
		Crystal Ball	Unit	AT123D	Unit	
	Correlation coefficient	-0.50	-	-0.50	-	Assumed
Porosity [c]	Minimum Value	27.00	%	27.00	%	DOE 1997a, DOE 1999a, DOE 1999c
	Likeliest Value	39.11	%	39.11	%	DOE 1997a, DOE 1999a, DOE 1999c
	Maximum Value	54.00	%	54.00	%	DOE 1997a, DOE 1999a, DOE 1999c
	Standard deviation	5.98	%	5.98	%	DOE 1997a, DOE 1999a, DOE 1999c
	Count	28	#	28	#	DOE 1997a, DOE 1999a, DOE 1999c
	Coefficient of Variation	15.29	%	15.29	%	DOE 1997a, DOE 1999a, DOE 1999c
	Skew	0.43	-	0.43	-	DOE 1997a, DOE 1999a, DOE 1999c
	Distribution	Normal	-	Normal	-	DOE 1997a, DOE 1999a, DOE 1999c
	Correlation pair	Hydraulic Gradient and Porosity	-	Hydraulic Gradient and Porosity	-	Assumed
	Correlation coefficient	-0.20	-	-0.20	-	Assumed
Organic Carbon Content	Minimum Value	0.003	%	0.003	%	KY 1992a, DOE 1997a, BJC 2006
	Likeliest Value	0.035	%	0.035	%	KY 1992a, DOE 1997a, BJC 2006
	Maximum Value	0.253	%	0.253	%	KY 1992a, DOE 1997a, BJC 2006
	Standard deviation	0.037	%	0.037	%	KY 1992a, DOE 1997a, BJC 2006
	Count	38	#	38	#	KY 1992a, DOE 1997a, BJC 2006
	Coefficient of Variation	1.05	%	1.05	%	KY 1992a, DOE 1997a, BJC 2006
	Skew	4.00	-	4.00	-	KY 1992a, DOE 1997a, BJC 2006
	Distribution	Log normal	-	Log normal	-	KY 1992a, DOE 1997a, BJC 2006
	Correlation pair	None	-	None	-	Assumed
	Correlation coefficient	NA	-	NA	-	NA

Deleted: , SWMU 4,

Table F.2.8. Statistics of variable inputs used in Monte Carlo sampling for AT123D modeling (see Table F.48) (continued)

Deleted: , SWMU 4,

Input Parameter	Statistics	SWMU 1 and C-720 Building				Remark
		Crystal Ball	Unit	AT123D	Unit	
Degradation Half-Life	Minimum Value	3.2	yr	NA	-	[d] See Attachment F.3
	Likeliest Value	NA	-	NA	-	NA
	Maximum Value	11.3	yr	NA	-	[d] See Attachment F.3
	Standard deviation	NA	-	NA	-	NA
	Count	NA	-	NA	-	NA
	Coefficient of Variation	NA	-	NA	-	NA
	Skew	NA	-	NA	-	NA
	Distribution	Uniform	-	NA	-	[d] See Attachment F.3
	Correlation pair	Hydraulic Gradient and Degradation Rate	-	NA	-	Assumed
	Correlation coefficient	-1.00	-	NA	-	[d] See Attachment F.3
Degradation Rate	Minimum Value	NA	-	7.01E-06	/hr	[d] See Attachment F.3
	Likeliest Value	NA	-	NA	-	NA
	Maximum Value	NA	-	2.45E-05	/hr	[d] See Attachment F.3
	Standard deviation	NA	-	NA	-	NA
	Count	NA	-	NA	-	NA
	Coefficient of Variation	NA	-	NA	-	NA
	Skew	NA	-	NA	-	NA
	Distribution	NA	-	Uniform	-	[d] See Attachment F.3
	Correlation pair	NA	-	Hydraulic Gradient and Degradation Rate	-	Assumed
	Correlation coefficient	NA	-	-1.00	-	[d] See Attachment F.3

[a] Multiple values were noted.
[b] The value selected for probabilistic method.
[c] Field observation was available for porosity. Therefore, effective porosity was estimated from porosity.
[d] Degradation rate was estimated from degradation half-life in units of hours using the formula: rate = [(ln 2)/degradation half-life].

BJC 2001a. C-746-U Solid Waste Landfill Groundwater Monitoring Plan Paducah Gaseous Diffusion Plant Paducah, Kentucky. BJC/PAD-205/R1, December.
BJC 2001b. Groundwater Monitoring Plan for the C-746-S Residential Landfill Paducah Gaseous Diffusion Plant Paducah, Kentucky. BJC/PAD-268/R1, December.

Table F.2.8. Statistics of variable inputs used in Monte Carlo sampling for AT123D modeling (see Table F.48) (continued)

		SWMU 1 and C-720 Building				
Input Parameter	**Statistics**	**Crystal Ball**	**Unit**	**AT123D**	**Unit**	**Remark**

Deleted: , SWMU 4,

BJC 2006.

DOE 1995. *Northeast Plume Preliminary Characterization Summary Report*, DOE/OR/07-1339/V2 & D2, July.

DOE 1997a. *Data Summary and Interpretation Report for Interim Remedial Design at Solid Waste Management Unit 2 of Waste Area Grouping 22 at the PGDP Paducah, Kentucky*, DOE/OR/07-1549&D1, February.

DOE 1997b. *Ground-Water Conceptual Model for the Paducah Gaseous Diffusion Plant Paducah, Kentucky*, DOE/OR/06-1628&D0, August.

DOE 1999a. *Remedial Investigation Report for Waste Area Grouping 6 at Paducah Gaseous Diffusion Plant Paducah, Kentucky*, DOE/OR/07-1727V1&D2, May.

DOE 1999b. R*emedial Investigation Report for Waste Area Grouping 27 at Paducah Gaseous Diffusion Plant Paducah, Kentucky*, DOE/OR/07-1777V1&D2, June.

DOE 1999c. *Remedial Investigation Report for Waste Area Grouping 6 at Paducah Gaseous Diffusion Plant Paducah, Kentucky*, DOE/OR/07-1727V2&D2, May.

DOE 2000a. *Data Report for the Sitewide Remedial Evaluation for Source Areas Contributing to Off-Site Groundwater Contamination at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1845/D1, January.

DOE 2000b. *Remedial Investigation Report for Waste Area Grouping 3 at the Paducah Gaseous Diffusion Plan, Paducah, Kentucky,* DOE/OR/07-1895/V2&D1, September.

DOE 2004. *Site Investigation Report for the Southwest Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-2180&D0, October.

KY 1992a. R*eport of the Paducah Gaseous Diffusion Plan Groundwater Investigation Phase III,* KY/E-150, November 25.

KY 1992b. *Results of the Site Investigation, Phase II, at the Paducah Gaseous Diffusion Plant,* KY/SUB/13B-97777C P-03/1991/1, April.

KY 1997. *Analysis and Interpretation of Water Levels in Observations Wells at the Paducah Gaseous Diffusion Plant 1990-1997,* KY/EM-210, June 30.

Table F.2.9. Statistics of variable inputs used in Monte Carlo runs for Source Term development and AT123D modeling (see Table F.50)

Input Parameter	[c] Statistics	Unit	SWMU 1 and C-720 Building
Aquifer Depth	Minimum	m	3.38
	Median	m	11.30
	Maximum	m	18.50
	Arithmetic Mean	m	10.90
	[c] Standard Deviation	m	3.44
Hydraulic Conductivity	Minimum	m/hr	0.97
	Median	m/hr	3.54
	Maximum	m/hr	17.60
	Arithmetic Mean	m/hr	4.77
	[c] Standard Deviation	m/hr	3.70
Hydraulic Gradient	Minimum	m/m	1.63E-04
	Median	m/m	1.37E-03
	Maximum	m/m	3.98E-03
	Arithmetic Mean	m/m	1.49E-03
	[c] Standard Deviation	m/m	9.20E-04
Porosity	[a] Minimum	%	27.16
	Median	%	38.27
	Maximum	%	53.09
	Arithmetic Mean	%	39.51
	[c] Standard Deviation	%	6.17
Effective Porosity	[a] Minimum	-	0.22
	Median	-	0.31
	Maximum	-	0.43
	Arithmetic Mean	-	0.32
	[c] Standard Deviation	-	0.05
Organic Carbon Content	Minimum	%	0.003
	Median	%	0.024
	Maximum	%	0.228
	Arithmetic Mean	%	0.034
	[c] Standard Deviation	%	0.034
Degradation Half-Life	[b] Minimum	yr	3.2
	Median	yr	4.9
	Maximum	yr	11.3
	Arithmetic Mean	yr	4.9
	[c] Standard Deviation	yr	NA
Degradation Rate	[b] Minimum	/hr	7.20E-06
	Median	/hr	1.62E-05
	Maximum	/hr	2.45E-05
	Arithmetic Mean	/hr	1.61E-05
	[c] Standard Deviation	/hr	NA

Deleted: , SWMU 4,

Table F.2.9. Statistics of variable inputs used in Monte Carlo runs for AT123D modeling (see Table F.50) (continued)

Input Parameter	Statistics	Unit	SWMU 1 and C-720 Building
Groundwater Concentration in the RGA[c]	Minimum	μg/L	2.92
	Median	μg/L	362.7
	Maximum	μg/L	25311
	Arithmetic Mean	μg/L	2138.6
	[c] Standard Deviation	μg/L	4534.8
Total Soil Concentration Derived from Groundwater Concentrations[c]	Minimum	mg/kg	7.25E-04
	Median	mg/kg	9.73E-02
	Maximum	mg/kg	5.68E+00
	Arithmetic Mean	mg/kg	5.72E-01
	[c] Standard Deviation	mg/kg	1.18E+00

Deleted: , SWMU 4,

[a] Effective porosity was estimated from porosity (see text).
[b] Degradation rate was estimated from degradation half-life in units of hours using the formula: rate = [(ln 2)/degradation half-life].
[c] This parameter was only used for secondary source term modeling.

Table F.2.10. Qualitative sensitivity of modeling results to input parameters for the Southwest Plume SI Report

Input Parameter	Degree of sensitivity Low	Medium	High
Bulk density	√		
Effective porosity		√	
Horizontal hydraulic conductivity in the RGA		√	
Vertical hydraulic conductivity in the UCRS	√		
Percolation rate		√	
Horizontal hydraulic gradient in the RGA		√	
Aquifer thickness	√		
Longitudinal dispersivity	√		
Soil-water partition coefficient (K_d)			√
Fraction of organic carbon (%)			√
Biodegradation half-life			√
Molecular diffusion	√		
Source Area		√	
Source term in the UCRS			√

Deleted: Source term in the RGA ... [1]

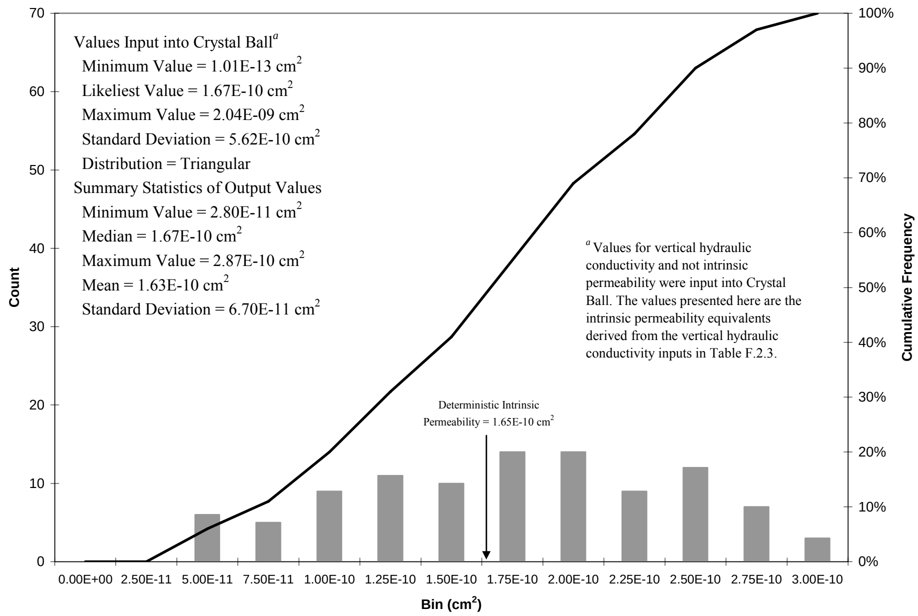


Fig. F.2.1. Histogram of Intrinsic Permeability SESOIL inputs for SWMU 1.

Deleted: <sp>

Deleted: **Fig. F.2.2. Histogram of Intrinsic Permeability SESOIL inputs for SWMU 4.**

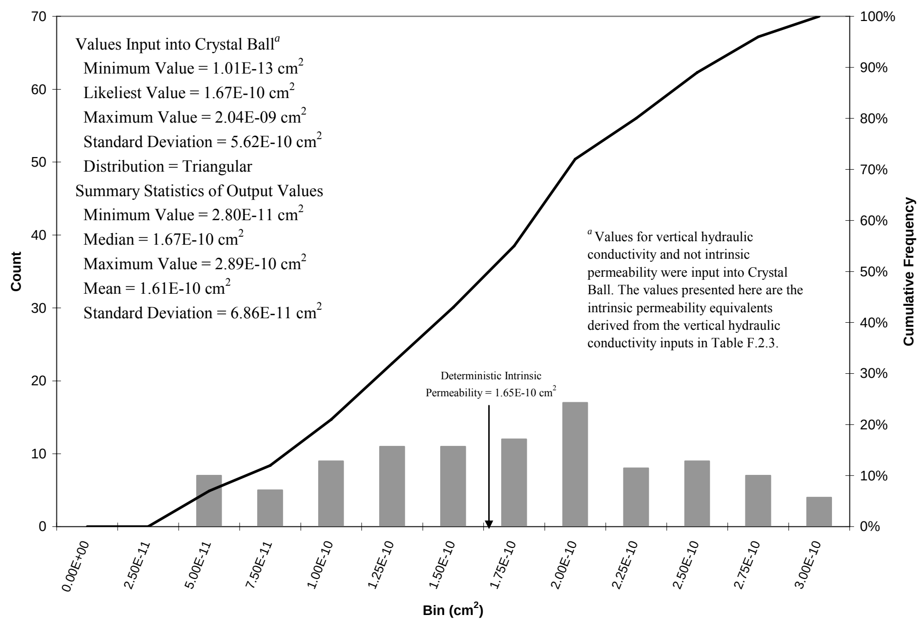


Fig. F.2.2. Histogram of Intrinsic Permeability SESOIL inputs for the C-720 Area.

Deleted: 3

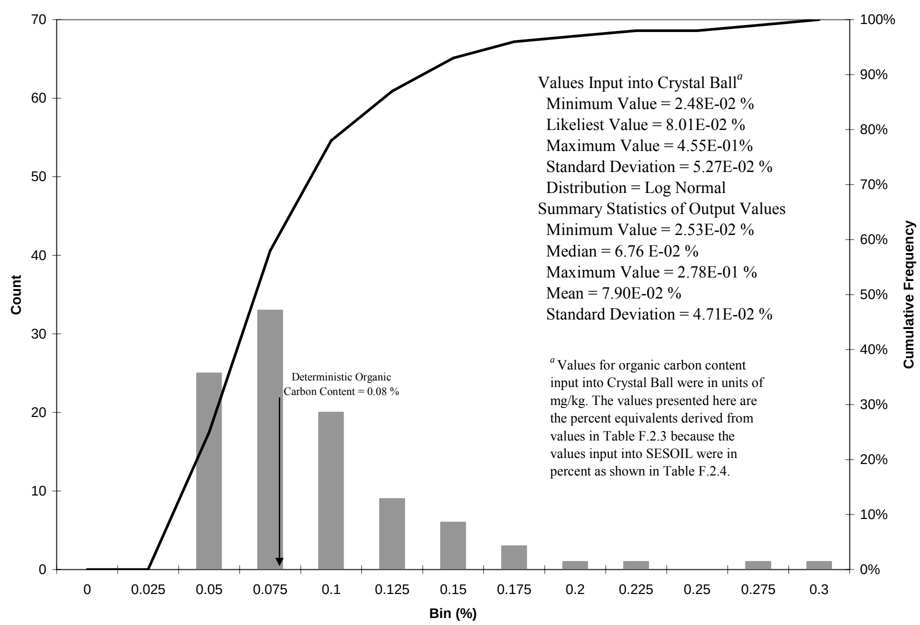


Fig. F.2.3. Histogram of Organic Carbon Content SESOIL inputs for SWMU 1.

Deleted: 4

Deleted: <sp><sp>

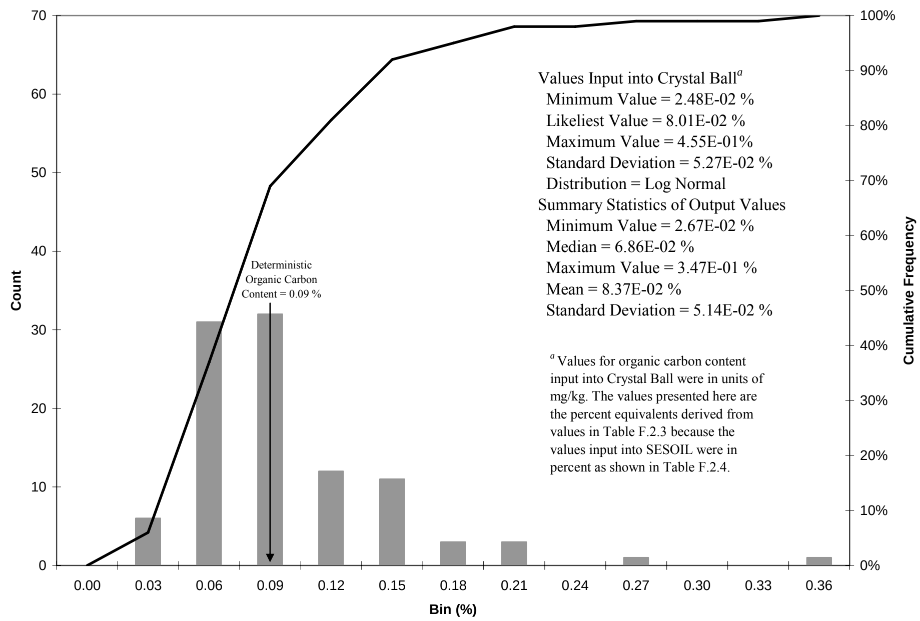


Fig. F.2.4. Histogram of Organic Carbon Content SESOIL inputs for the C-720 Area.

Deleted: 6

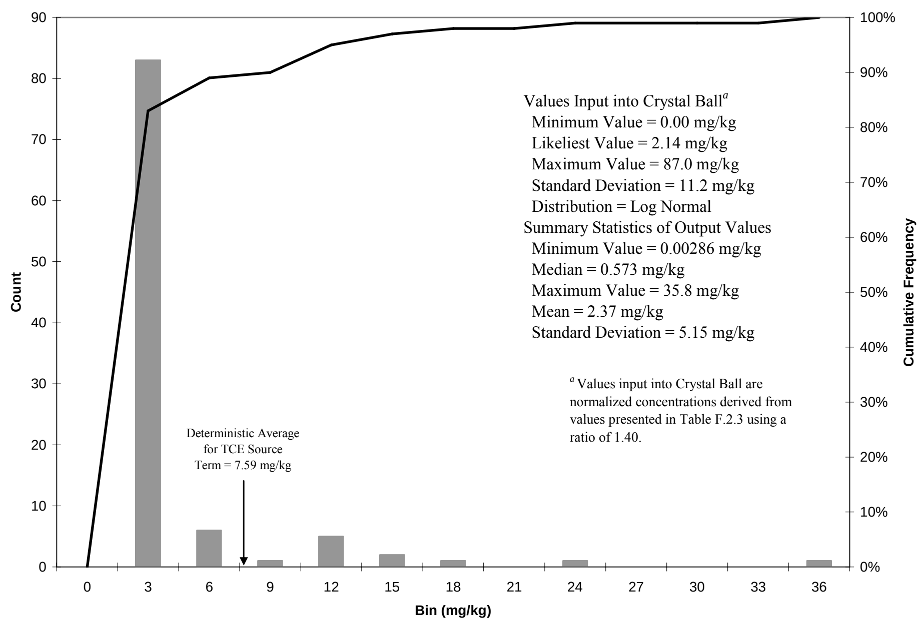


Fig. F.2.5. Histogram of Layer 1 TCE concentrations at SWMU 1 used as SESOIL inputs.

Deleted: 7

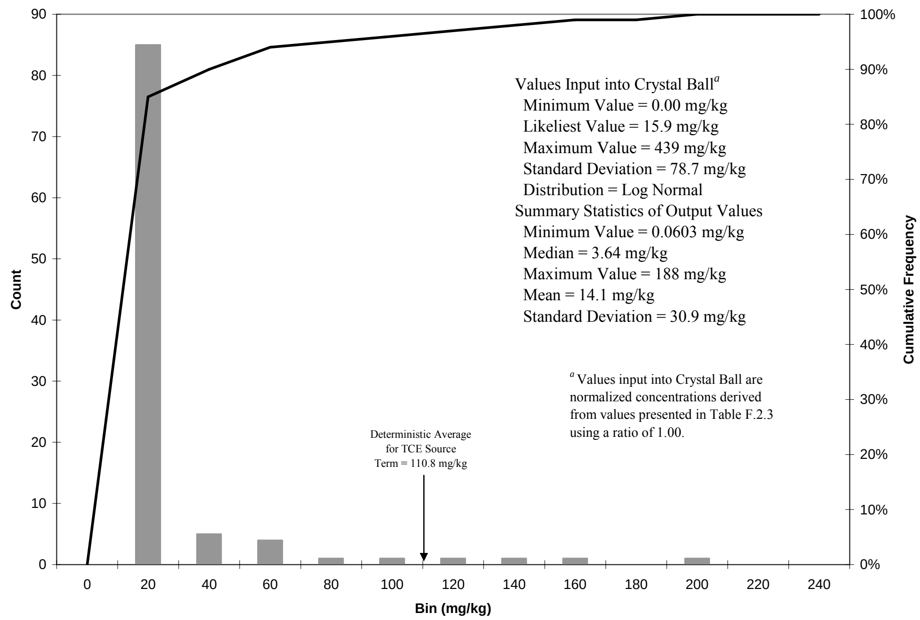


Fig. F.2.6. Histogram of Layer 2 TCE concentrations at SWMU 1 used as SESOIL inputs.

Deleted: 8

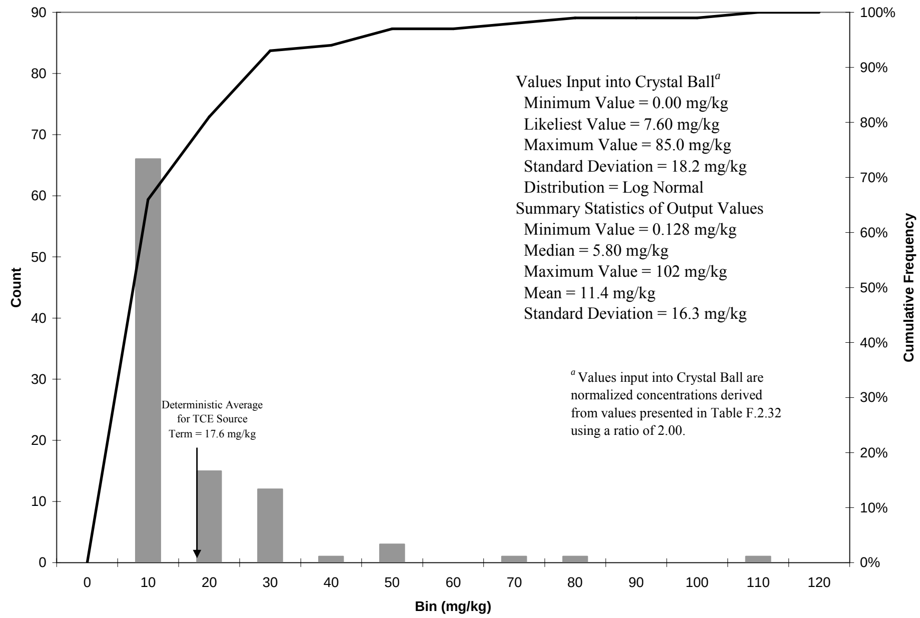


Fig. F.2.7. Histogram of Layer 3 TCE concentrations at SWMU 1 used as SESOIL inputs.

Deleted: 9

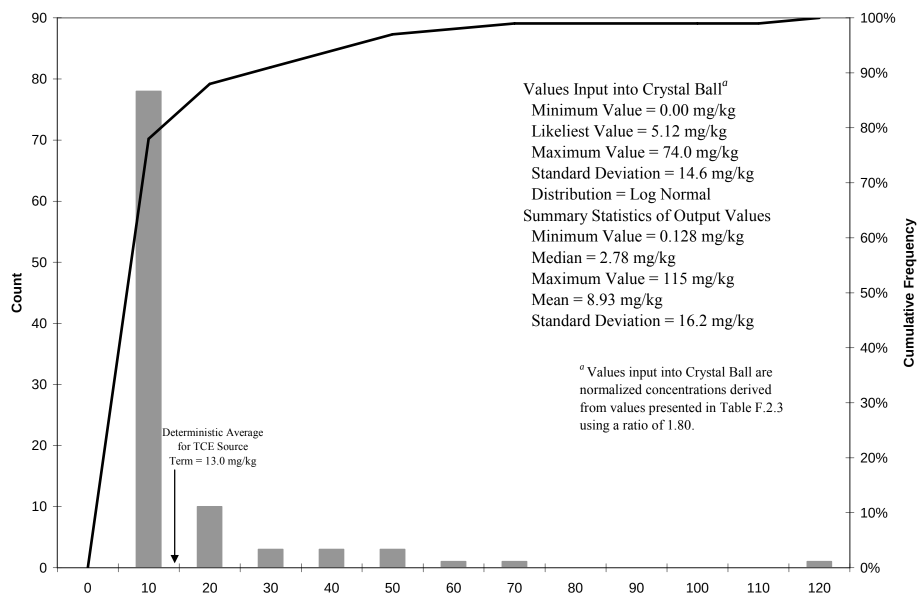


Fig. F.2.8. Histogram of Layer 4 TCE concentrations at SWMU 1 used as SESOIL inputs.

Deleted: 10

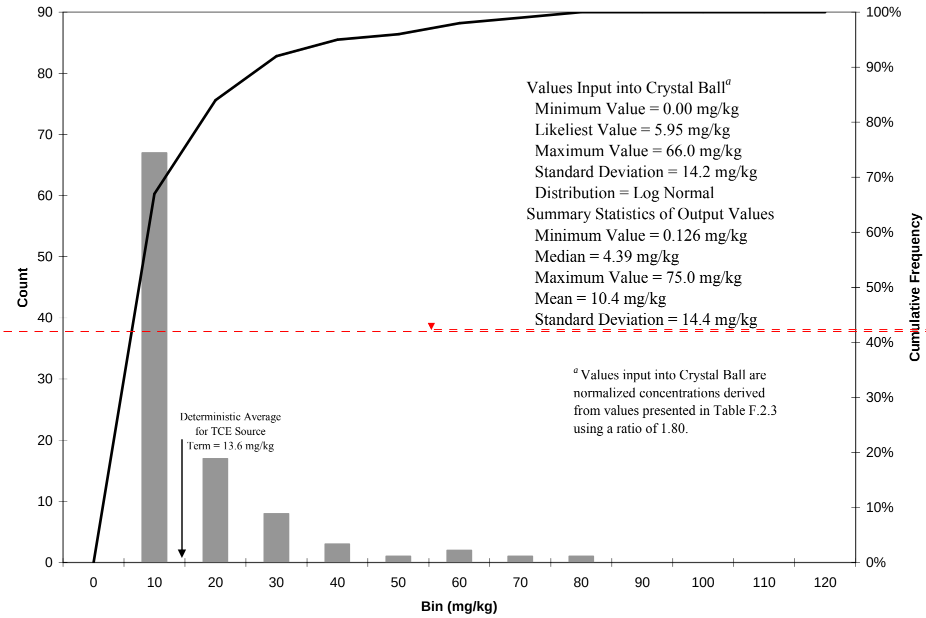


Fig. F.2.9. Histogram of Layer 5 TCE concentrations at SWMU 1 used as SESOIL inputs.

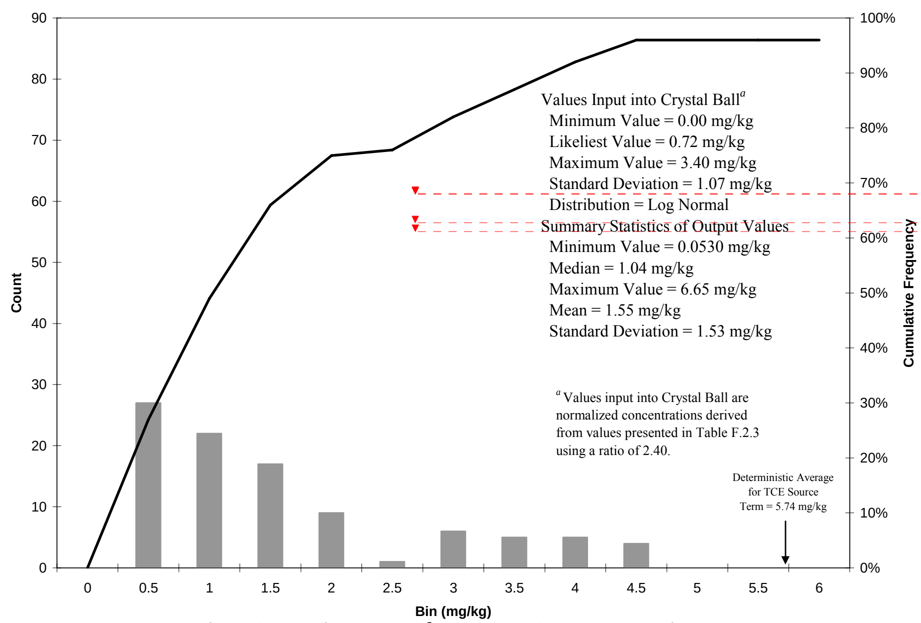


Fig. F.2.10. Histogram of Layer 6 TCE concentrations at SWMU 1 used as SESOIL inputs.

Deleted: ¶
Deleted: <sp><sp>
Deleted: ¶
Deleted: ¶ ¶ ¶
Deleted: ¶ ¶
Deleted: <sp>
Deleted: ¶
Deleted: ¶
Deleted: ¶
Deleted: ¶
Deleted: ¶
Deleted: Fig. F.2.16. Histogram of Layer 4 TCE concentrations at SWMU 4 used as SESOIL inputs.
Deleted: 11
Deleted: Fig. F.2.17. Histogram of Layer 5 TCE concentrations at SWMU 4 used as SESOIL inputs.
Deleted: Fig. F.2.15. Histogram of Layer 3 TCE concentrations at SWMU 4 used as SESOIL inputs.
Deleted: Fig. F.2.18. Histogram of Layer 6 TCE concentrations at SWMU 4 used as SESOIL inputs.
Deleted: Fig. F.2.14. Histogram of Layer 2 TCE concentrations at SWMU 4 used as SESOIL inputs.
Deleted: 2
Deleted: Fig. F.2.13. Histogram of Layer 1 TCE concentrations at SWMU 4 used as SESOIL inputs.

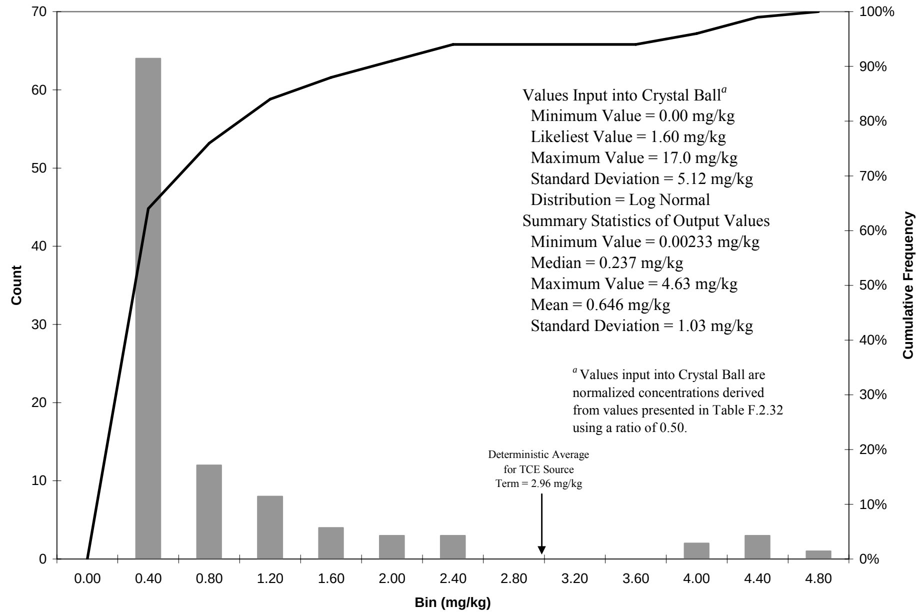


Fig. F.2.11. Histogram of Layer 1 TCE concentrations at C-720 Area used as SESOIL inputs.

Deleted: 9

Deleted: ¶

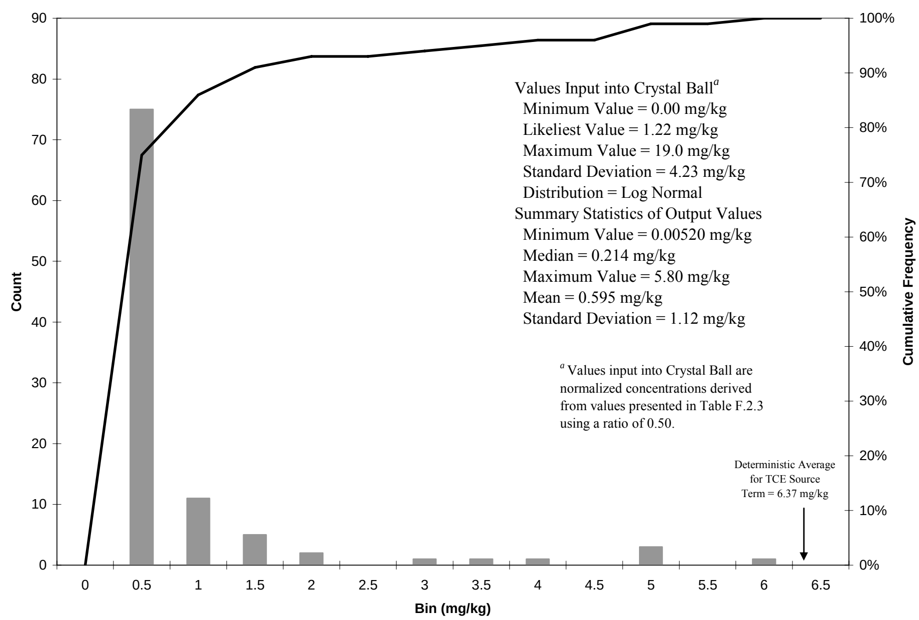


Fig. F.2.12. Histogram of Layer 2 TCE concentrations at C-720 Area used as SESOIL inputs.

Deleted: 20

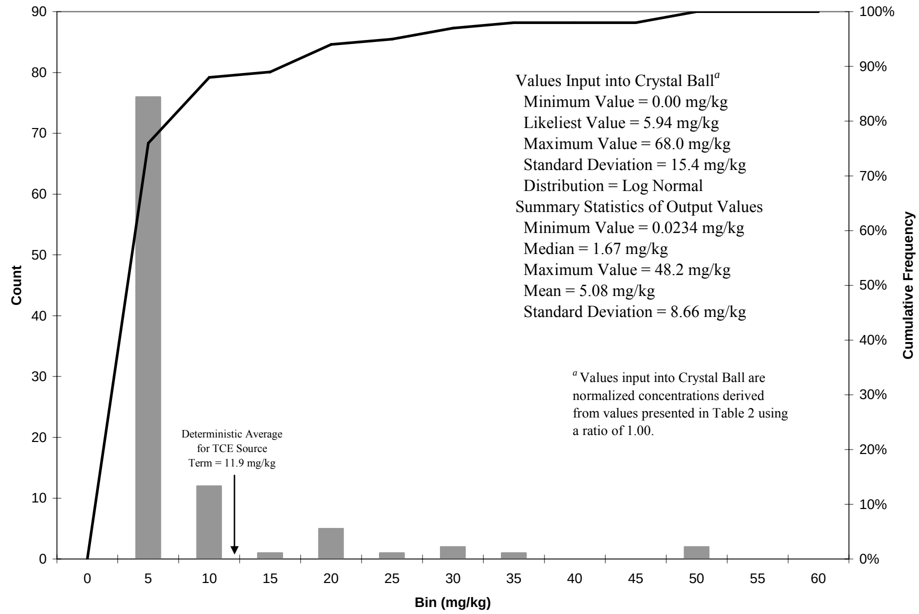


Fig. F.2.13. Histogram of Layer 3 TCE concentrations at C-720 Area used as SESOIL inputs.

Deleted: 21

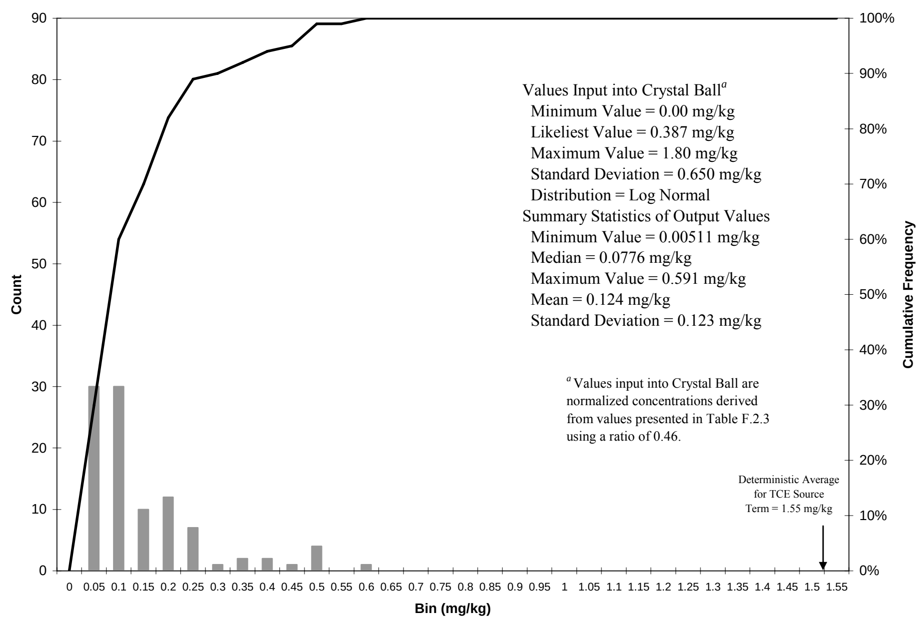


Fig. F.2.14. Histogram of Layer 4 TCE concentrations at C-720 Area used as SESOIL inputs.

Deleted: 22

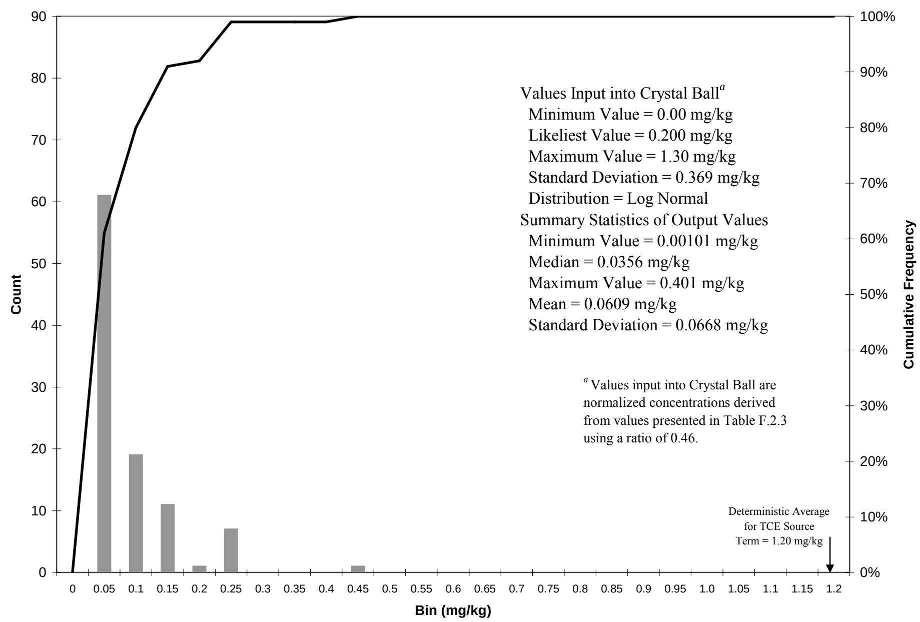


Fig. F.2.15. Histogram of Layer 5 TCE concentrations at C-720 Area used as SESOIL inputs.

Deleted: 23

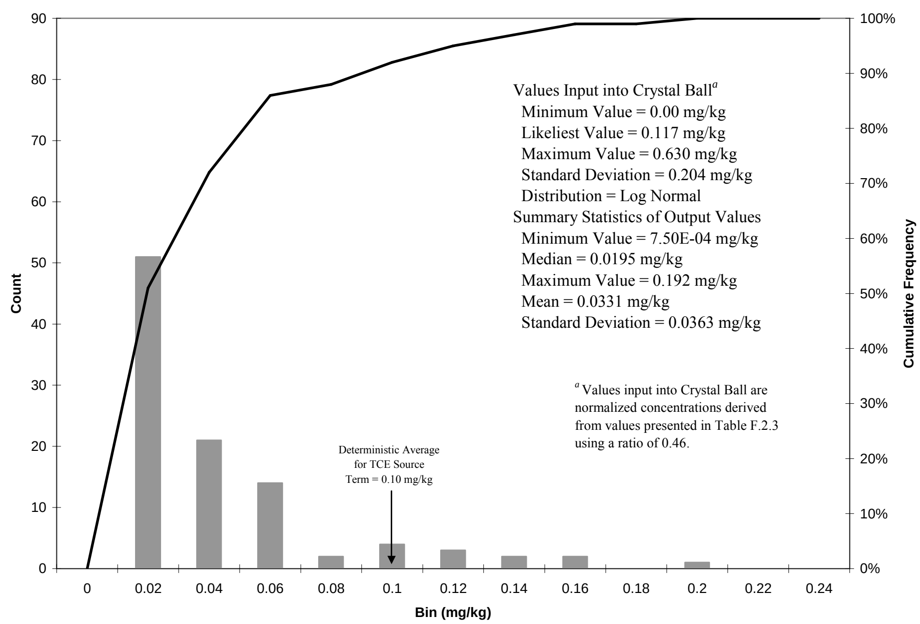


Fig. F.2.16. Histogram of Layer 6 TCE concentrations at C-720 Area used as SESOIL inputs.

Deleted: 24

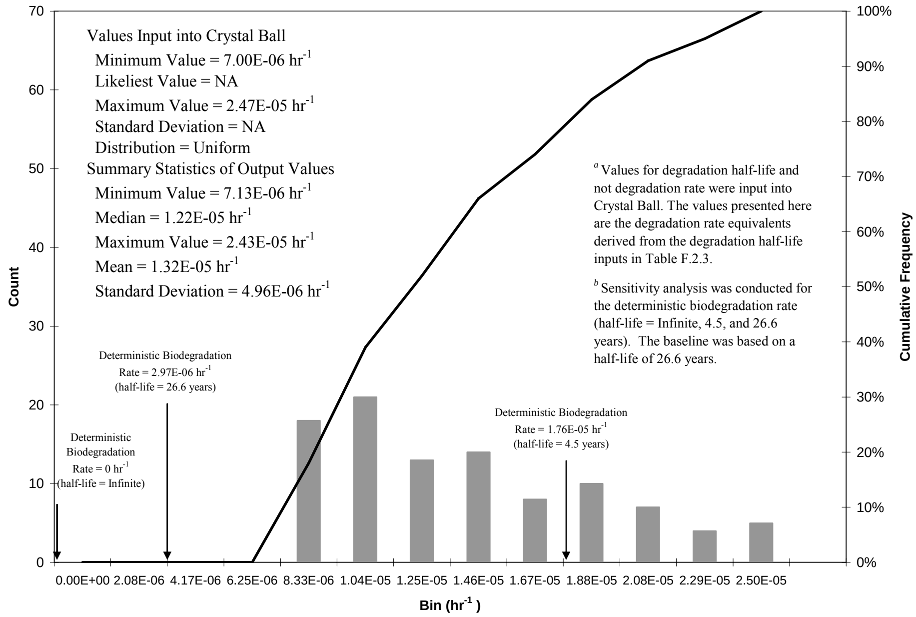


Fig. F.2.17. Histogram of Degradation Rate SESOIL inputs for SWMU 1.

Deleted: 25

Deleted: Fig. F.2.26. Histogram of Degradation Rate SESOIL inputs for SWMU 4.

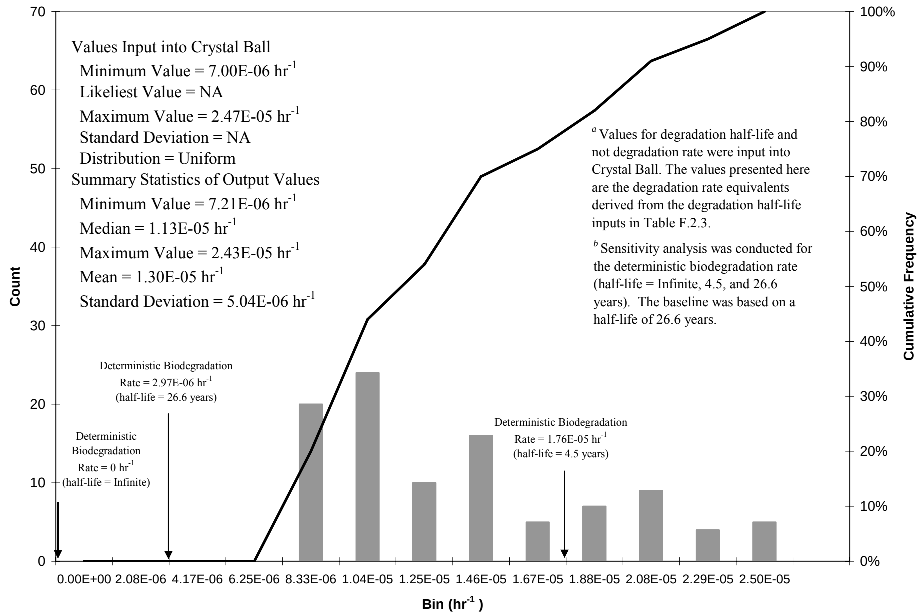


Fig. F.2.18. Histogram of Degradation Rate SESOIL inputs for C-720 Area.

Deleted: 27

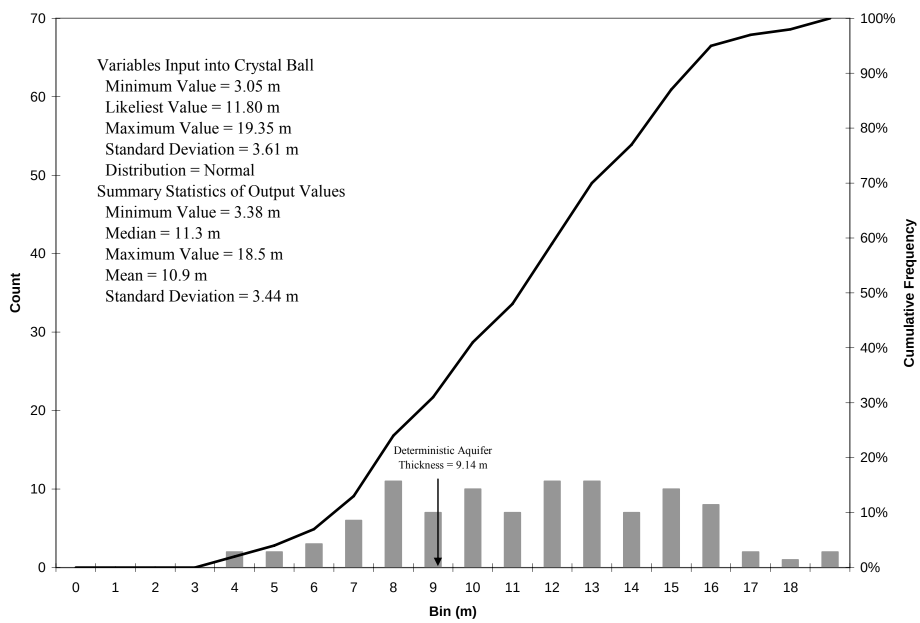


Fig. F.2.19. Histogram of Aquifer Thickness AT123D inputs for SWMU 1 and the C-720 Area.

Deleted: 28

Deleted: , SWMU 4,

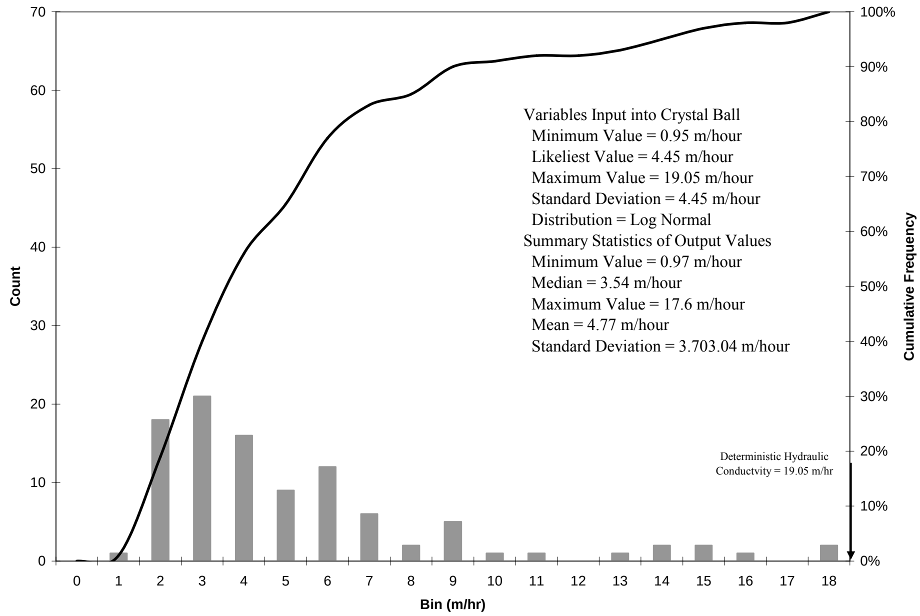


Fig. F.2.20. Histogram of Hydraulic Conductivity AT123D inputs for SWMU 1 and the C-720 Area.

Deleted: 9

Deleted: , SWMU 4,

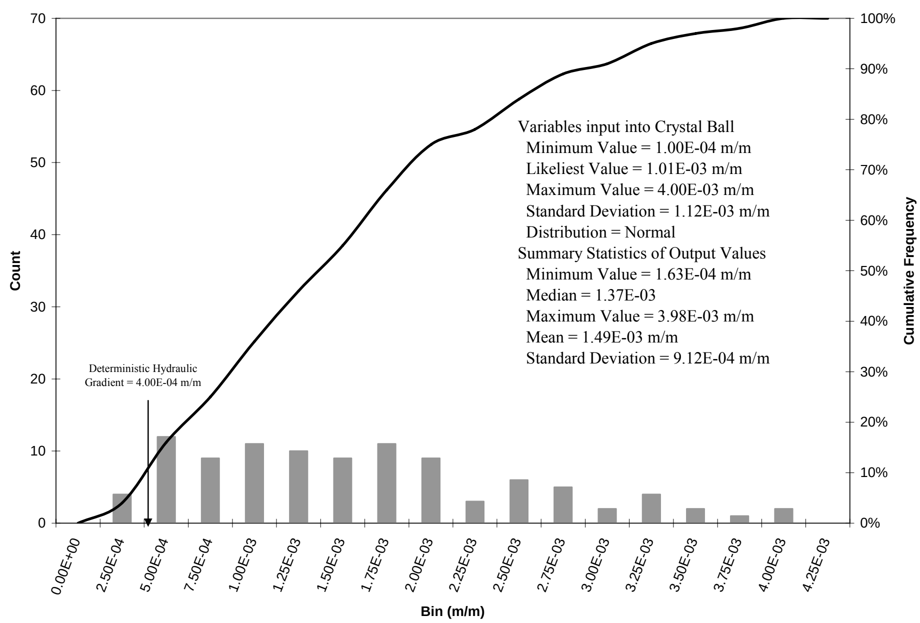


Fig. F.2.21. Histogram of Hydraulic Gradient AT123D inputs for SWMU 1 and the C-720 Area.

Deleted: 30

Deleted: , SWMU 4,

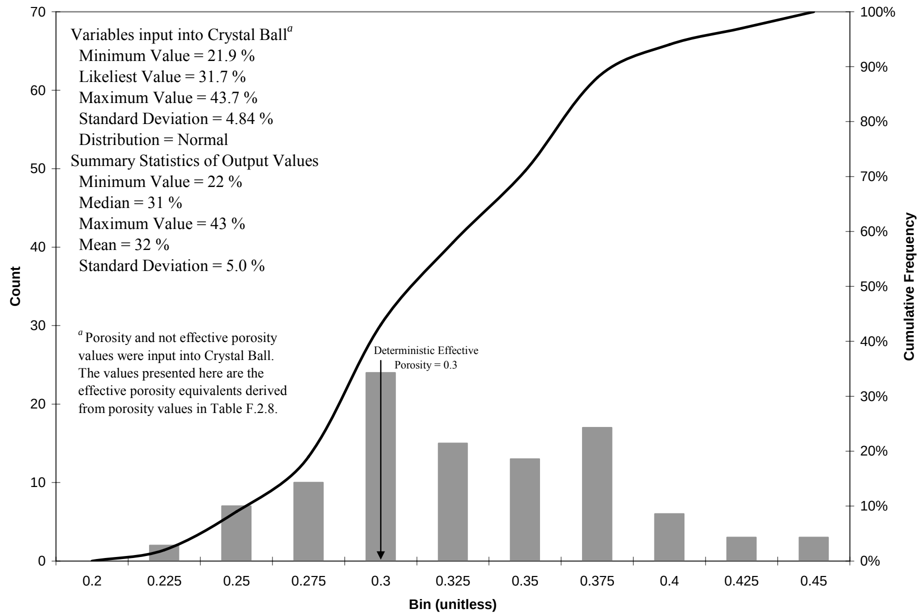


Fig. F.2.22. Histogram of Effective Porosity AT123D inputs for SWMU 1 and the C-720 Area.

Deleted: 31

Deleted: , SWMU 4,

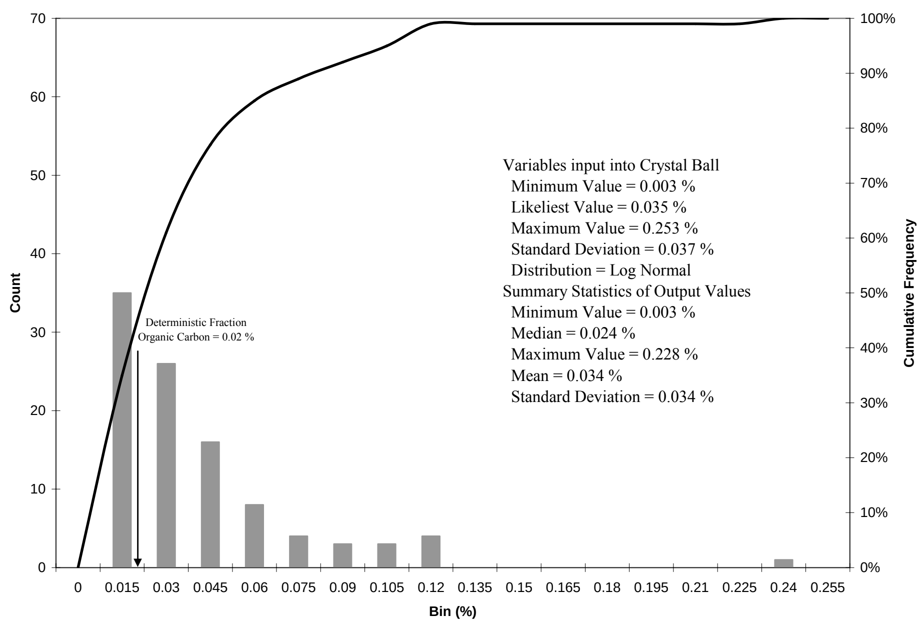


Fig. F.2.23. Histogram of Organic Carbon Content AT123D inputs for SWMU 1 and the C-720 Area.

Deleted: 32

Deleted: , SWMU 4,

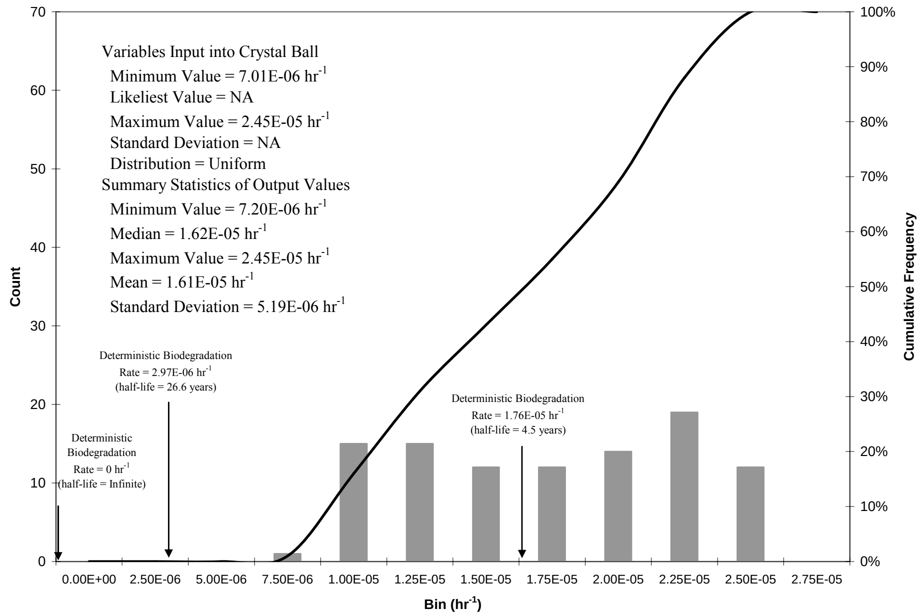


Fig. F.2.24. Histogram of Degradation Rate inputs for SWMU 1, and the C-720 Area.

Deleted: 33

Deleted: , SWMU 4

Deleted: Fig. F.2.34. Histogram of RGA groundwater concentration (used for developing contaminant loading) AT123D inputs for SWMU 4.

Deleted: <sp>

Deleted: ¶

Deleted: ¶
¶
Page Break

Deleted: DEGRADATION FACTOR

APPENDIX F
ATTACHMENT 3

TCE DEGRADATION RATE COEFFICIENT

Deleted: Att F3-

THIS PAGE INTENTIONALLY LEFT BLANK.

Deleted: Page Break

Deleted: Att F3-

DERIVATION OF THE DISSOLVED TRICHLOROETHENE DEGRADATION RATE COEFFICIENT FOR THE REGIONAL GRAVEL AQUIFER AT THE PADUCAH GASEOUS DIFFUSION PLANT, PADUCAH, KENTUCKY

Deleted: ¶
Section Break (Next Page)

Deleted: DEGRADATION FACTOR

Deleted: Att F3-

THIS PAGE INTENTIONALLY LEFT BLANK.

Deleted: Page Break

Deleted: Att F3-

CONTENTS

Deleted: 7
Deleted: v
Deleted: 7
Deleted: v
Deleted: 7
Deleted: v
Deleted: 9
Deleted: vii
Deleted: 11
Deleted: 1
Deleted: 11
Deleted: 1
Deleted: 12
Deleted: 2
Deleted: 13
Deleted: 3
Deleted: 13
Deleted: 3
Deleted: 14
Deleted: 4
Deleted: 15
Deleted: 5
Deleted: 15
Deleted: 5
Deleted: 16
Deleted: 6
Deleted: 17
Deleted: 7
Deleted: 18
Deleted: 8
Deleted: 111111
Formatted ... [1]
Deleted: 1111121
Formatted ... [2]
Deleted: 414141
Formatted ... [3]
Deleted: 38
Deleted: 45
Deleted: 38
Deleted: 45
Deleted: 38
Deleted: 45
Deleted: 39
Deleted: 46
Deleted: iii¶

Deleted: Page Break

THIS PAGE INTENTIONALLY LEFT BLANK.

Deleted: iii¶

Deleted: Att F3-iii

Formatted

Deleted: Page Break

FIGURES

TABLES

Formatted: French (France)

APPENDIX

Deleted: iii¶

Formatted: Font: 11 pt

Deleted: Att F3-iii

Deleted: Page Break

THIS PAGE INTENTIONALLY LEFT BLANK.

Deleted: iii¶

Deleted: Att F3-iii

Formatted

Deleted: Page Break

Deleted: DEGRADATION FACTOR

DERIVATION OF THE DISSOLVED TRICHLOROETHENE DEGRADATION RATE COEFFICIENT FOR THE REGIONAL GRAVEL AQUIFER AT THE PADUCAH GASEOUS DIFFUSION PLANT, PADUCAH, KENTUCKY

EXECUTIVE SUMMARY

The Paducah Gaseous Diffusion Plant (PGDP) is the source of three groundwater contaminant plumes in the Regional Gravel Aquifer, the shallow aquifer underlying PGDP and the contiguous property to the north. These plumes, which are defined by trichloroethene (TCE), a chlorinated solvent, and technetium-99 (^{99}Tc), a radionuclide, are called the Northwest, Northeast, and Southwest Plumes.

As part of the investigation of these plumes and the development of response actions, the U.S. Department of Energy (DOE) is completing fate and transport modeling. An important component of this modeling is the development of degradation rate coefficients for TCE found in source areas and in the dissolved-phase groundwater plumes.

Deleted: degradation factor

This report uses regulatory accepted methods presented in *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water* (EPA 1998) and data from the Northwest Plume, the most thoroughly characterized of the plumes at PGDP, to derive a degradation rate coefficient (first-order rate constant) for TCE found in the dissolved-phase groundwater plume. Sampling results collected from the Northwest Plume indicate that TCE concentrations decrease with distance at a faster rate than selected inorganic contaminants (i.e., chloride and ^{99}Tc). Analyses using these inorganic tracers yield a dissolved-phase TCE degradation rate coefficient with a range of 0.0614 to 0.2149 year^{-1}. This degradation rate coefficient corresponds to a TCE half-life of 11.3 to 3.2 years, respectively.

Deleted: degradation factor

Deleted: degradation factor

Deleted: degradation factor

Deleted: iii¶

Formatted: Font: 11 pt

Deleted: Att F3-iii

Deleted: Page Break

THIS PAGE INTENTIONALLY LEFT BLANK.

Deleted: iii¶

Deleted: Att F3-iii

DERIVATION OF THE DISSOLVED TRICHLOROETHENE DEGRADATION RATE COEFFICIENT FOR THE REGIONAL GRAVEL AQUIFER AT THE PADUCAH GASEOUS DIFFUSION PLANT, PADUCAH, KENTUCKY

Deleted: DEGRADATION FACTOR

INTRODUCTION

The Paducah Gaseous Diffusion Plant (PGDP) is the source of three groundwater contaminant plumes in the Regional Gravel Aquifer (RGA), the shallow aquifer underlying PGDP and the contiguous property to the north (Figures 1 and 2). These plumes, which are defined by trichloroethene (TCE), a chlorinated solvent, and technetium-99 (^{99}Tc), a radionuclide, are called the Northwest, Northeast, and Southwest Plumes.

DOE is completing fate and transport modeling, following the PGDP modeling matrix (DOE 2000a), as part of the investigation of these plumes and the development of response actions. An important component of this modeling is the degradation rate of TCE in source areas and the dissolved-phase groundwater plumes. This report describes the derivation of the degradation rate for TCE in the dissolved-phase plume.

Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water (EPA 1998) documents several methods for derivation of a degradation rate coefficient for chlorinated solvents. A preferred method is the calculation of a first-order rate constant by normalizing (correcting) downgradient chlorinated solvent concentrations. This approach uses the rate of downgradient decline of total chloride concentration, or decline of the level of other non-reactive chemical tracer that is associated with the chlorinated solvent plume, as a measure of natural attenuation processes, exclusive of degradation, sorption, and volatilization. The rate of additional loss of chlorinated solvent, adjusted for sorption, is the degradation rate, assuming volatilization is negligible.

Deleted: degradation factor

The Northwest Plume is the best characterized of the PGDP groundwater contamination plumes. Observations of dissolved TCE, chloride, and ^{99}Tc levels within the Northwest Plume indicate that TCE attenuates over distance at a faster rate than either chloride or ^{99}Tc. Sampling results from the Northwest Plume collected prior to start-up of two extraction well fields on August 28, 1995 provide the data set for derivation of the dissolved TCE degradation rate coefficient, using both chloride and ^{99}Tc as inorganic tracers. As shown, analyses using these inorganic tracers yield similar results. Using chloride, the range for the degradation rate coefficient is 0.0719 to 0.2149 year^{-1} at groundwater flow rates of 1 and 3 ft/day, respectively, which corresponds to a TCE half-life range of 9.6 to 3.2 years. Using ^{99}Tc, the range for the degradation rate coefficient is 0.0614 to 0.1836 year^{-1} at groundwater flow rates of 1 and 3 ft/day, respectively, which corresponds to a TCE half-life range of 11.3 to 3.8 years. . While these degradation rate coefficients were only derived for the Northwest Plume, the range should be applicable to other PGDP plumes. A prior report describing site-wide geochemistry (Clausen *et al*, 1992) noted there is little variability in RGA geochemistry across the site, particularly with the major ion chemistry.

Deleted: degradation factor

Deleted: degradation factor

Deleted: degradation factor

SITE BACKGROUND

Off-site groundwater contamination associated with PGDP was discovered in August 1988. PGDP immediately established a residential well monitoring program and supplied water to affected households. Under the framework of an Administrative Order by Consent with the U.S. Environmental Protection Agency (EPA), and agreed to by the Commonwealth of Kentucky, the DOE undertook a comprehensive Site Investigation beginning in 1989 (completed in 1991) that documented nature and extent of

Deleted: iii¶

Formatted: Font: 11 pt

Field Code Changed

Deleted: Att F3-iii

groundwater contamination related to PGDP (CH2M HILL 1991 and 1992). This action resulted in the installation of many monitoring wells in the RGA, located throughout the area of the dissolved contaminant plumes.

The Northwest Plume extends from the C-400 Cleaning Building, located at the center of the industrial complex, to near the Ohio River, a distance of approximately 3.6 miles. A Record of Decision for an interim remedial action for the Northwest Plume (DOE 1993a) mandated installation of a two-well-field containment system with one well field (the south well field) located near the point where the plume migrates beyond the boundary of the PGDP industrial complex (at the northwest corner of the facility) and the other well field (the north well field) located at the downgradient limit of the core of the plume (defined by TCE concentrations greater than 1 mg/L). The length of the groundwater flow path between the two well fields is approximately 1.2 miles.

The DOE executed an investigation of the Northwest Plume to support the location of the extraction well fields. *Characterization of the Northwest Plume Utilizing a Driven Discrete-Depth Sampling System* (DOE 1993b) reports the results of the first phase of the investigation (September and October of 1992). The second phase of investigation (August 1993 through March 1994) is summarized in *Final Report on Drive-Point Sampling of the Northwest Plume and Analysis of Related Data* (DOE 1995). The two-phased investigation, collectively, characterized five transects of the Northwest Plume with groundwater analyses from 38 temporary soil borings and from existing monitoring wells. The transects defined the 3-dimensional extent of the core of the Northwest Plume over a distance of approximately 1.2 miles, as measured along the axis of the Northwest Plume. Appendix A summarizes the methodology and results of the Northwest Plume investigation.

Each of the two well fields consists of two extraction wells screened across the thickness of the RGA and seven RGA monitoring wells. Construction of the monitoring wells was completed on October 3, 1994. The DOE began operation of the extraction wells on August 28, 1995. The DOE has continued operation of the Northwest Plume well fields with little interruption since 1995.

SITE HYDROGEOLOGY OVERVIEW

The shallow groundwater flow systems at PGDP are developed primarily in continental sediments filling a buried valley of the ancestral Tennessee River, which previously flowed near the present course of the Ohio River in far western Kentucky. In general, the valley fill sediments consist of a basal gravel and sand unit (the Lower Continental Deposits), overlain by a silt member (the Upper Continental Deposits), and, in turn, overlain by a loess deposit to land surface. Groundwater flow in the loess deposit and underlying silt member (collectively averaging 60 ft thick at PGDP) is predominately downward, to recharge lateral flow in the basal sand and gravel deposits. This vertical flow system is termed the Upper Continental Recharge System (UCRS) at PGDP. The basal gravel and sand deposit averages 30 ft thick beneath PGDP and extends northward to the Ohio River, and into southern Illinois. The south-most bank of the buried ancestral Tennessee River Valley occurs under PGDP; thus, local groundwater flow in the gravel and sand deposit (the RGA) begins under PGDP and migrates northward to the Ohio River (the groundwater discharge feature for the region).

At PGDP, the Upper Continental Deposits consist of 3 distinct hydrogeologic units (HUs). HU1 is the near-surface loess deposit. A common horizon of sand and gravel lenses beneath the loess is known as HU2. The underlying silt member is HU3. Collectively, these comprise the UCRS. The RGA consists of an upper horizon of fine-grading-downward-to-medium sand (HU4) and a lower horizon of medium-to-coarse-sand-and-gravel (HU5). Individual gravel and sand deposits in the RGA typically are on the order of inches-to-several-ft thick and have only limited lateral extent; thus, the range of hydraulic conductivity in a vertical profile of the RGA is highly variable. However, site data, specifically pumping and other aquifer tests and groundwater plume trends, define distinct zones of gross high and low hydraulic

Deleted: iii¶
Formatted: Font: 11 pt
Field Code Changed
Deleted: Att F3-iii

conductivity in the RGA. Measurements of RGA hydraulic conductivity from pumping tests range from 1.87 x 10^{-2} to 2.01 cm/sec (53 to 5,700 ft/day). (The range of RGA hydraulic conductivity derived from all types of measurements is 3.52 x 10^{-8} to 300 cm/s [1.00 x 10^{-4} to 8.5 x 10^{5} ft/day]).

The stage of the Ohio River is a primary control to the hydraulic gradient in the RGA. Except for short periods (days) following extreme rise of Ohio River stage, the RGA hydraulic potential slopes toward the Ohio River with a gradient between 0.001 and 0.0001 ft/ft.

Measurements of the porosity of the RGA matrix range from 27 to 54% (Appendix H of DOE 1999a). The following derivation of the dissolved TCE degradation rate coefficient is based on an assumption that the average effective porosity of the RGA matrix is 30%, which is within the 25-to-40% range attributable to gravel, as reported in Freeze and Cherry (1979), and matches the effective porosity used in recent fate and transport modeling at PGDP (DOE 1999a, DOE 1999b, DOE 2000b, DOE 2000c, DOE 2001a, DOE 2005). Taken together, hydraulic conductivity, hydraulic gradient, and effective porosity determine groundwater flow velocity. . Groundwater flow velocity in the RGA has been reported to range from 0.15 to 15.9 ft/day with an average of 1.3 ft/day (Clausen *et al*. 1997). At PGDP, long-term, area-averaged, groundwater flow velocity ranges between 1 and 3 ft/day.

Deleted: degradation factor

The RGA is dominantly an aerobic aquifer with dissolved oxygen levels that range from 2 to 8 mg/L (Clausen *et al*. 1997). Because the matrix consists of chert gravel and quartz sand (non-reactive media) and has an organic carbon content (F_{oc}) of 0.02% (DOE 1999a), the RGA offers little sorption potential to TCE or inorganic tracers. Assuming a TCE organic carbon partition coefficient (K_{oc}) of 94 L/kg (EPA 1996) and an organic carbon content of 0.02%, the migration of TCE is retarded by a factor of 0.91 relative to the groundwater flow rate.

Note that the quantitative values used in the Attachment F3 equations and modeling to derive the biodegradation rate coefficient are specific to the Northwest Plume, where applicable, and do not strictly match parameter values used in other modeling of the SI, which represents site-wide conditions.

Deleted: degradation factor

OCCURRENCE OF TRICHLOROETHENE AND TECHNETIUM-99

Discrete areas within the RGA (and the overlying sediments) are contaminated with TCE in the form of dense non-aqueous phase liquid (DNAPL). The largest of these DNAPL zones, located at the southeast corner of PGDP's C-400 Cleaning Building, is the principal source of dissolved TCE to the Northwest Plume. Dissolved TCE concentrations in the immediate vicinity of DNAPL should be approximately the compound's solubility limit in water of 1,100 mg/L. The Northwest Plume investigation (DOE 1993b and 1994) sampled groundwater with dissolved TCE levels as high as 16 mg/L near the Northwest Plume south well field and 0.68 mg/L near the Northwest Plume north well field. Dissolved TCE levels in the Northwest Plume well fields in 1995, prior to start-up of the extraction wells, ranged as high as 13 mg/L at the south well field and 1.8 mg/L at the north well field.

The main source of ^{99}Tc to the Northwest Plume also is found at the C-400 Cleaning Building. The greatest ^{99}Tc activities found in the RGA at the C-400 source area are near 17,000 pCi/L. The Northwest Plume investigation collected RGA groundwater with ^{99}Tc activities as high as 4,800 pCi/L at the south well field and 294 pCi/L at the north well field. Groundwater monitoring analyses for the Northwest Plume in 1995, prior to start-up of the extraction wells, found ^{99}Tc activities as high as 3,860 pCi/L at the south well field and 1,120 pCi/L at the north well field.

PREVIOIUS SITE NATURAL ATTENUATION STUDIES

Evaluation of Natural Attenuation Processes for Trichloroethylene and Technetium-99 in the Northeast and Northwest Plumes at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky (Clausen

Deleted: iii¶
Formatted: Font: 11 pt
Field Code Changed
Deleted: Att F3-iii

et al. 1997) documents a 1997 investigation of biodegradation of TCE in the RGA. The study reports that although natural attenuation processes are active and plume attenuation is occurring, the rate is insufficient to utilize as a remedial measure (in the absence of a source zone remedial measure).

The Clausen *et al*. (1997) report concluded that biodegradation is occurring and presented two scenarios to explain the geochemical data. The first scenario assumed that current intrinsic biodegradation is negligible and the present evidence for biodegradation is a remnant of past microbiological activity, when co-metabolites (now depleted) were sufficient to support aerobic degradation. The second scenario, assumed the presence of organic-rich, anaerobic, microenvironments within the RGA, which support reductive dechlorination of the TCE. Under the second scenario, any TCE degradation products produced are assumed to remain sorbed to the organic-rich materials of the microenvironments.

As part of Clausen *et al*. (1997), the authors attempted to quantify the TCE biodegradation rate, based on the downgradient decline of mass flux of TCE through several transects of the Northwest Plume and using the geochemical model BIOSCREEN (Newell *et al*. 1996). The analysis yielded an estimate for TCE attenuation in the RGA, ignoring the effects of sorption and diffusion, with a range of 0.0206 to 0.074 $year^{-1}$, which corresponds to a TCE half-life range of 9.4 to 26.7 years. Considering the impact of sorption and diffusion, the authors estimated a biodegradation half-life of greater than 25 years for TCE in the RGA.

In a peer-reviewed paper based in part on results in Clausen *et al*. (1997), *Chlorine Isotope Investigation of Natural Attenuation of Trichloroethene in an Aerobic Aquifer* (Sturchio *et al*. 1998), the authors reported chlorine isotope ratio data for the RGA. The authors concluded that the data is consistent with a model of past TCE degradation in the overlying UCRS and little or no current degradation of TCE in the RGA.

DATA SET

Analyses (TCE, chloride, and ^{99}Tc) of the Northwest Plume well field monitoring wells, sampled monthly between March and August 1995, comprise the selected data set for the derivation of the dissolved TCE degradation rate coefficient (Table 1). These analyses represent contaminant and inorganic tracer levels at two locations in the Northwest Plume prior to start-up of the extraction wells. In each well field, three monitoring wells with higher contaminant levels were selected to represent the core of the Northwest Plume.

Deleted: degradation factor

All RGA monitoring wells of the two Northwest Plume well fields (Figures 3 and 4) are constructed with 10-ft length well screen in the upper RGA. The six wells selected for this analysis, wells MW236, MW238, MW241, MW243, MW248, and MW250, share the common screen elevation of 294-to-299 ft above mean sea level (Table 2). Samples collected from these wells approximate the average groundwater quality in the upper RGA at two locations along the same groundwater flow line, separated by approximately 6,900 ft.

The analyses of August 1995 were selected as the basis for the derivation of the dissolved TCE degradation rate coefficient. Plots of TCE analyses from the data set (Figure 5) reveal that the TCE analyses of August 1995 tend to be the highest among the March-through-August 1995 data set. Moreover, chloride and ^{99}Tc analyses for August 1995 are representative (Figures 6 and 7). These data best approximate a “snapshot” of groundwater quality in the core of the Northwest Plume, as samples collected within a short time frame and when contaminant concentrations are highest.

Deleted: degradation factor

Area soil borings document that the thickness of the RGA in the area of the Northwest Plume varies widely. In the south well field, the thickness of the RGA at the extraction wells ranges from 27 to 39 ft (the RGA occurs over the elevation ranges 273 to 312 ft and 280 to 307 ft above mean sea level in the

Deleted: iii¶

Formatted: Font: 11 pt

Field Code Changed

Deleted: Att F3-iii

2 wells), and is 27 and 28 ft thick at the extraction wells of the north well field (the RGA occurs over the elevation ranges 280 to 307 ft and 287 to 315 ft above mean sea level in the 2 wells). Although the six wells selected for this analysis only partially penetrate the RGA, the contaminant levels observed in the wells are representative of the core of the Northwest Plume. A good measure of the average contaminant level in the core of the Northwest Plume is the contaminant level in the extraction wells. Analyses of TCE and ^{99}Tc levels in the individual extraction wells are first available in 1997 when hand valves were installed in the system plumbing to permit discrete sampling. In both well fields, the analyses from the wells with highest contaminant levels closely match those in the data set used for analysis of the TCE degradation rate coefficient (Table 3).

Deleted: degradation factor

METHOD OF ANALYSIS

Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water (EPA 1998) describes the methods applied in this analysis to derive a TCE degradation rate coefficient for the RGA. The guidance is based on the assessment of reductive dechlorination, an anaerobic process that is not a primary degradation mechanism in the RGA. (Aerobic conditions predominate in the RGA and there is a general absence of intermediate reductive dechlorination products in the RGA groundwater.) However, the guidance methods *Normalization Using Inorganics as Tracers* (Section C.3.3.2.2) and estimation of a first-order degradation rate (Section C.3.3.3.1) are not specific to anaerobic or aerobic settings and are applicable to the selected data set.

Deleted: degradation factor

Site data indicate that the C-400 area sources of TCE and ^{99}Tc to the Northwest Plume are not being rapidly depleted and that the Northwest Plume was approximately stable prior to the start up of the extraction wells in 1995. TCE and ^{99}Tc analyses of RGA groundwater from upgradient wells to the south extraction well field (MW261 and MW339) demonstrate that contaminant levels have remained relatively unchanged for the period of monitoring (1995 – 2005) (Figure 8). The extent of the Northwest Plume, first suggested in 1988, indicates that high levels of contaminants existed in the core of the Northwest Plume well before 1988. Thus, the conditions are appropriate (source contaminant levels are not varying with time) for use of a first-order rate constant to approximate degradation, by assessing the reduction in contaminant concentration over groundwater flow distance. The Commonwealth of Kentucky, however, suggest that available data including increasing TCE concentrations in the Northeast Plume MW-99 monitoring well contradict the DOE suggestion that the plumes are stable. The degree of plume stability will continue to be evaluated utilizing information developed from the ongoing KRCEE TCE Degradation Analysis and PGDP groundwater model upgrading process.

HYDROGEOLOGIC INPUTS

The primary hydrogeologic variables to the calculations for the TCE degradation rate coefficient are the RGA groundwater flow velocity and fraction of organic carbon in the RGA matrix. These two factors control the TCE migration velocity.

Deleted: degradation factor

Groundwater flow velocity is determined by hydraulic conductivity, which varies significantly over short distances in the RGA, and groundwater gradient, which varies seasonally. Because, PGDP groundwater plumes extend over long distances (miles) and have remained stable since their discovery, long-term averages for hydraulic conductivity and gradient are useful measures in the analysis of the RGA dissolved TCE degradation rate. The long-term average of groundwater flow velocity ranges from 1 to 3 ft/day. This range is determined primarily by regional variability of the RGA hydraulic conductivity and is reasonable considering the length of the Northwest Plume. Because of concerns with the characterization of PGDP groundwater plumes as being stable, further assessment of plume stability is recommended (the ongoing pump and treat interim remedial actions have resulted in a perturbed flow system). In addition, the PGDP site-wide groundwater model is to be upgraded to incorporate information from previous models as well as additional hydrogeologic information collected since the last model

Deleted: .

Deleted: iii¶

Formatted: Font: 11 pt

Field Code Changed

Deleted: Att F3-iii

upgrade in 1999. A component of model upgrade will be the ability to simulate groundwater conditions under a variety of conditions which will allow the site to evaluate the stability of contaminant levels.

The total organic carbon content in the RGA matrix is minimal. Analyses of RGA soils (38 measurements) range from 29,000 to 2,530,000 µg/kg total organic carbon (Table 4).). While most of the measurements are from the C-400 area, low organic carbon is consistent with observed soil cores from the RGA across the site and would be expected in a high-energy fluvial environment in which the RGA was deposited. If only the lower part of the RGA (Hydrogeologic Unit 5) is considered, and the high value of total organic carbon is dismissed as an outlier, the total organic carbon ranges from 42,000 to 796,000 µg/kg. The true mean of this subset of measurements, with a 95% confidence level, lies between 198,251 and 319,915 µg/kg. The mean of the subset (240,357 µg/kg) is used in the calculations of the degradation rate coefficient (as the fraction of organic carbon [F_{OC}] of 0.02%). Thus, the TCE migration velocity ranges from 0.91 ft/day (for a groundwater velocity of 1 ft/day) to 2.72 ft/day (for a groundwater velocity of 3 ft/day), and is calculated as follows:

$$\text{TCE migration velocity} = \text{groundwater flow rate/coefficient of retardation (R)}$$

$$\text{And } R = 1 + \frac{(\text{rho x } K_{OC} \text{ x } F_{OC})}{n_e}$$

Where:

rho = RGA matrix bulk density (1.67 kg/L)
K_{OC} = organic carbon partition coefficient (94 L/kg)
F_{OC} = fraction of organic carbon (0.02%)
n_e = effective porosity (0.3)

Deleted: 100
Deleted: 0
Deleted: 177,950
Deleted: 302,764
Deleted: median
Deleted: dataset
Deleted: 196,500
Deleted: 228,500
Deleted: degradation factor
Formatted: French (France)

CHLORIDE ANALYSIS

Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water (EPA 1998), Section C.3.3.2, documents the method of using inorganic solutes, and specifically chloride, as a tracer to derive a first-order rate of degradation of chlorinated solvents by normalizing the downgradient chlorinated solvent concentration for the effects of dispersion, dilution, diffusion, and sorption. The method uses the following equation to solve for the normalized TCE concentration:

$$TCE_{B,\ normalized} = TCE_B \text{ x } \left(\frac{Tracer_A}{Tracer_B}\right)$$

Where:

$TCE_{B,\ normalized}$ = normalized TCE concentration at the downgradient location
TCE_B = measured TCE concentration at the downgradient location
$Tracer_A$ = measured tracer level at the upgradient location
$Tracer_B$ = measured tracer level at the downgradient location

Where chloride concentrations in the chlorinated solvent source zone are significantly elevated above background (the case in the Northwest Plume), chloride is a near-ideal tracer. The three requirements of a tracer are 1) the source of the tracer should either be the source of the dissolved chlorinated solvent plume or must be co-located, 2) the tracer should not degrade within the aquifer, and 3) the relative sorption of the tracer and the chlorinated solvent on the aquifer matrix should be known (Sorrenson *et al*. 2000).

The elevated chloride levels in the Northwest Plume are directly related to the TCE source zone. In 1995, chloride analyses for the C-400 TCE source zone wells MW155 (lower RGA) and MW156 (upper RGA) were 84 and 68 mg/L, respectively. Background chloride levels for PGDP, as measured in

Deleted: iii¶
Formatted: Font: 11 pt
Field Code Changed
Deleted: Att F3-iii

upgradient well MW103, ranged from 3.4 to 7.0 mg/L through 1995. The difference in background and source area concentrations meets the 10% criterion for use of chloride as a tracer per the technical protocol (EPA 1998). Chloride does not degrade, and it does not readily complex with other solutes in the RGA. The matrix of the RGA is composed primarily of chert gravel, coated with an iron-oxide patina, and quartz sand, with little silt and clay content. Chloride is not significantly sorbed to the RGA matrix.

Per the technical protocol (EPA 1998), the total chloride concentration, consisting of the sum of concentration of ionic chloride and organic chlorine, is the basis of comparison with TCE concentrations. In the case of the Northwest Plume, TCE is essentially the only chlorinated solvent that is present. (The concentrations of *cis*-1,2-dichloroethene, 1,1-dichloroethene, and vinyl chloride in RGA groundwater at the C-400 TCE source zone and in the downgradient plume typically are below laboratory detection limits.) Chlorine composes 80.9% of the mass of the TCE molecule. Thus, the total chloride concentration to be used in the analysis is the sum of the chloride concentration and 80.9% of the dissolved TCE concentration.

The TCE degradation rate coefficient is related to the upgradient and normalized downgradient TCE concentrations by the following equation:

$$\text{TCE degradation rate coefficient } (\lambda) = \frac{\ln\left(\frac{TCE_{B,\ normalized}}{TCE_A}\right)}{t}$$

Where:

$TCE_{B,\ normalized}$ = normalized TCE concentration at the downgradient location
TCE_A = measured TCE concentration at the upgradient location
t = travel time between upgradient and downgradient locations

The travel time (t) between two points is given by

$$t = \frac{x}{v_{TCE}}$$

Where:

x = distance between the north and south well fields
v_{TCE} = TCE transport velocity

Because travel time is inversely related to groundwater flow velocity, the degradation rate varies directly with the flow velocity.

Figures 9 and 10 present the derivation of the dissolved TCE degradation rate coefficient based on the Northwest Plume's chloride levels. The derived values range from a degradation rate coefficient of 0.0719 year^{-1} (half-life of 9.6 years) at a groundwater flow rate of 1 ft/day to a degradation rate coefficient of 0.2149 year^{-1} (half-life of 3.2 years) at a groundwater flow rate of 3 ft/day.

TECHNETIUM-99 ANALYSIS

The radionuclide ^{99}Tc is the primary co-contaminant, with TCE, in the PGDP's Northwest Plume. As with TCE, the main source of ^{99}Tc to the Northwest Plume is at the C-400 Cleaning Building, located near the center of the PGDP industrial complex. Both sources contribute to the same groundwater flow path that becomes the Northwest Plume. *Final Report on Drive-Point Sampling of the Northwest Plume and Analysis of Related Data* (DOE 1995) describes the strong correlation (correlation coefficient of 0.96) of TCE and ^{99}Tc levels in the Northwest Plume (Figure 11).

Deleted: 0.003
Deleted: .007
Deleted: far exceeds
Deleted: ¶
Deleted: Page Break
Deleted: degradation factor
Deleted: degradation factor
Deleted: degradation factor
Deleted: degradation factor
Deleted: degradation factor
Deleted: iii¶
Formatted: Font: 11 pt
Field Code Changed
Deleted: Att F3-iii

^{99}Tc degrades to ^{99}ruthenium by beta and gamma decay, with a half-life of 212,000 years. In aerobic settings such as the RGA, ^{99}Tc is in the form of the pertechnetate anion (TCO_4^-) (Del Cul *et al*. 1993), which is only weakly reactive with the RGA aquifer matrix and other groundwater solutes. Previous studies of ^{99}Tc transport in the RGA have shown that ^{99}Tc likely migrates as a dissolved species and does not form colloids (MMES 1994). More recent sensitivity analysis of the PGDP groundwater fate and transport model (DOE 2002) determined that the distribution coefficient (K_d) of ^{99}Tc ranges from 0.0 to 0.1 L/kg, with a mode of 0.0 L/kg. (The distribution coefficient is the measure of sorption in the site's groundwater fate and transport model. A distribution coefficient of 0.0 means that the solute travels at the speed of groundwater, that is, the migration of the solute is not retarded.) For comparison, the same study determined that the distribution coefficient of TCE ranges from 0.01 to 0.1 L/kg, with a mode of 0.01 L/kg. Therefore, the migration of TCE is very slightly retarded relative to groundwater flow and ^{99}Tc migration in the RGA.

Deleted: ¶

Technetium-99 meets the three requirements of a tracer (Sorrenson *et al*. 2000), as follows. The ^{99}Tc source is co-located with the TCE source. Technetium-99 does not degrade within the aquifer relative to the potential age of the sources (a maximum of 43 years age for the source, in 1995, relative to a half-life of 212,000 years). The relative sorption of ^{99}Tc and TCE is well understood. Using methods in Section C.3.3.2 of EPA's technical protocol (1998), the presence of a nonreactive co-contaminant such as ^{99}Tc may be used as a tracer to evaluate the rate of degradation of TCE within a dissolved-phase plume. As with the chloride analysis, the rate of decline of the ^{99}Tc level is used to normalize downgradient TCE levels. In this analysis, the difference in actual and normalized levels in the downgradient locations is attributable to degradation and volatilization. Because the RGA is a semiconfined aquifer, with a top at depths of 48 to 60 ft below ground surface at the two extraction well fields, volatilization of dissolved TCE in the RGA is not significant at these locations. Analyses of soil gas from the UCRS near the north and south well fields of the Northwest Plume did not detect TCE or any of the common intermediate TCE dechlorination products (Kannard 2006).

The analysis using ^{99}Tc as a conservative tracer yields a TCE degradation rate coefficient of 0.0614 year^{-1} (half-life of 11.3 years), for a groundwater flow rate of 1 ft/day, and a degradation rate coefficient of 0.1836 year^{-1} (half-life of 3.8 years), for a groundwater flow rate of 3 ft/day (Figures 12 and 13). Calculations of the RGA TCE degradation rate using both chloride and ^{99}Tc as inorganic tracers give very similar values. Uncertainty with these analyses exists due to a limited number of wells being located near the plume centroid that can be used for the evaluation (a total of six wells at two locations) and limiting the analyses to a time-frame prior to start-up of pumping on the Northwest Plume.

Deleted: degradation factor

Deleted: degradation factor

EVALUATION OF ANALYSES

Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water (EPA 1998) reviewed literature documenting TCE degradation rates and found that most of the rates clustered between 0.3 and 3.0 year^{-1} (approximately equal to a TCE half-life range of 2.3 to 0.2 years). The authors note that most of the published studies reflect settings with anaerobic degradation. BIOCHLOR, an EPA screening model to simulate natural attenuation of dissolved organic solvents (Aziz *et al*. 2002), uses values of 0.001 to 0.01 day^{-1} (0.3 to 3.2 year^{-1}) to approximate the range of biodegradation rate constants due to anaerobic processes (approximately equal to a TCE half-life of 1.9 to 0.2 years).

Idaho National Engineering and Environmental Laboratory (INEEL) is one of a few aerobic aquifer settings where the dissolved TCE degradation rate has been documented. *An Evaluation of Aerobic Trichloroethene Attenuation Using First-Order Rate Estimation* (Sorenson *et al*. 2000) summarizes the hydrogeologic settings, contaminant levels (TCE is the primary chlorinated solvent being degraded), and

Deleted: iii¶

Formatted: Font: 11 pt

Field Code Changed

Deleted: Att F3-iii

methods of analysis. Using the co-contaminants tetrachloroethene and tritium as tracers to normalize the downgradient TCE concentrations, the authors determined that the TCE degradation half-life for INEEL ranged between 13 to 21 years.

The following rationale suggests that the PGDP TCE degradation rate coefficient should be intermediate to those observed in general for anaerobic sites and those specifically documented at INEEL.

Deleted: degradation factor

1. EPA's technical protocol (EPA 1998) summarizes that anaerobic degradation of chlorinated solvents in groundwater settings is a more efficient process than aerobic degradation (such as at PGDP). Therefore, TCE degradation in the dissolved plume in RGA at PGDP should be slower than that seen in anaerobic settings.

2. The INEEL setting is an aerobic aquifer system, with little dissolved organic carbon (up to 1.2 mg/L) (Sorenson *et al*. 2000). Although the authors do not know what process is responsible for aerobic degradation at INEEL, they propose that the dissolved organic carbon may be sufficient, or may be evidence, for biological processes. In the RGA at PGDP, dissolved organic carbon levels typically range from less-than-1 up to 6 mg/L. Therefore, TCE degradation in the dissolved plume in the RGA at PGDP should be faster than that reported for INEEL if the higher dissolved organic carbon levels at PGDP are bioavailable to support the faster degradation.

Deleted: because the

Consistent with this rationale, the PGDP site-specific TCE degradation rate ranges from 0.0614 to 0.2149 year^{-1} (TCE half-life range of 11.3 to 3.2 years). This range overlaps the slowest rates reported for anaerobic degradation and is slightly faster than the range documented for the INEEL aerobic aquifer.

BIOCHLOR MODEL SENSITIVITY ANALYSIS

BIOCHLOR is a screening model that simulates natural attenuation of dissolved solvents. The software, programmed in a Microsoft© Excel spreadsheet, is based on the Domenico semi-analytical solution for reactive transport with first-order decay and a planar source geometry. BIOCHLOR has the ability to simulate 1-dimensional advection, 3-dimensional dispersion, linear adsorption, and biotransformation under anaerobic conditions. Because anaerobic conditions do not occur in the RGA at the site, the BIOCHLOR model essentially was used in the sensitivity analysis as a pre-processor for the Domenico solute transport model to test various scenarios of adsorption (through use of a retardation factor) and degradation. The model was not used to simulate biotransformation because under aerobic conditions, such as those in the RGA, TCE degrades to epoxides, aldehydes, chlorinated oxides, and ethanols rather than the common anaerobic degradation products *cis*-1,2-dichloroethene and vinyl chloride (Figure 14) that are simulated by the model.

The hydrogeologic and chemical-specific parameters used in the model are presented in Table 5. These parameters are consistent with site-specific data and previous modeling (DOE 1999a, DOE 1999b, DOE 2000b, DOE 2000c, DOE 2001a, DOE 2005). The groundwater flow rate used for the model, calculated from the hydrogeologic parameters, was approximately 1.4 ft/day. This lies within the 1.0 - 3.0 ft/day flow rate range needed to produce a plume with the length observed in the Northwest Plume and the range used in calculating TCE degradation rates for the RGA. The source was modeled as a continuous, planar source immediately downgradient of the C-400 DNAPL source zone with a width of 300 ft, thickness of 35 ft, and a TCE concentration of 250 mg/L. The source concentration was based generally on concentrations in MW156 located near the C-400 DNAPL source zone and the width was estimated from Figure 4 of the *Record of Decision for Interim Remedial Action for the Groundwater Operable Unit for the Volatile Organic Compound Contamination at the C-400 Cleaning Building at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE, 2005).

Deleted: iii¶

Formatted: Font: 11 pt

Field Code Changed

Deleted: Att F3-iii

Dispersivity (α_x) initially was calculated using the relationship for longitudinal dispersivity provided in the BIOCHLOR manual where:

$$\alpha_x = 3.28 \text{ x } 0.82 \text{ x } \left[\log_{10}\left(\frac{Lp}{3.28}\right)\right]^{2.446}$$

Lp is the TCE plume length (estimated at approximately 19,000 ft (3.6 miles) for the Northwest Plume).

This provided a longitudinal dispersivity of approximately 69 ft. To validate the estimate of dispersivity, the co-contaminant ^{99}Tc, assumed to be a nonreactive solute, was modeled with retardation set to 1.0 and degradation set to 0.0 yr^{-1}. The values for longitudinal, transverse, and vertical dispersivity then were adjusted until a suitable match to observed data was reached.

The predicted dissolved TCE concentrations along the plume's flow path, using the parameters in Table 5 and a 40-year simulation time, are shown in Figure 15. The figure indicates a reasonable fit of the modeled contaminant profiles to the observed data (1995 pre-pumping concentrations). For the scenario with no TCE degradation, (and with a retardation factor of 1.1) the modeled levels are significantly greater than the observed levels. At the north well field of the Northwest Plume containment system, for instance, modeled dissolved TCE levels with no degradation are approximately an order of magnitude greater than observed levels.

Deleted: ¶ Page Break

A sensitivity analysis was conducted on the first-order degradation rate and the retardation factor. The first case maintains the same input parameters except that the first-order degradation rate varies. Figure 16 presents the resulting plume profiles generated by the model at different degradation rates. The second case varies the retardation factor to determine the effect of retardation on the plume profile. Figure 17 shows these results. To better quantify the changes observed by varying the degradation rate and retardation factor, the absolute changes in concentration from the baseline-calibrated model were compared at two locations along the modeled plume (Figure 18). This figure indicates the model is more sensitive to changes in the degradation rate. However, distal portions of the plume appear to be equally sensitive to large changes in degradation rate and retardation factor. Sensitivity analyses were not conducted on the source zone concentration or width. In general, the downgradient concentrations vary proportionately with the source zone concentration if the width is held constant.

A case has been made that the degradation rate at the site, at least within the RGA, is 0 yr^{-1}. To test this case, the model was run with degradation at 0.0 yr^{-1} and retardation increased to 1.9 (a retardation factor of 1.9 is possible if the organic content of the RGA is >0.17%). Using a retardation of 1.9 causes the modeled TCE concentrations near the North well field to closely approximate observed values. The results, shown in Figure 19, overestimate the observed TCE concentrations throughout most of the plume and underestimate the concentrations at the distal portion of the plume. Based on the model, the TCE plume would be attenuated below 1 µg/L at a distance between 12,500 ft to 15,000 ft from the source and would not reach the Little Bayou Creek seeps located approximately 17,000 ft from the source, at least within the 40-year simulation time. (The Northwest Plume discharges, in part, to Little Bayou Creek.)

DISCUSSION OF DEGRADATION PATHWAY(S)

Evaluation of Natural Attenuation Processes for Trichloroethylene and Technetium-99 in the Northeast and Northwest Plumes at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky (Clausen *et al*. 1997) is the primary, site-specific review of biodegradation potential within the RGA and is summarized in the following sentences. The authors found that screening criteria for the assessment of biodegradation of chlorinated solvents (Wiedemeier *et al*. 1996) (Table 6) strongly suggest anaerobic biodegradation is not viable. Additionally, the authors' own review of site data, including groundwater

Deleted: iii¶
Formatted: Font: 11 pt
Field Code Changed
Deleted: Att F3-iii

analyses of samples collected specifically for the study, support the absence of anaerobic processes, in general, in the RGA.

The authors of *Evaluation of Natural Attenuation Processes for Trichloroethylene and Technetium-99 in the Northeast and Northwest Plumes at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, however, cite the following site-specific data as evidence of biodegradation:

1. Chloride levels above background concentrations are associated with the dissolved TCE plumes in the RGA. Chloride is a degradation product of TCE. Other likely sources of chloride are unknown for the PGDP plumes.

2. Dissolved gasses are indicative of microbial respiration. RGA groundwater samples collected for the natural attenuation study contained "depleted" dissolved oxygen levels (relative to dissolved nitrogen levels) and elevated carbon dioxide levels (a biological respiration product).[1]

3. Both carbon and chlorine isotopic ratios ($^{13}C/^{12}C$ and $^{37}Cl/^{35}Cl$) of RGA groundwater are consistent with microbial degradation of TCE within the main contaminant plumes.[2]

The data of the PGDP environmental monitoring program demonstrate conclusively that the RGA is dominantly an aerobic environment. Low levels (typically less than 1 mg/L) of TCE intermediate dechlorination products (anaerobic degradation) are found in RGA groundwater in some on-site locations. These occurrences may be related to degradation of TCE in the UCRS, the groundwater flow system overlying the RGA. The TCE intermediate dechlorination products are generally absent in RGA groundwater in the downgradient Northwest Plume. (Laboratory detection levels have commonly ranged from 5 to 50 µg/L for 1,1-dichloroethene and *cis*-1,2-dichloroethene and have commonly ranged from 2 to 100 µg/L for vinyl chloride.) Trace levels of *cis*-1,2-dichloroethene are common in RGA groundwater of the PGDP's Northeast Plume. Although the RGA environment is dominantly aerobic, there are other potential mechanism, in addition to aerobic cometabolism of TCE that could be responsible for the Cl^- trends, O_2/CO_2 concentrations and the $^{13}C/^{12}C$ and $^{37}Cl/^{35}Cl$ ratios.

Within the Northwest Plume, the main evidence of degradation is (1) the disappearance of TCE in the downgradient plume, beyond that attributable to dispersion, sorption, and volatilization, and (2) significantly elevated chloride levels in the upgradient plume. (The continuing presence of high chloride levels at the C-400 TCE source zone indicates that the degradation process is continuing.) Rates of non-biologic (abiotic) processes of TCE destruction in aerobic groundwater are insufficient, alone, to account for the observed TCE degradation rate. The most common abiotic reactions likely to affect TCE are hydrolysis and dehydrohalogenation (EPA 1998) with half-lives that range from 1.0×10^5 years (Jeffers and Wolf 1996) to 1.3×10^6 years (Jeffers *et al*. 1989). Other mechanisms including potential abiotic mechanisms such as interaction with iron or clay minerals could be responsible for the trends in TCE reductions; however, currently the mechanisms transforming the TCE in the RGA is unknown. While site-specific evidence of aerobic biodegradation exists for the RGA, the mechanism remains undefined.

Among the aerobic degradation processes common to groundwater, co-metabolism is among the most robust. In co-metabolism, TCE is not a source of energy for the microbes, but it is degraded by the enzymes that the microbes generate to catalyze oxidation of other organic material (which may be naturally occurring or a groundwater co-contaminant). Measures of organic carbon in the RGA document

[1] The dissolved gas data from the RGA is also consistent with degradation occurring in the UCRS.

[2] Chlorine Isotope Investigation of Natural Attenuation of Trichloroethene in an Aerobic Aquifer (Sturchio *et al*. 1998).

Deleted: .

Formatted: Numbered + Level: 1 + Numbering Style: 1, 2, 3, ... + Start at: 1 + Alignment: Left + Aligned at: 0.25" + Tab after: 0.5" + Indent at: 0.5"

Formatted: Superscript

Formatted: Subscript

Formatted: Subscript

Formatted: Superscript

Formatted: Superscript

Formatted: Superscript

Formatted: Superscript

Formatted: Font: 8 pt

Deleted: iii¶

Formatted: Font: 11 pt

Field Code Changed

Deleted: Att F3-iii

that the amount of naturally occurring carbon is limited. (Dissolved organic carbon in RGA groundwater ranges up to 6 mg/L. The fraction of organic carbon in the RGA matrix is typically 0.02% [200,000 µg/kg]). Moreover, the levels of organic co-contaminants in the Northwest Plume, outside of the PGDP industrial complex, are very low.

Formatted: Indent: First line: 0"

Potential compounds that may serve as co-metabolic substrates are found locally in the RGA beneath the PGDP industrial complex, but their existence is largely unknown in the downgradient plumes. Appendix A, Data Summary Report to *Feasibility Study for the Groundwater Operable Unit at Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 2001) documents the contaminants of the RGA. In the Northwest Plume, outside of the PGDP industrial complex, chloroform (at levels up to 15 µg/L, found at 5 of 25 sample stations), and 1,2-dichloroethene (at levels up to 27 µg/L, found at 3 of 9 sample stations) were the only volatile organic compounds to be detected. Benzene at concentrations of 5 µg/L or less (found at 4 of 24 sample stations) was the only other common organic contaminant. None of these contaminants have been detected in the monitoring wells of the Northwest Plume north and south well fields. In addition, total organic carbon analyses in RGA monitoring wells in the Northwest Plume have ranged from non-detect up to 285 mg/L, with an average of approximately 1.7 mg/L (detected in 12 of 16 sample stations). Some of this organic carbon may be related to naturally occurring humic acids which may act as a co-metabolic substrate. Specific analyses to identify humic acids in PGDP groundwater have not been performed.

Deleted: co-metabolite

Deleted: are

Deleted: dissolved

SUMMARY AND RECOMMENDATIONS

The downgradient decrease of TCE levels relative to chloride and ^{99}Tc in the Northwest Plume provides a means for the derivation of a site-specific TCE degradation rate coefficient for the dissolved-phase TCE contamination in the RGA. The range of the TCE degradation rate coefficient, 0.0614 to 0.2149 year^{-1} (equivalent to a TCE half-life range of 11.3 to 3.2 years, respectively) is determined primarily by the range in groundwater flow rate at PGDP, which varies along the length of the groundwater flow paths and contaminant plumes. For groundwater fate and transport modeling of the PGDP plumes, the model should incorporate the TCE degradation rate coefficient using a probabilistic approach (i.e., employing a range) where the TCE degradation rate coefficient has a uniform distribution, and the degradation rate coefficient is correlated with groundwater flow rate with a correlation coefficient of 1.0.

Deleted: degradation factor

Deleted: degradation factor

Deleted: degradation factor

Deleted: degradation factor

Deleted: degradation factor

REFERENCES

Aziz, C.E., C.J. Newell, J.R. Gonzales 2002. BIOCHLOR Natural Attenuation Decision Support System, User's Manual Version 2.2, U.S. EPA, Office of Research and Development, EPA/600/R-00/008, Washington DC, March.
www.epa.gov/ada/csmos/models/biochlor.html.

CL Solutions 2006. *CL-OUT Cometabolism – PCE Breakdown*, CL Solutions, LLC., www.cl-solutions.com/pages/TechBulletins/PCEchart.html.

Clausen, J.L., K.R. Davis, J.W. Douthitt, B.E. Phillips 1992. *Report of the Paducah Gaseous Diffusion Plant Groundwater Investigation Phase III*, KY/E-150, Martin Marietta Energy Systems, Inc. Paducah, KY, November.

Clausen, J.L, N.C. Sturchio, L.J. Heraty, L. Huang, and T. Abranjano 1997. *Evaluation of Natural Attenuation Processes for Trichloroethylene and Technetium-99 in the Northeast and Northwest Plumes*

Formatted: French (France)

Deleted: www.cl-solutions.com/pages/TechBulletins/PCEchart.html.¶

Deleted: iii¶

Formatted: Font: 11 pt

Deleted: Att F3-iii

at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky, KY/EM-113, Lockheed Martin Energy Systems, Inc., Paducah, KY, November 25.

CH2M HILL 1991. *Results of the Site Investigation, Phase I, Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, KY/ER-4, CH2M HILL Southeast, Inc., Oak Ridge, TN, March.

CH2M HILL 1992. *Results of the Site Investigation, Phase II, Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, KY/SUB/13B-97777C P-03/1991/1, CH2M HILL Southeast, Inc., Oak Ridge, TN, April.

Del Cul, G.D., W.D. Bostick, D.R. Trotter, and P.E. Osborne 1993. "Technetium-99 removal from process solutions and contaminated groundwater" in *Separation Science and Technology*, Volume 28, Issue 1-3, Marcel Dekker, Inc., New York, NY, January.

DOE (United States Department of Energy) 1993a. *Record of Decision for Interim Remedial Action of the Northwest Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/06-1143&D4, U.S. Department of Energy, Paducah, KY, July.

DOE 1993b. *Characterization of the Northwest Plume Utilizing a Driven Discrete-Depth Sampling System*, KY/ER-22, Martin Marietta Energy Systems, Inc., Paducah, KY, April 26.

DOE 1995. *Final Report on Drive-Point Sampling of the Northwest Plume and Analysis of Related Data*, KY/ER-66, Martin Marietta Energy Systems, Inc., Paducah, KY, April 17.

DOE 1999a. *Remedial Investigation Report for Waste Area Grouping 6 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1727&D2, U.S. Department of Energy, Paducah, KY, May.

DOE 1999b. *Remedial Investigation Report for Waste Area Grouping 27 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1777/V4&D2, U.S. Department of Energy, Paducah, KY, June.

DOE 2000a. *Methods for Conducting Risk Assessment and Risk Evaluations at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky. Volume 1. Human Health* and *Volume II. Ecological,* DOE/OR/07-1506&D2/V1&V2/R0, U.S. Department of Energy, Paducah, KY, December.

DOE 2000b. *Remedial Investigation Report for Waste Area Grouping 28 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1846/V4&D2, U.S. Department of Energy, Paducah, KY, August.

DOE 2000c. *Remedial Investigation Report for Waste Area Grouping 3 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1895/V1&D1, U.S. Department of Energy, Paducah, KY, September.

DOE 2001. *Feasibility Study for the Groundwater Operable Unit at Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1857&D2, U.S. Department of Energy, Paducah, KY, August.

DOE 2002. *Final White Paper on Sensitivity Analyses on the Distribution Coefficients (K_d) for Tc-99 and TCE with the Regional Flow and Transport Model*, Science Applications International Corporation, Paducah, KY, June.

DOE 2005. *Site Investigation Report for the Southwest Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-2180&D1, U.S. Department of Energy, Paducah, KY, February.

Formatted

Deleted: iii¶

Formatted: Font: 11 pt

Deleted: Att F3-iii

DOE 2005. *Record of Decision for Interim Remedial Action for the Groundwater Operable Unit for the Volatile Organic Compound Contamination at the C-400 Cleaning Building at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-2150&D2/R2, U.S. Department of Energy, Paducah, KY, July.

EPA (United States Environmental Protection Agency) 1996. Soil Screening Guidance: Technical Background Document, EPA/540/R-95/128, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington DC, May.

EPA 1998. *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water*, EPA/600/R-98/128, U.S. Environmental Protection Agency, Washington D.C., September.

Freeze, R.A. and J.A. Cherry 1979. *Groundwater*, Prentice-Hall, Incorporated, Englewood Cliffs, NJ.

Jeffers, P.M., L.M. Ward, L.M. Woytowitch, and N.L. Wolfe 1989. "Homogeneous hydrolysis rate constants for selected chlorinated methanes, ethanes, ethenes, and propanes" in *Environmental Science and Technology*, Volume 23, Issue 8, pp. 965-969, American Chemical Society, Columbus, OH, August.

Jeffers, P.M. and N.L. Wolf 1996. "Homogeneous Hydrolysis Rate Constants – Part II: Additions, Corrections, and Halogen Effects" in *Environmental Toxicology and Chemistry* Volume 15, Issue 7, pp. 1066-1070, SETAC and Alliance Communications Group, Lawrence, KS, July.

Kannard 2006. Kannard, J.R., Bechtel Jacobs Company LLC, Paducah Manager of Projects, letter to William E. Murphie, Manager, U.S. Department of Energy, Portsmouth/Paducah Project Office, January 11.

LMES 1996. *Aquifer Test Analysis of the Northwest Plume, Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, KY/ER-145, Lockheed Martin Energy Systems, Incorporated, Paducah, KY, June.

MMES 1994. *Assessment of the Influences of Groundwater Colloids on the Migration of Technetium-99 at the Paducah Gaseous Diffusion Plant Site in Paducah, Kentucky*, ORNL/TM-1247, Martin Marietta Energy Systems, Incorporated, Oak Ridge, TN, July.

Newell, C.J., R.K. McLeod, and J.R. Gonzales 1996. BIOSCREEN Natural Attenuation Decision Support System, User's Manual Version 1.3, U.S. EPA, Office of Research and Development, EPA/600/R-96/087, Cincinnati, OH, August.
www.epa.gov/ada/csmos/models/bioscrn.html.

Sorrenson, K.S., Jr., L.N. Peterson, R.L. Ely, and R.E. Hinchee 2000. *An Evaluation of Aerobic Trichloroethene Attenuation Using First-Order Rate Estimation*, Appendix E of the "Field Demonstration Report, Test Area North Final Groundwater Remediation, Operable Unit 1-07B" (DOE/ID-10718), Idaho National Engineering and Environmental Laboratory, March 27.

Sturchio, N.C., J.L. Clausen, L.J. Heraty, L.Huang, B.D. Holt, and T.A. Abranjano, Jr. 1998. "Chlorine Isotope Investigation of Natural Attenuation of Trichloroethene in an Aerobic Aquifer" in *Environmental Science and Technology*, Volume 32, Number 20, pp. 3037-3042, American Chemical Society.

Wiedemeier, T.H., M.A. Swanson, D.A. Moutoux, E.K. Gordon, J.T. Wilson, B.H. Wilson, D.H. Kampbell, J.E. Hansen, P. Haas, and F.H. Chapelle 1996. *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater*. Air Force Center for Environmental Excellence, Brooks Air Force Base, San Antonio, TX, November.

Deleted: iii¶
Formatted: Font: 11 pt
Deleted: Att F3-iii

Deleted: ¶
Page Break

THIS PAGE INTENTIONALLY LEFT BLANK.

Deleted: iii¶

Deleted: Att F3-iii

Table 1. Analyses (1995) for select monitoring wells of the Northwest Plume well fields

WELL FIELD	WELL	DATE	TCE (µg/L)	1,1-DCE (µg/L)	cis-1,2-DDCE (µg/L)	trans-1,2-DDCE (µg/L)	Vinyl Chloride (µg/L)	Chloride (µg/L)	^{99}Tc (pCi/L)
NORTH	MW236	3/23/1995	1,010	<50	<50	<50	<100	33,600	591
		4/11/1995	1,300	<50	<50	<50	<100	34,100	718
		5/3/1995	1,200	<100	<100	<100	<200	33,600	803
		6/5/1995	1,200	<100	<100	<100	<200	33,700	837
		7/20/1995	1,300	<100	<100	<100	<200	31,700	827
		8/7/1995	1,400	<100	<100	<100	<200	31,900	913
	MW238	3/30/1995	1,200	<50	<50	<50	<100	34,400	706
		4/12/1995	1,300	<100	<100	<100	<200	35,200	803
		5/4/1995	1,300	<100	<100	<100	<200	34,400	929
		6/5/1995	1,500	<100	<100	<100	<200	34,400	997
		7/24/1995	1,500	<100	<100	<100	<200	31,800	948
		8/9/1995	1,500	<100	<100	<100	<200	30,600	948
	MW241	3/29/1995	1,700	<50	<50	<50	<100	32,500	1,120
		4/13/1995	1,800	<100	<100	<100	<200	32,300	1,047
		5/3/1995	1,500	<250	<250	<250	<500	31,300	1,011
		6/7/1995	1,400	<250	<250	<250	<500	30,800	946
		7/24/1995	1,200	<100	<100	<100	<200	28,600	836
		8/9/1995	1,400	<250	<250	<250	<500	27,600	874
SOUTH	MW243	3/28/1995	12,000	<5,000	<5,000	<5,000	<10,000	53,700	3,540
		4/6/1995	12,000	<5,000	<5,000	<5,000	<10,000	54,800	3,860
		5/24/1995	12,000	<2,500	<2,500	<2,500	<5,000	53,600	3,418
		6/13/1995	13,000	<1,250	<1,250	<1,250	<2,500	55,500	3,358
		7/31/1995	12,000	<1,250	<1,250	<1,250	<2,500	52,800	3,615
		8/24/1995	13,000	<1,250	<1,250	<1,250	<2,500	51,600	3,167
	MW248	3/27/1995	9,700	<5,000	<5,000	<5,000	<10,000	52,900	1,786
		4/19/1995	13,000	<5,000	<5,000	<5,000	<10,000	54,700	1,894
		5/24/1995	11,000	<2,500	<2,500	<2,500	<5,000	53,200	1,804
		6/13/1995	11,000	<1,000	<1,000	<1,000	<2,000	52,700	1,886
		7/19/1995	9,500	<1,000	<1,000	<1,000	<2,000	53,100	1,881
		8/29/1995	13,000	<1,000	<1,000	<1,000	<2,000	54,900	1,815
	MW250	3/27/1995	8,000	<500	<500	<500	<1,000	53,000	1,860
		4/6/1995	7,100	<5,000	<5,000	<5,000	<10,000	54,400	1,851
		6/13/1995	4,600	<1,000	<1,000	<1,000	<2,000	43,800	1,032
		7/19/1995	4,000	<500	<500	<500	<1,000	44,800	945
		8/22/1995	11,000	<500	<500	<500	<1,000	51,200	2,220

Formatted

Deleted: Page Break

Deleted: iii¶

Deleted: Att F3-iii

Formatted

Deleted: Page Break

Table 2. Northwest Plume Containment System well construction data

WELL FIELD	WELL	GROUND ELEVATION (ft amsl[1])	ELEVATION OF TOP OF SCREEN (ft amsl)	ELEVATION OF BOTTOM OF SCREEN (ft amsl)	AQUIFER SYSTEM
NORTH	EW228	370	307	280	RGA
	EW229	369	315	287	RGA
	MW233	370	301	291	RGA
	MW234	369	300	290	RGA
	MW235	370	302	292	RGA
	MW236	369	299	289	RGA
	MW237	367	344	334	UCRS[2]
	MW238	371	300	290	RGA
	MW239	370	223	213	McN[3]
	MW240	370	300	290	RGA
	MW241	370	303	293	RGA
SOUTH	EW230	368	312	273	RGA
	EW231	367	307	280	RGA
	MW242	370	304	294	RGA
	MW243	368	302	292	RGA
	MW244	366	301	291	RGA
	MW245	369	304	294	RGA
	MW246	367	351	341	UCRS
	MW247	367	231	221	McN
	MW248	368	300	290	RGA
	MW249	367	301	291	RGA
	MW250	368	304	294	RGA

[1]amsl = above mean sea level

[2]UCRS = Upper Continental Recharge System (groundwater system overlying the RGA)

[3]McN = McNairy Formation Flow System (groundwater system underlying the RGA)

Deleted: iii¶

Deleted: Att F3-iii

Formatted

Deleted: Page Break

Table 3. TCE and ^{99}Tc levels in the Northwest Plume extraction wells and the data set

WELL FIELD	WELL/ SAMPLE POINT	SAMPLE DATE	ANALYSES TCE (µg/L)	ANALYSES ^{99}Tc (pCi/L)	MONITORING WELL DATA SET (AUGUST 1995) TCE (µg/L)	MONITORING WELL DATA SET (AUGUST 1995) ^{99}Tc (pCi/L)
NORTH	EW228/ HV004	10/22/97	569	350	1,400 to 1,500	874 to 913
		12/29/97	574	369		
	EW229/ HV009	10/22/97	1,395	786		
		12/29/97	1,182	721		
SOUTH	EW230/ HV015	10/3/97	12,710		11,000 to 13,000	1,815 to 3,167
		10/10/97	10,214			
		10/17/97	11,184			
		10/22/97	11,731	1,602		
		10/31/97	10,699			
		12/29/97	11,289	1,481		
	EW231/ HV20	10/3/97	6,112			
		10/10/97	4,216			
		10/17/97	4,528			
		10/22/97	475	773		
		10/31/97	3,932			
		12/29/97	1,553	627		

Deleted: iii¶

Deleted: Att F3-iii

Formatted

Deleted: Page Break

Formatted: French (France)

Table 4. RGA matrix organic carbon concentrations

BORING	DEPTH (ft)	HU[1]	TOTAL ORGANIC CARBON (µg/kg)	
400-036	62	HU4	29,000	
400-036	79	HU5	42,000	
400-036	69	HU5	49,000	
400-207	83	HU5	79,000	
400-207	67	HU5	101,000	
400-207	72	HU5	117,000	
400-038	61	HU5	141,000	
400-212	79	HU5	147,000	
400-212	70.5	HU5	149,000	
400-210	73.5	HU5	149,000	
400-210	61	HU5	154,000	
400-208	71	HU5	156,000	
026-001	60	HU5	171,000	
400-038	87.5	HU5	179,000	
400-212	50.5	HU4	194,000	
400-038	73	HU5	194,000	
SWMU2-17	85	HU5	199,000	
400-208	63	HU5	210,000	
026-001	72	HU5	213,000	
026-001	82	HU5	244,000	
400-212	60.5	HU5	262,000	
400-038	80.5	HU5	276,000	
400-212	90	HU5	297,000	
400-208	81	HU5	298,000	
SWMU2-13	80.5	HU5	321,000	
400-208	48.5	HU4?[2]	353,000	
001-169	50	HU4?	380,000	
SWMU2-09	75	HU5	394,000	
001-168	47	HU4?	398,000	
400-210	80	HU5	444,000	
SWMU2-05	70	HU5	453,000	
SWMU2-17	50	HU4	464,000	
400-036	91	HU5	495,000	
001-168	50	HU4?	638,000	
001-174	50	HU4?	695,000	
SWMU2-13	80.5	HU5	796,000	
SWMU2-13	63	HU4	1,060,000	
SWMU2-03	70	HU5	2,530,000	Foc (%)
		AVERAGE	354,500	0.03545
		MEDIAN	228,500	0.02285

[1]HU = hydrogeologic unit. RGA = HU4 + HU5
[2]? = The observation is either from a HU3 or HU4 sample.

Deleted: iii¶

Deleted: Att F3-iii

Deleted: Page Break

Table 5. Parameters used for modeling

INPUT PARAMETER	UNIT	VALUE
Hydraulic Conductivity	cm/sec	0.242
Hydraulic Gradient	ft/ft	0.0006
Effective Porosity	%	30
Dispersivity – Longitudinal	ft	60
Dispersivity – Transverse	ft	6
Dispersivity – Vertical	ft	1.5
Aquifer Bulk Density	kg/L	1.67
Organic Carbon Content	%	0.02
TCE Organic Partition Coeff.	L/kg	94
TCE Degradation Rate	yr^{-1}	0.083
Aquifer Thickness	ft	35
TCE Source Width	ft	300
TCE Source Concentration	mg/L	250

Deleted: iii¶

Deleted: Att F3-iii

Deleted: Page Break

Table 6. Assessment of natural attenuation potential (from DOE 1995)

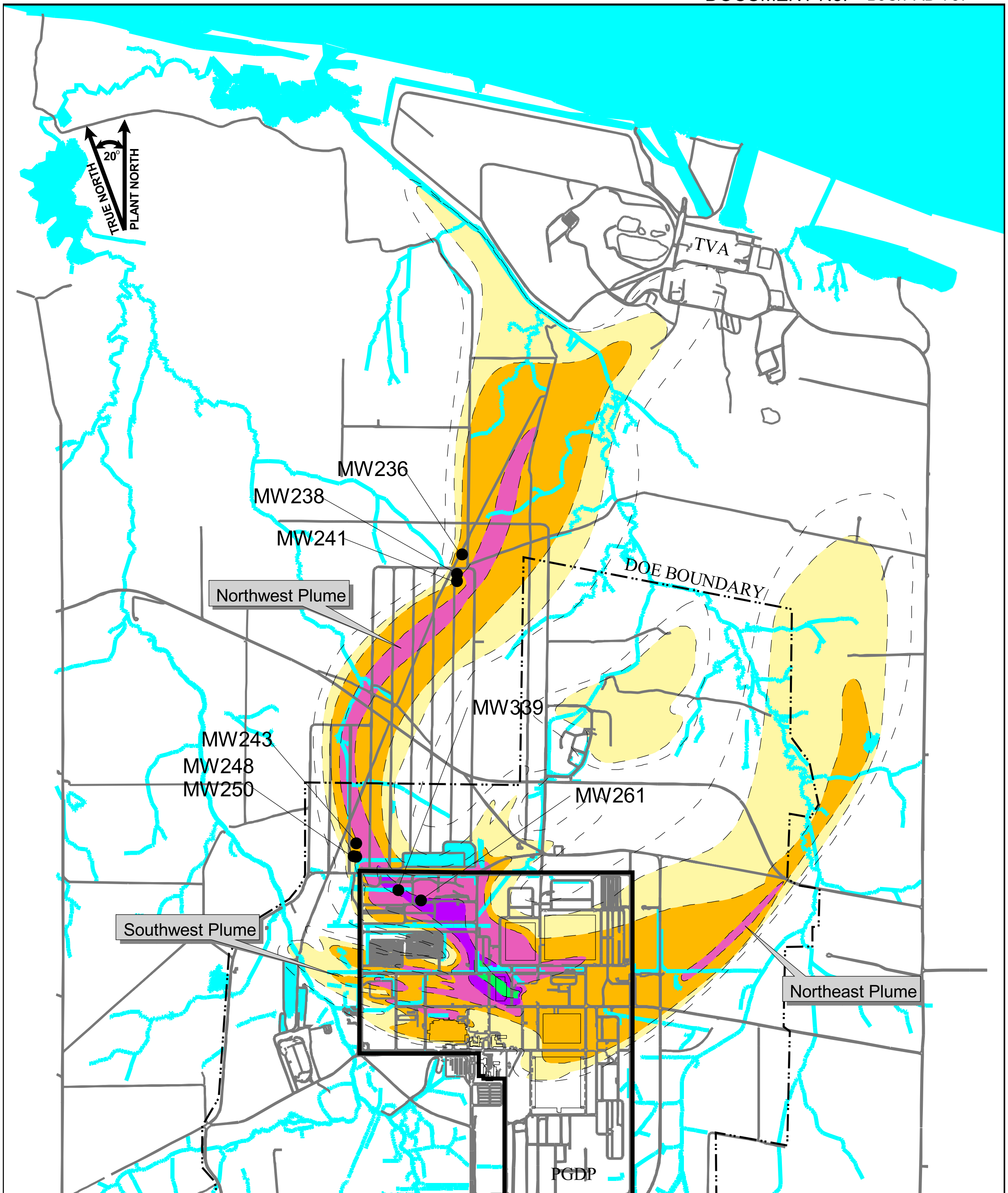
ANALYSIS	CONCENTRATION IN MOST CONTAMINATED ZONE	INTERPRETATION	VALUE
Oxygen	<0.5 mg/L >1 mg/L	Higher concentrations suppress reductive pathway. Vinyl chloride may be oxidized aerobically.	3 -3
Nitrate	<1 mg/L	Higher concentrations may compete with reductive pathway.	2
Iron (II)	>1 mg/L	Reductive pathway possible.	3
Sulfate	<20 mg/L	Higher concentrations may compete with reductive pathway.	2
Sulfide	>1 mg/L	Reductive pathway possible.	3
Methane	<0.5 mg/L >0.5 mg/L	Vinyl chloride oxidizes. Vinyl chloride accumulates.	3
Eh	<50 mV <-100 mV	Reductive pathway possible. Reductive pathway likely.	1 2
pH	5<pH<9 5>pH>9	Optimal range for reductive pathway. Outside optimal range.	0 -2
Total Organic Carbon	>20 mg/L	Carbon source for biochemical processes.	2
Temperature	>20°C	At temperature >20°C, biochemical processes are accelerated.	1
Carbon Dioxide	>2x Background	Ultimate oxidative daughter product.	1
Alkalinity	>2x Background	Interaction of carbon dioxide with aquifer matrix.	1
Chloride	>2x Background	Daughter product of organic chlorine.	2
Hydrogen	>1 nM <1 nM	Reductive pathway possible. Vinyl chloride oxidized.	3 0
Volatile Fatty Acids	>0.1 mg/L	Intermediate product of biodegradation.	2
BTEX[a]	>0.1 mg/L	Drives dechlorination.	2
TCE		Material released.	
cis-1,2-Dichloroethene[b]		Daughter product of TCE.	2[b]
Vinyl Chloride[b]		Daughter product of *cis*-1,2-Dichloroethene.	2[b]
Ethene/ Ethane[b]	> 0.01 mg/L >0.1 mg/L	Daughter product of Vinyl Chloride. Daughter product of Ethene.	2[b] 3[b]
Chloroethane[b]		Daughter product of Vinyl Chloride.	2[b]
1,1-Dichloroethene[b]		Daughter product of TCE.	2[b]

[a]BTEX = benzene, toluene, ethylbenzene, and xylene
[b]Points awarded only if the compound is a daughter product and not a constituent of the source DNAPL. Modified from Wiedemeier et al. 1996.

Deleted: iii¶

Deleted: Att F3-iii

DOCUMENT No. BJC/PAD-757



LEGEND:

ISOCONCENTRATION BOUNDARY (INTERPRETED)

MONITORING WELL LOCATION

3000 0 3000 Ft

TCE CONCENTRATIONS (ug/L)

- >100,000
- 10,000 - 100,000
- 1,000 - 10,000
- 100 - 1,000
- 5 - 100
- 1 - 5

U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS

BECHTEL JACOBS COMPANY LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-03OR22980
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

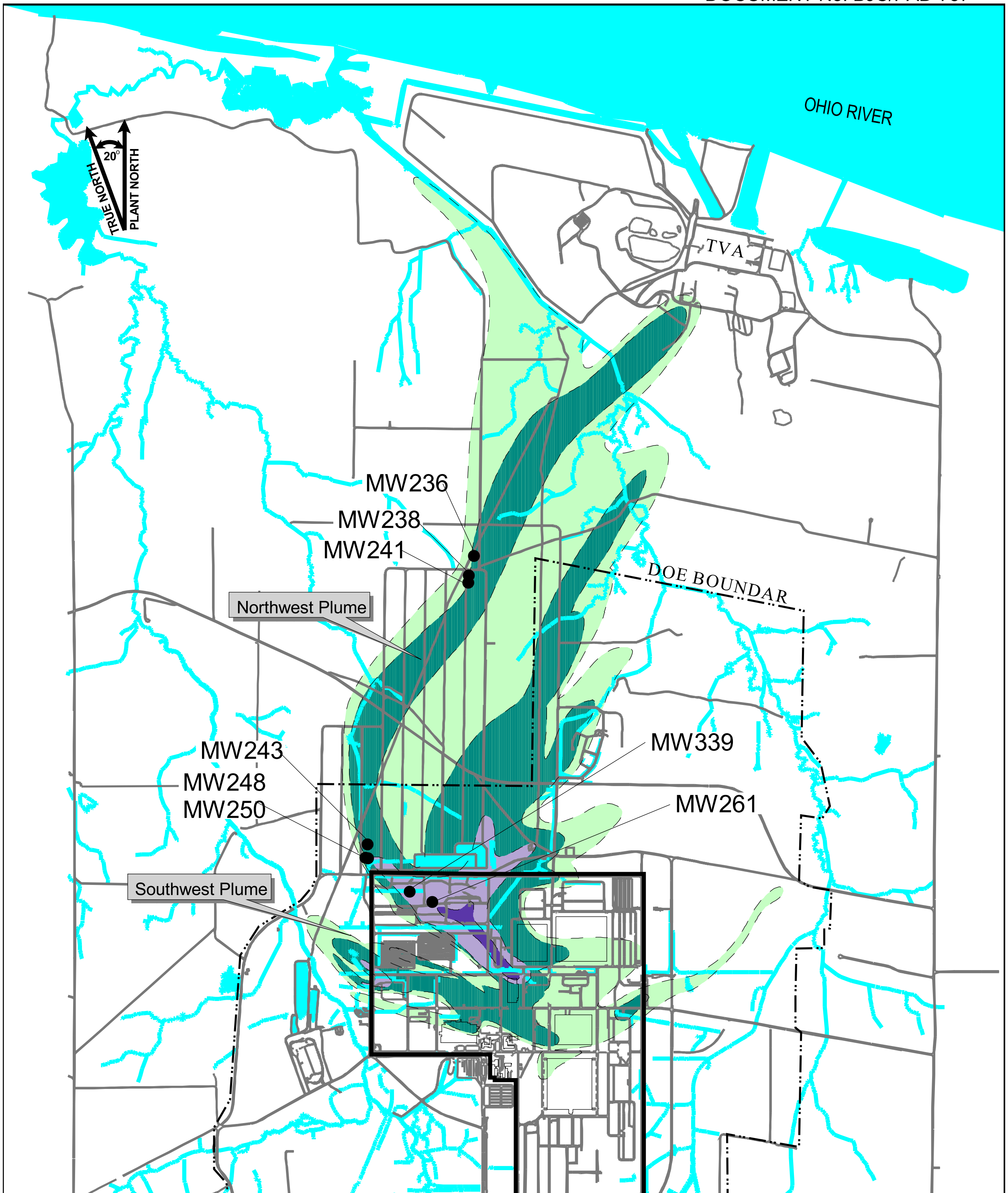
Fig. 1. Trichloroethene plume locations (Year 2004).

SAIC

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

FIGURE No. White_paper_2006.apr
DATE 01-17-06

DOCUMENT No. BJC/PAD-757



LEGEND:

ISOCONCENTRATION BOUNDARY (INTERPRETED)

MONITORING WELL LOCATION

3000 0 3000 Ft

Tc-99 ACTIVITIES (pCi/L)

- >3,790
- 900 - 3,790
- 100 - 900
- 25 - 100

U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

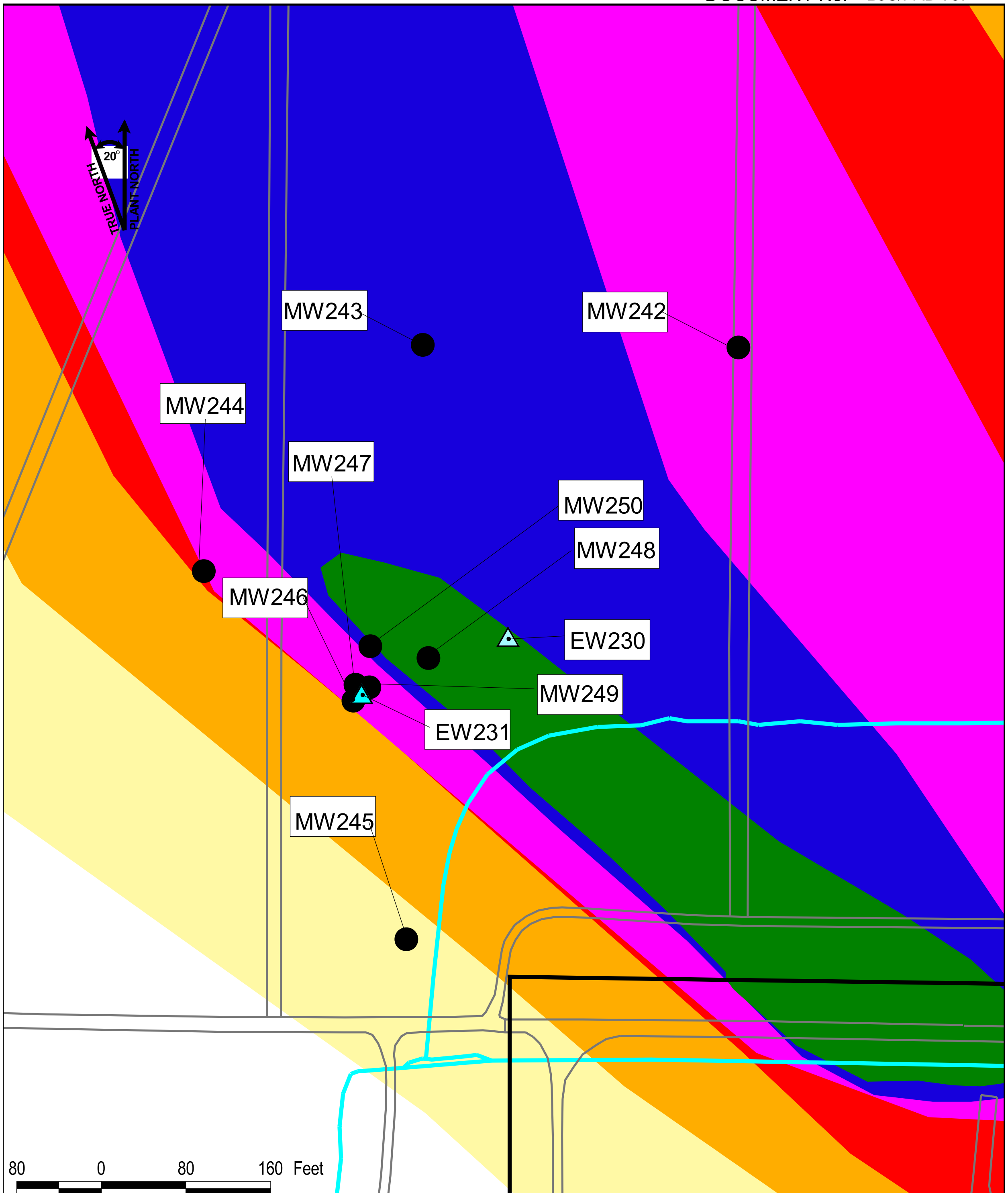
BECHTEL JACOBS COMPANY LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-03OR22980
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Fig. 2. 99Technetium plume locations (Year 2004).

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

FIGURE No. White_paper_2006_tc99.apr
DATE 01-20-06

DOCUMENT No. BJC/PAD-757



LEGEND:

ISOCONCENTRATION BOUNDARY (INTERPRETED)
MONITORING WELL LOCATION
EXTRACTION WELL LOCATION

TCE CONCENTRATIONS (ug/L)
TCE 10000
TCE 5000
TCE 1000
TCE 100
TCE 10
TCE 0

U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

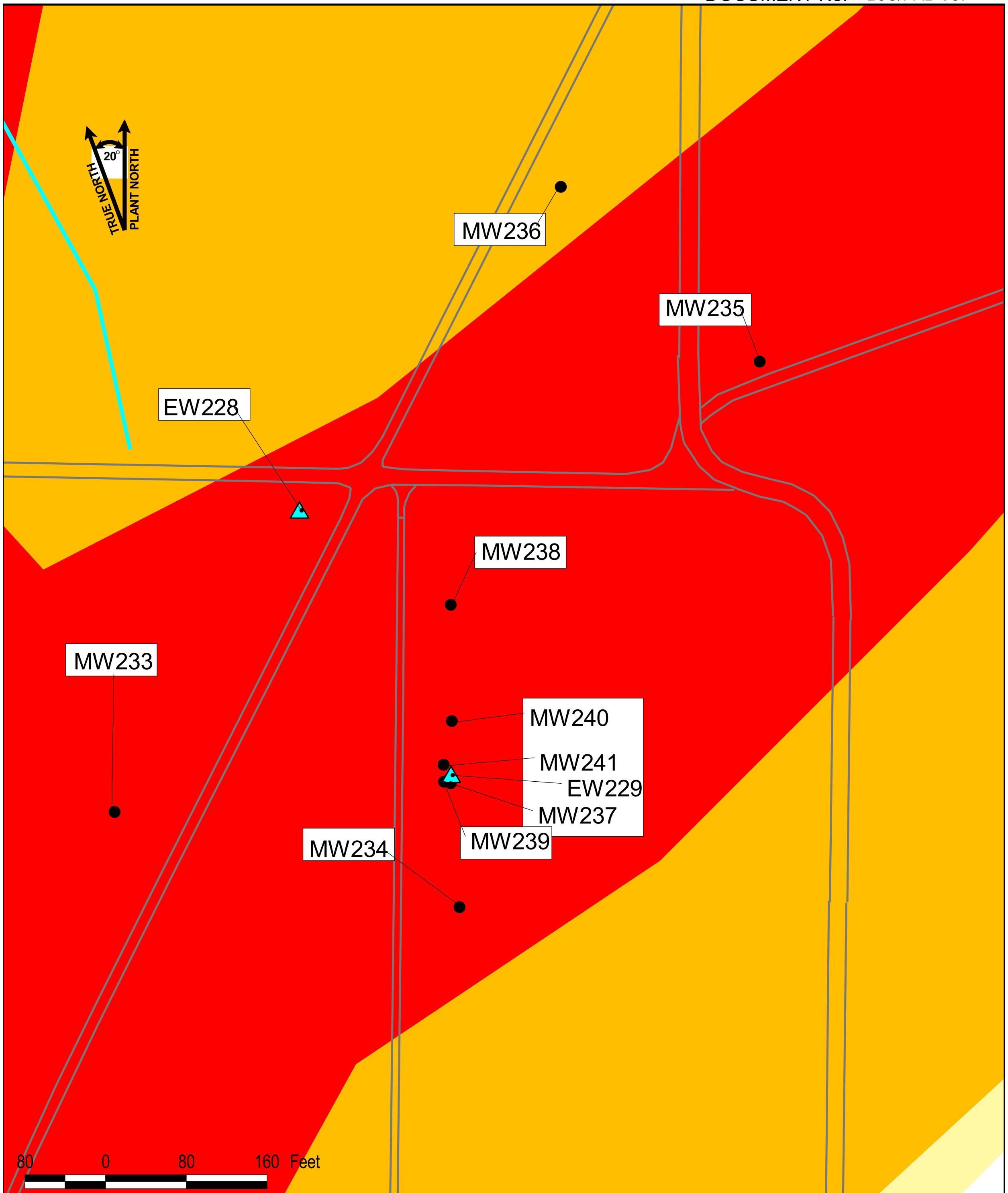
BECHTEL JACOBS
BECHTEL JACOBS COMPANY LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-03OR22980
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Fig. 3. Northwest Plume Containment System, south well field with the Year 1995 TCE Plume.

SAIC
Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

FIGURE No. White_paper_2006.apr
DATE 01-30-06

DOCUMENT No. BJC/PAD-757



LEGEND:

- ISOCONCENTRATION BOUNDARY (INTERPRETED)
- MONITORING WELL LOCATION
- EXTRACTION WELL LOCATION

TCE CONCENTRATIONS (ug/L)

- TCE 10000
- TCE 5000
- TCE 1000
- TCE 100
- TCE 10
- TCE 0

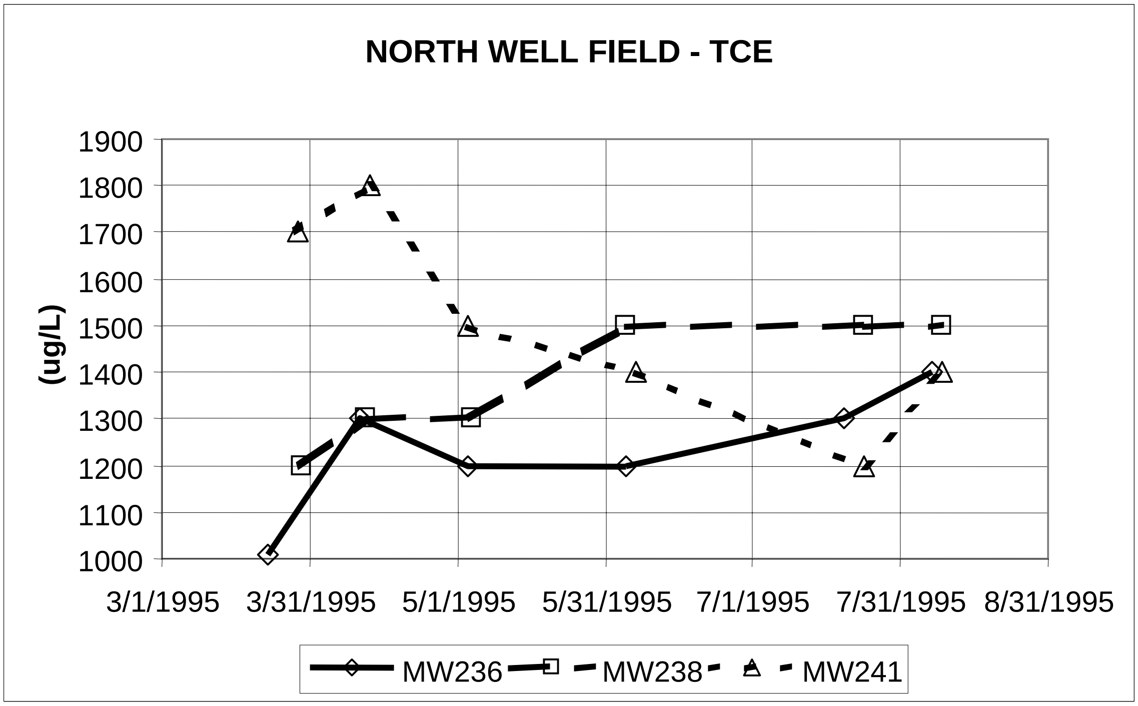
U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

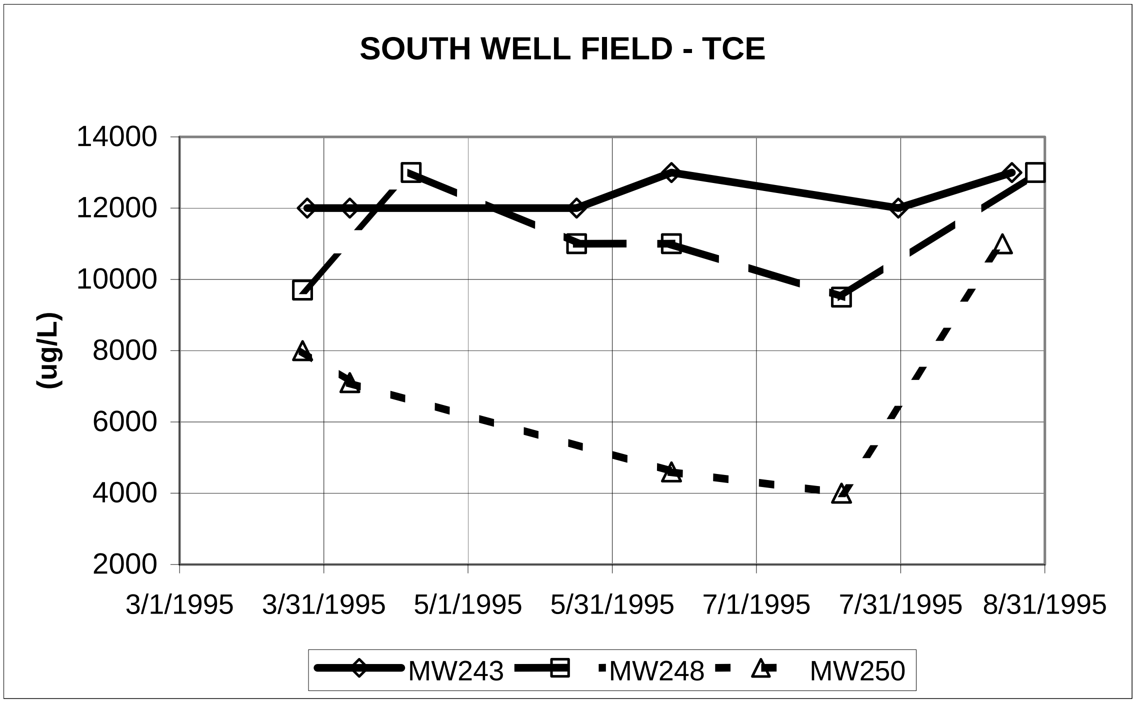
BECHTEL JACOBS COMPANY LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-03OR22980
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Fig. 4. Northwest Plume Containment System, north well field with the Year 1995 TCE Plume.

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

FIGURE No. White_paper_2006.apr
DATE 01-30-06





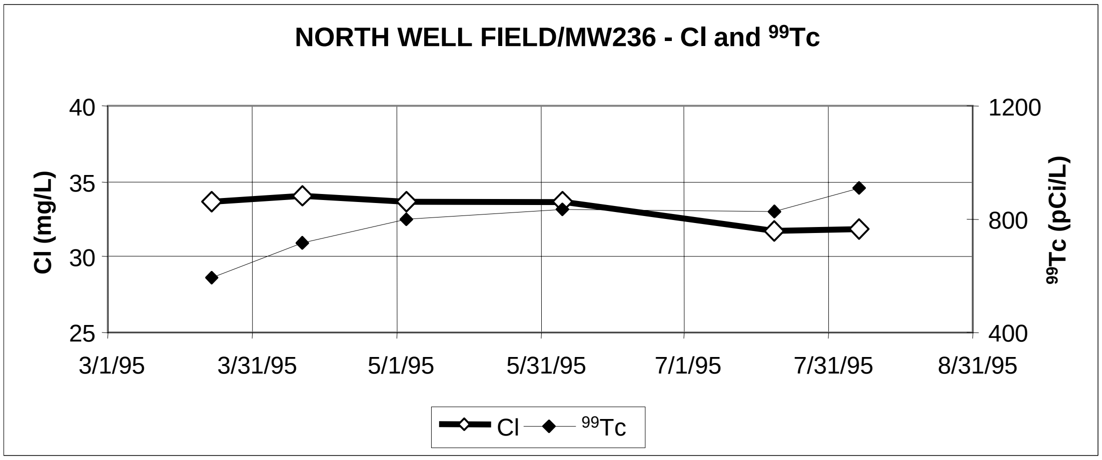
U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

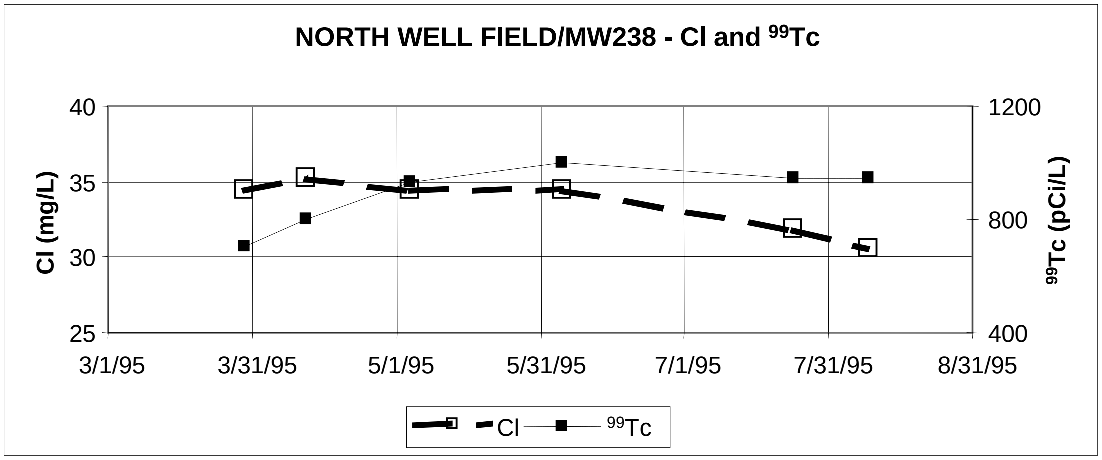
BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-03OR22980
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

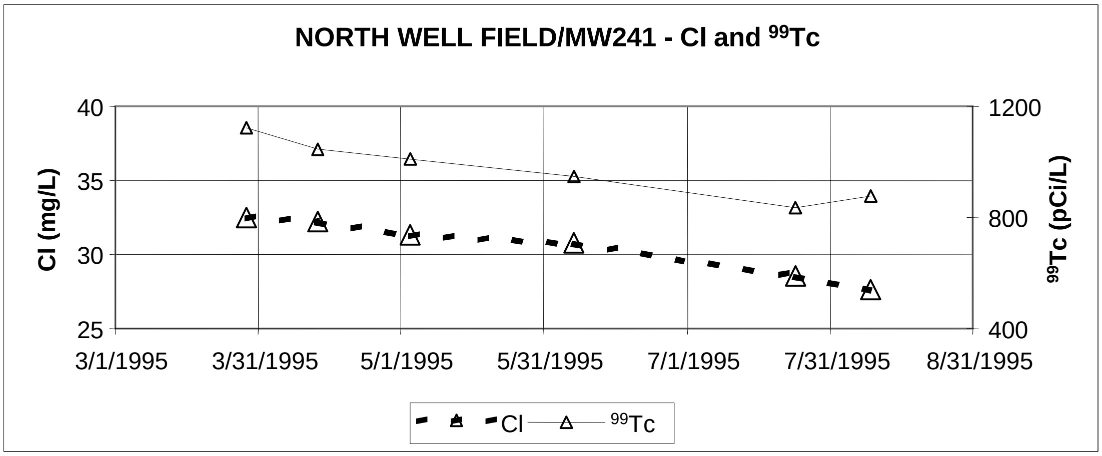
Science Applications
International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 5. Plots of dissolved TCE concentrations in the Northwest Plume north and south well fields, March – August 1995.

FIGURE No.Fig5.ppt
DATE 01-30-06







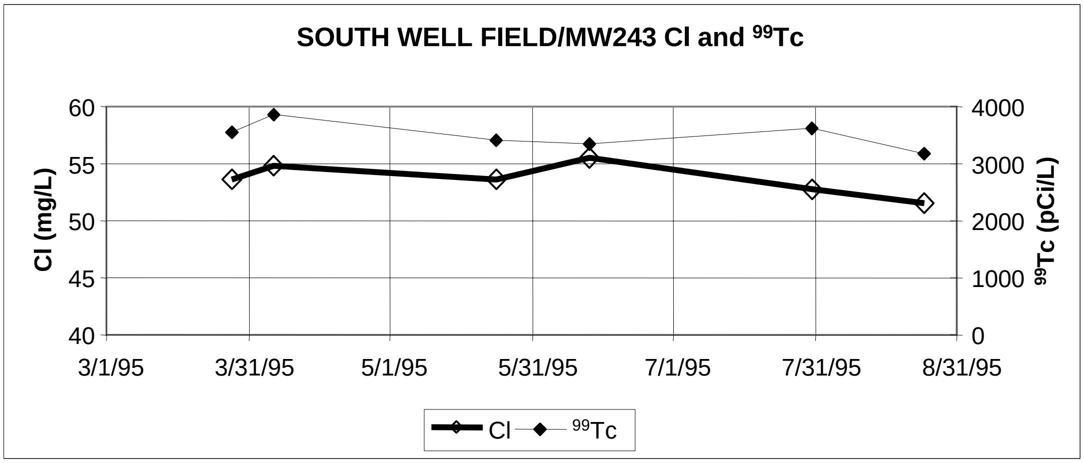
U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

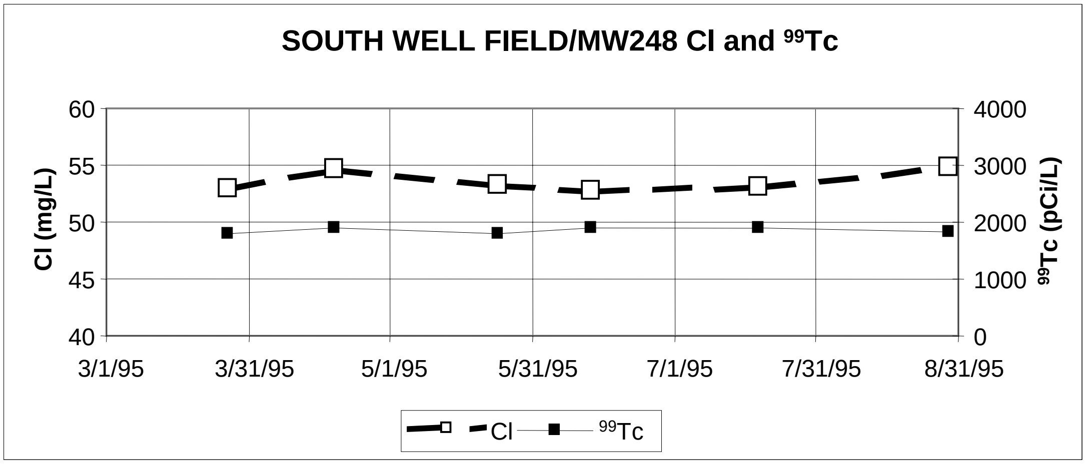
BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-03OR22980
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

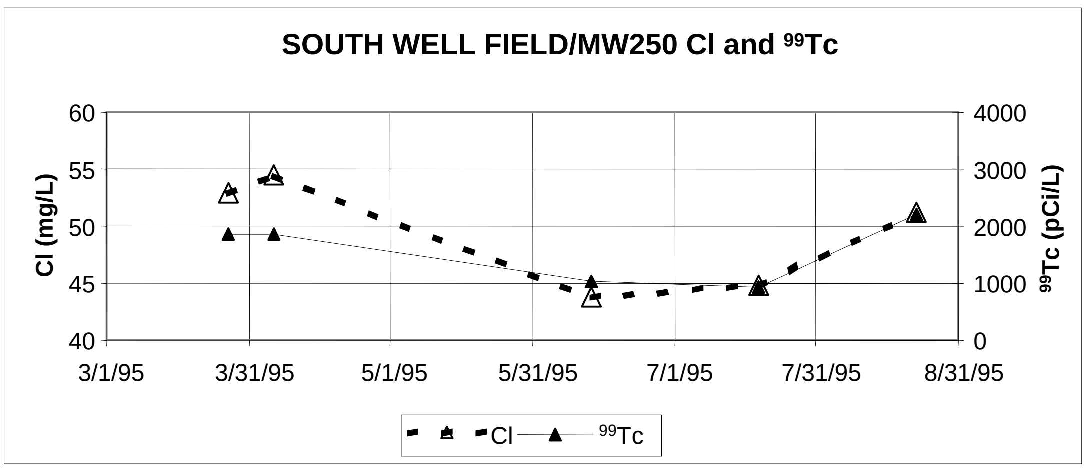
Fig. 6. Plots of dissolved Cl and ^{99}Tc levels in the Northwest Plume north well field, March – August 1995.

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

FIGURE No.Fig6.ppt
DATE 01-30-06







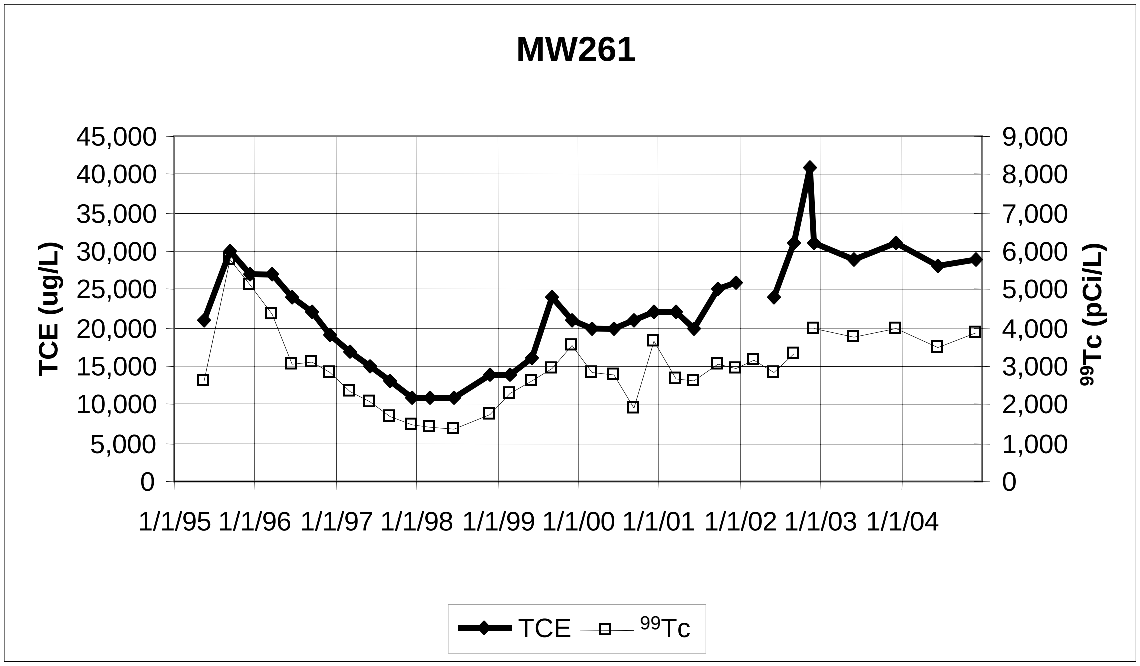
U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

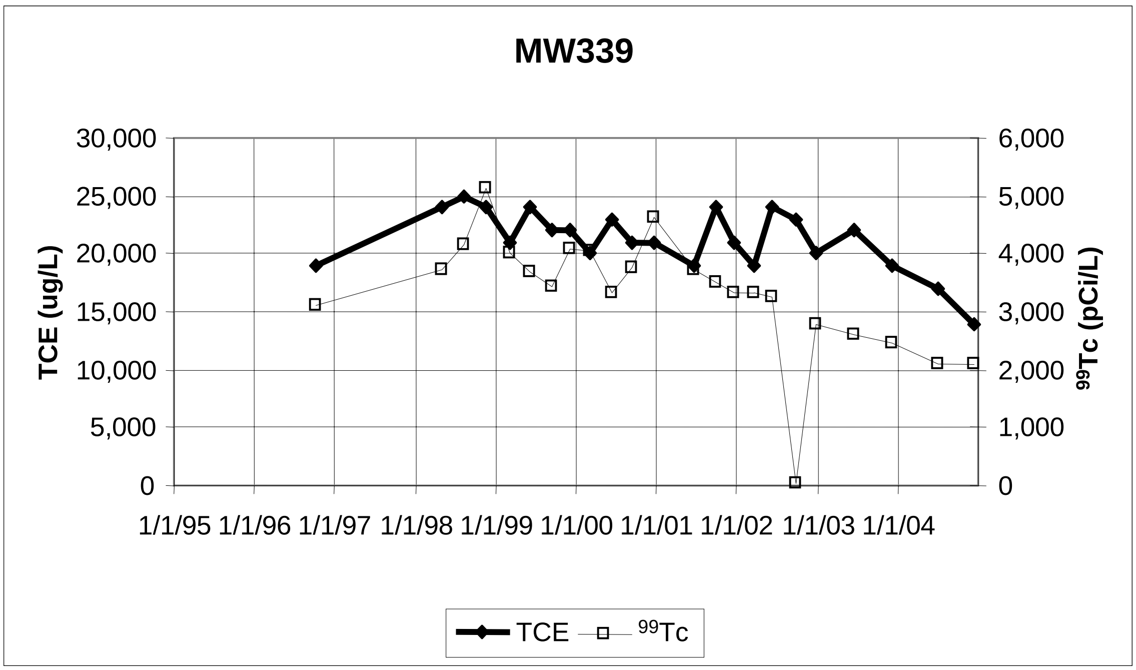
BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-03OR22980
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Fig. 7. Plots of dissolved Cl and ^{99}Tc levels in the Northwest Plume south well field, March – August 1995.

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

FIGURE No.Fig7.ppt
DATE 01-30-06





U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-03OR22980
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

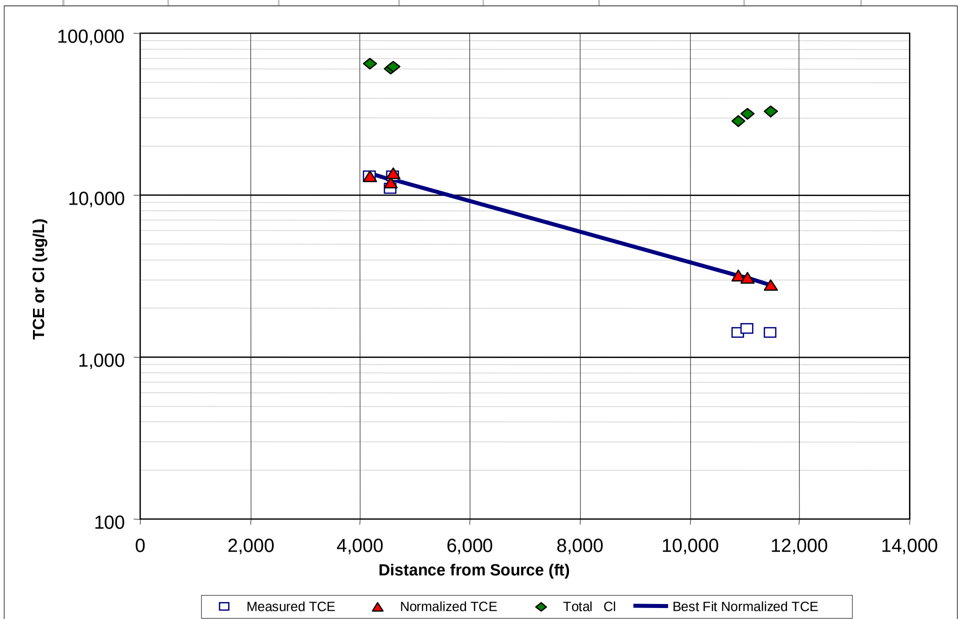
Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 8. Upgradient contaminant levels.

FIGURE No.Fig8.ppt
DATE 01-30-06

Location	Distance from Source	Measured TCE	Normalized TCE	Total Cl	Best Fit Normalized TCE	Normalization Factor	Ln Normalized TCE
MW248	4,170	13,000	13,000	65,417	13,618	65,417/65,417	9.4727
MW250	4,545	11,000	11,973	60,099	12,556	65,417/60,099	9.3904
MW243	4,592	13,000	13,691	62,117	12,429	65,417/62,117	9.5245
MW241	10,892	1,400	3,187	28,733	3,179	65,417/28,733	8.0670
MW238	11,051	1,500	3,084	31,814	3,071	65,417/31,814	8.0341
MW236	11,479	1,400	2,773	33,033	2,800	65,417/33,033	7.9275

	Normalized TCE
Slope	-2.164E-04
Ln Intercept	10.422
Intercept	33,580
Correl	-0.998
R^2	0.996
TCE Degradation Factor (year^{-1})	0.0719
TCE Half-life (years)	9.6
Assumed Contam. Transport Rate (ft/day)	0.91
GW Flow Rate (ft/day)	1.00



(Data are from August 1995)

Location	Measured TCE	Organic Cl	Measured Cl	Total Cl
MW248	13,000	10,517	54,900	65,417
MW250	11,000	8,899	51,200	60,099
MW243	13,000	10,517	51,600	62,117
MW241	1,400	1,133	27,600	28,733
MW238	1,500	1,214	30,600	31,814
MW236	1,400	1,133	31,900	33,033

TCE Degradation Factor (year^{-1}) =
Slope (1/ft) x 365 days/year x Assumed Contam. Transport Rate (ft/day)

TCE Half-life (years) =
natural logarithm 2/TCE Attenuation Rate (year $^{-1}$)

U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-03OR22980
Oak Ridge, Tennessee ● Paducah, Kentucky ● Portsmouth, Ohio

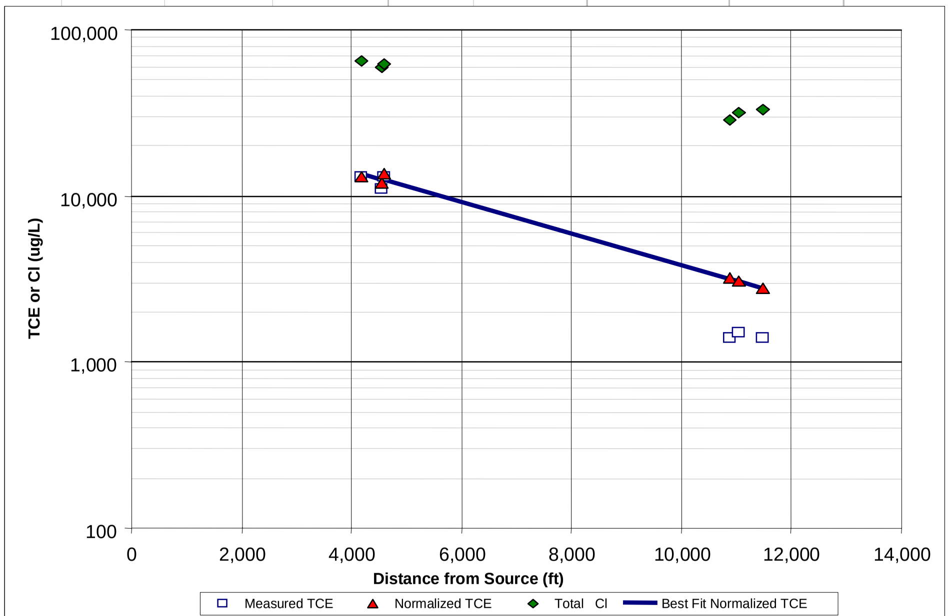
Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 9. Derivation of dissolved TCE degradation rate using chloride – groundwater flow rate = 1 ft/d.

FIGURE No.Fig9.ppt
DATE 01-30-06

Location	Distance from Source	Measured TCE	Normalized TCE	Total Cl	Best Fit Normalized TCE	Normalization Factor	Ln Normalized TCE
MW248	4,170	13,000	13,000	65,417	13,618	65,417/65,417	9.4727
MW250	4,545	11,000	11,973	60,099	12,556	65,417/60,099	9.3904
MW243	4,592	13,000	13,691	62,117	12,429	65,417/62,117	9.5245
MW241	10,892	1,400	3,187	28,733	3,179	65,417/28,733	8.0670
MW238	11,051	1,500	3,084	31,814	3,071	65,417/31,814	8.0341
MW236	11,479	1,400	2,773	33,033	2,800	65,417/33,033	7.9275

	Normalized TCE
Slope	-2.164E-04
Ln Intercept	10.422
Intercept	33,580
Correl	-0.998
R^2	0.996
TCE Degradation Factor (year^{-1})	0.2149
TCE Half-life (years)	3.2
Assumed Contam. Transport Rate (ft/day)	2.72
GW Flow Rate (ft/day)	3.00



Data are from August 1995

Location	Measured TCE	Organic Cl	Measured Cl	Total Cl
MW248	13,000	10,517	54,900	65,417
MW250	11,000	8,899	51,200	60,099
MW243	13,000	10,517	51,600	62,117
MW241	1,400	1,133	27,600	28,733
MW238	1,500	1,214	30,600	31,814
MW236	1,400	1,133	31,900	33,033

TCE Degradation Factor (year^{-1}) =
Slope (1/ft) x 365 days/year x Assumed Contam. Transport Rate (ft/day)

TCE Half-life (years) =
natural logarithm 2/TCE Attenuation Rate (year $^{-1}$)

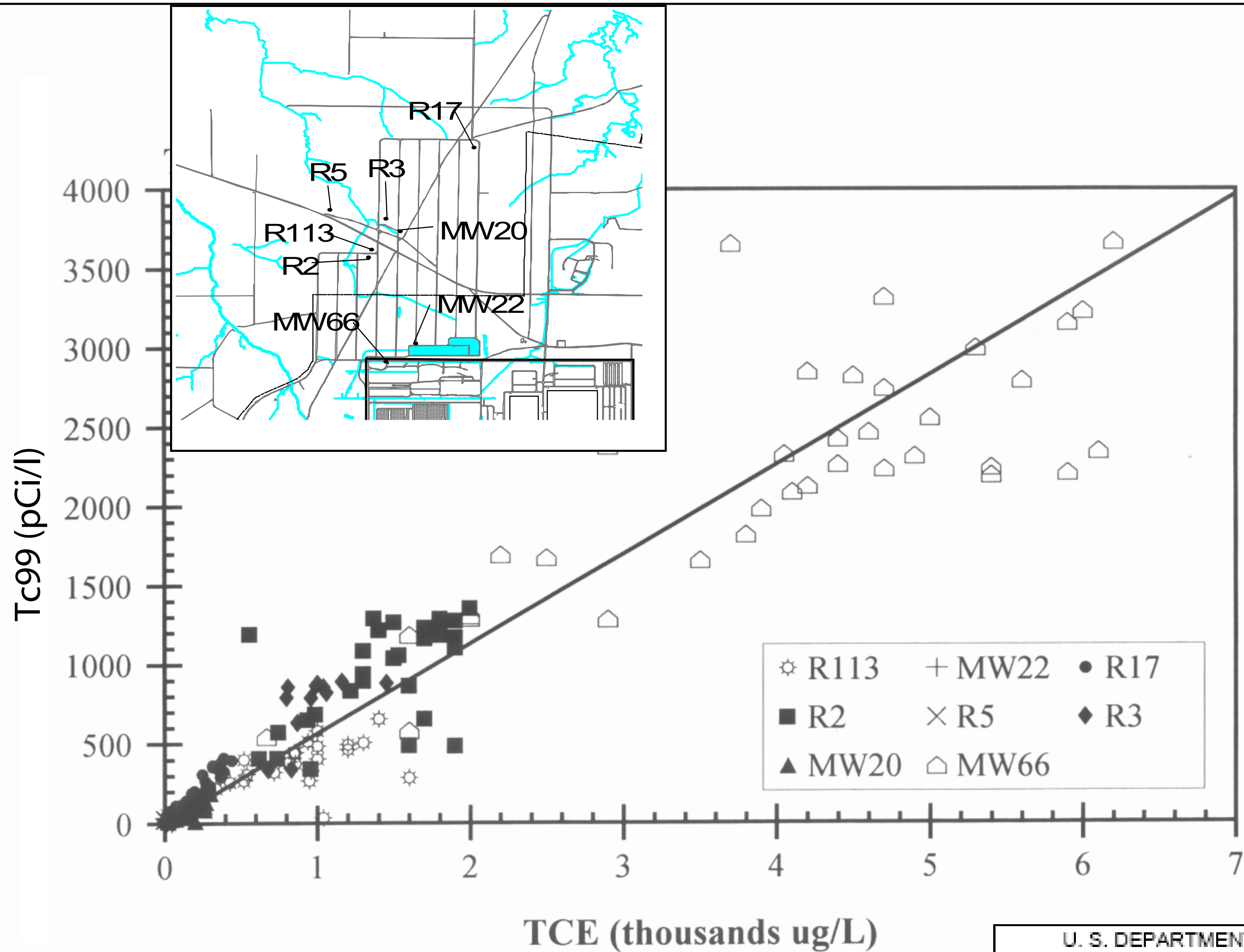
U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-03OR22980
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 10. Derivation of dissolved TCE degradation rate using chloride – groundwater flow rate = 3 ft/d.

FIGURE No. Fig10.ppt
DATE 01-23-06



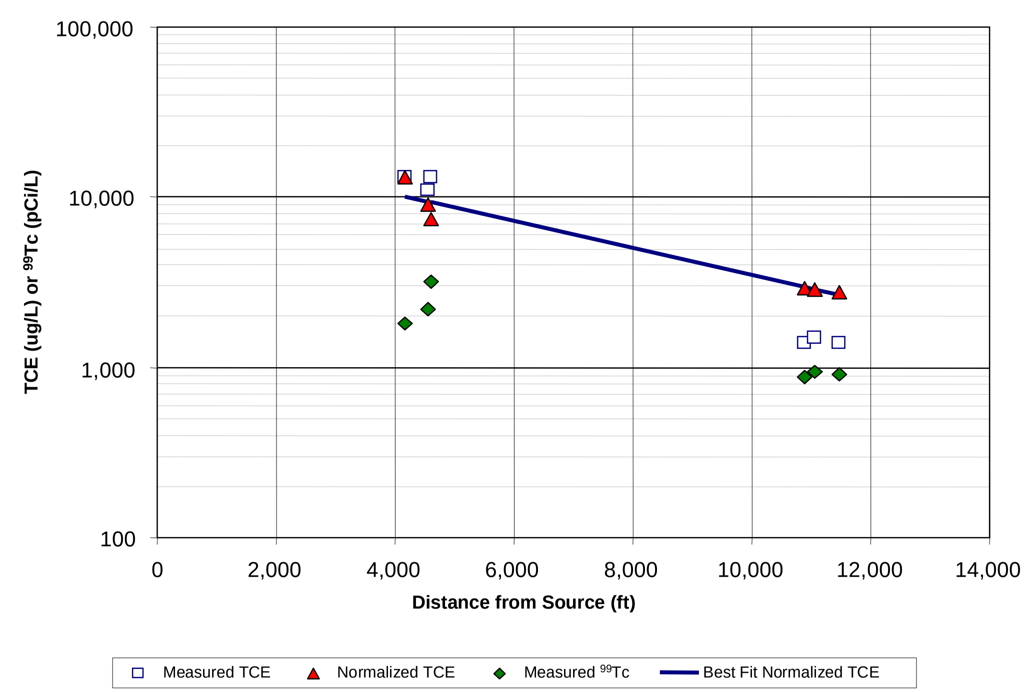
U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-03OR22980
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications
International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Figure 11. Comparison of TCE versus Tc-99 for wells in the Northwest Plume.

		August 1995 Data							
Location	Distance from Source	Measured TCE	Normalized TCE	Measured ^{99}Tc	Best Fit Normalized TCE	Normalization Factor	Ln Normalized TCE		Normalized TCE
MW248	4,170	13,000	13,000	1,815	10,066	1,815/1,815	9.4727	Slope	-1.815E-04
MW250	4,545	11,000	8,993	2,220	9,404	1,815/2,220	9.1042	Ln Intercept	9.974
MW243	4,592	13,000	7,450	3,167	9,324	1,815/3,167	8.9160	Intercept	21,453
MW241	10,892	1,400	2,907	874	2,972	1,815/874	7.9750	Correl	-0.974
MW238	11,051	1,500	2,872	948	2,888	1,815/948	7.9627	R^2	0.949
MW236	11,479	1,400	2,783	913	2,672	1,815/913	7.9313		



TCE Degradation Factor (year^{-1})	0.0603
TCE Half-life (years)	11.5
Assumed Contam. Transport Rate (ft/day)	0.91
GW Flow Rate (ft/day)	1.00

TCE Degradation Factor (year^{-1}) =
Slope (1/ft) x 365 day/yr x Assumed Contam. Transport Rate (ft/day)

TCE Half-life (years) =
natural logarithm 2/ TCE Attenuation Rate (year^{-1})

Fig. 12. Derivation of dissolved TCE degradation rate using ^{99}Tc – groundwater flow rate = 1 ft/d.

U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

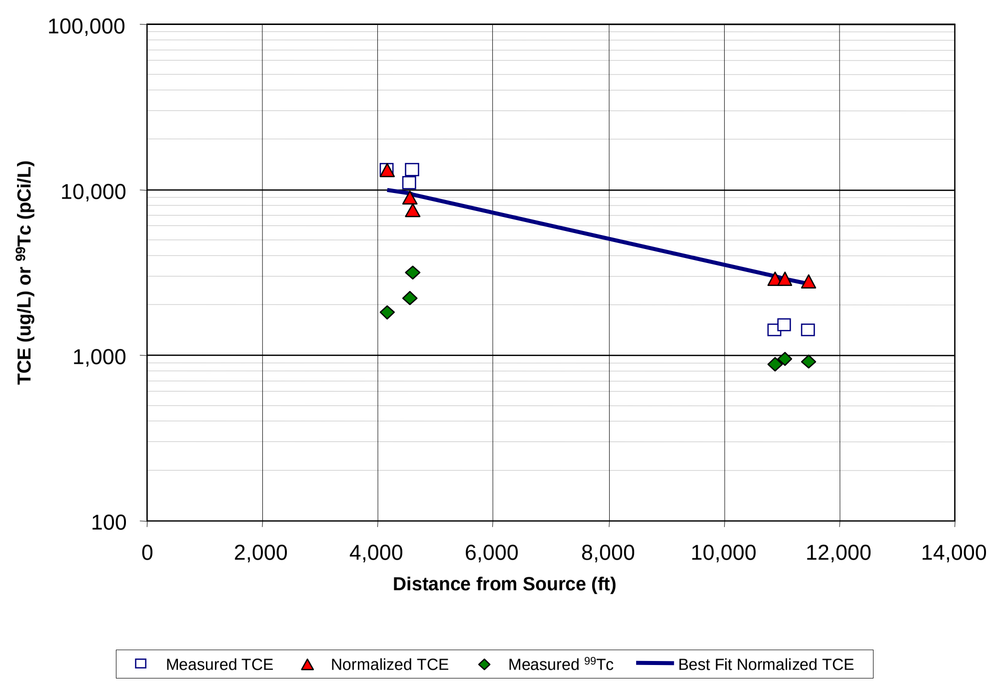
BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-03OR22980
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

FIGURE No.Fig12.ppt
DATE 01-30-06

Location	Distance from Source	Measured TCE	Normalized TCE	Measured ^{99}Tc	Normalization Factor	Best Fit Normalized TCE	Ln Normalized TCE
	August 1995 Data						
MW248	4,170	13,000	13,000	1,815	1,815/1,815	10,066	9.4727
MW250	4,545	11,000	8,993	2,220	1,815/2,220	9,404	9.1042
MW243	4,592	13,000	7,450	3,167	1,815/3,167	9,324	8.9160
MW241	10,892	1,400	2,907	874	1,815/874	2,972	7.9750
MW238	11,051	1,500	2,872	948	1,815/948	2,888	7.9627
MW236	11,479	1,400	2,783	913	1,815/913	2,672	7.9313

	Normalized TCE
Slope	-1.815E-04
Ln Intercept	9.974
Intercept	21,453
Correl	-0.974
R^2	0.949



TCE Degradation Factor (year $^{-1}$)	0.1802
TCE Half-life (years)	3.8
Assumed Contam. Transport Rate (ft/day)	2.72
GW Flow Rate (ft/day)	3.00

TCE Degradation Factor (year $^{-1}$) =
Slope (1/ft) x 365 day/yr x Assumed Contam. Transport Rate (ft/day)

TCE Half-life (years) =
natural logarithm 2/
TCE Attenuation Rate (year $^{-1}$)

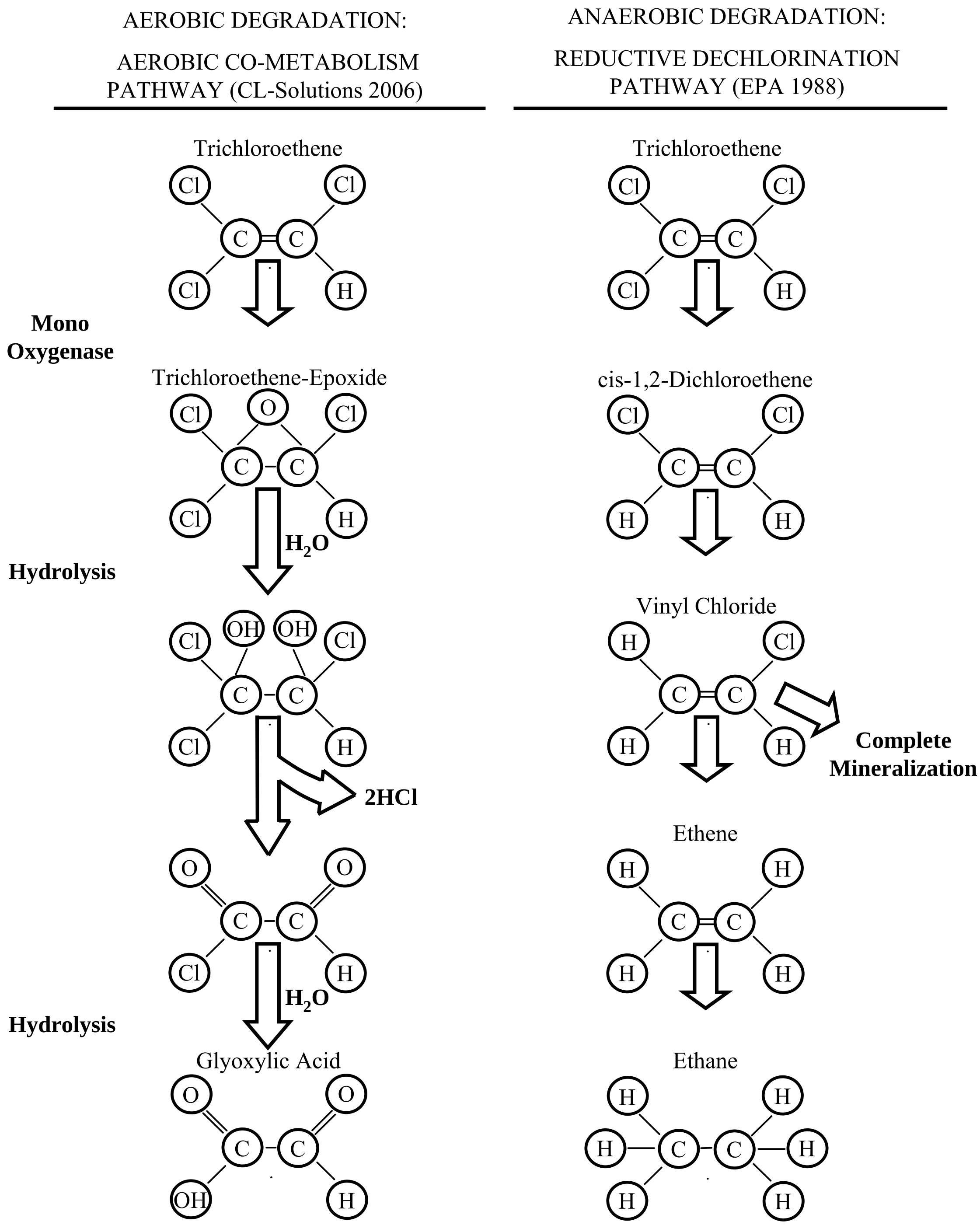
Fig. 13. Derivation of dissolved TCE degradation rate using ^{99}Tc – groundwater flow rate = 3 ft/d.

U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-03OR22980
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

FIGURE No.Fig13.ppt
DATE 01-30-06



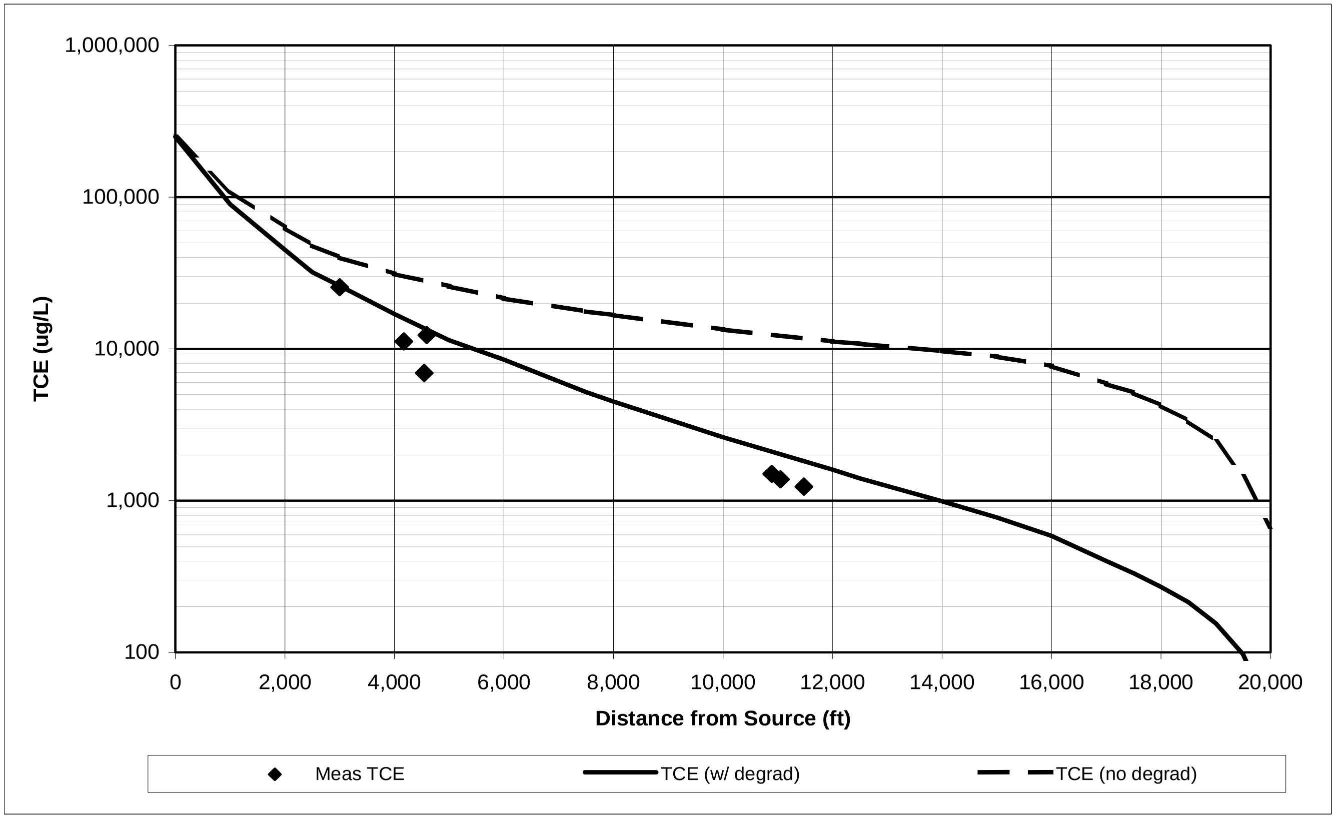
U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-03OR22980
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 14. TCE biodegradation pathways.

FIGURE No.Fig14.ppt
DATE 01-30-06



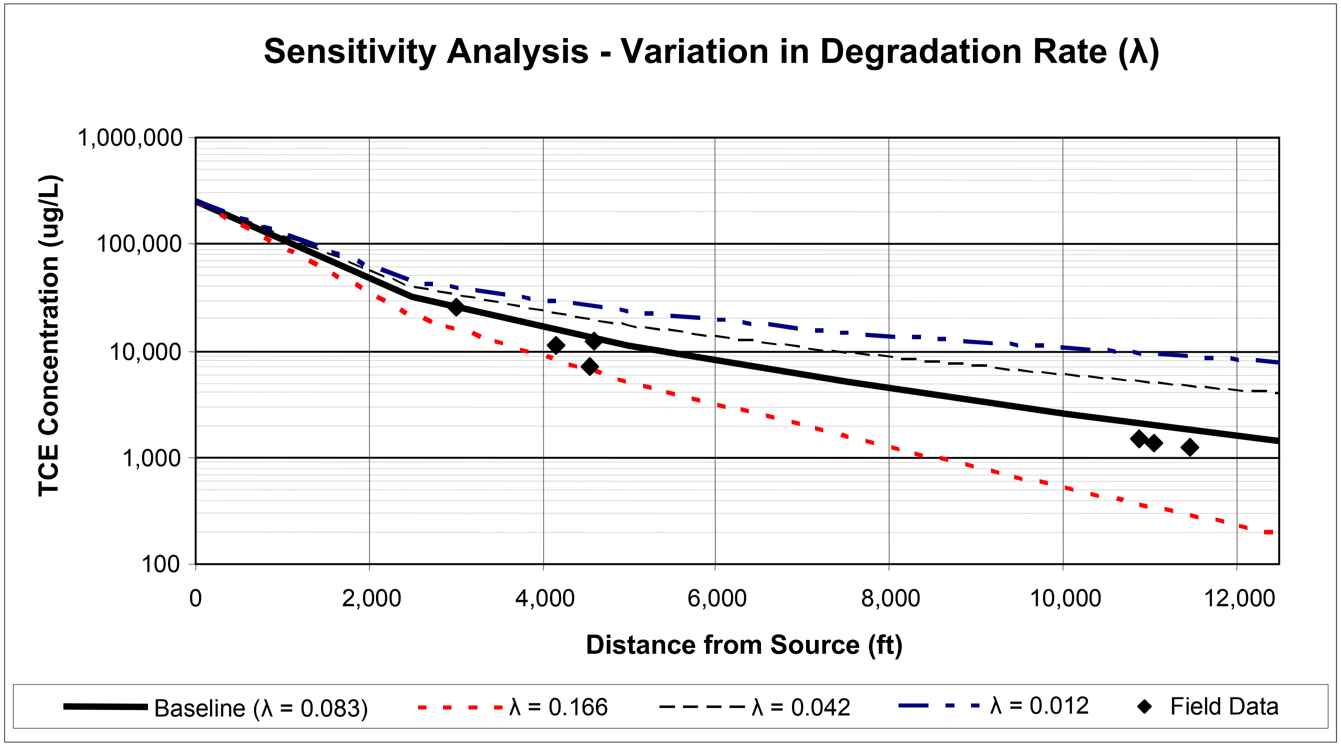
U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-03OR22980
Oak Ridge, Tennessee ● Paducah, Kentucky ● Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

FIGURE No.Fig15.ppt
DATE 01-30-06

Fig. 15. Contaminant concentrations along the Northwest Plume centerline determined by modeling.



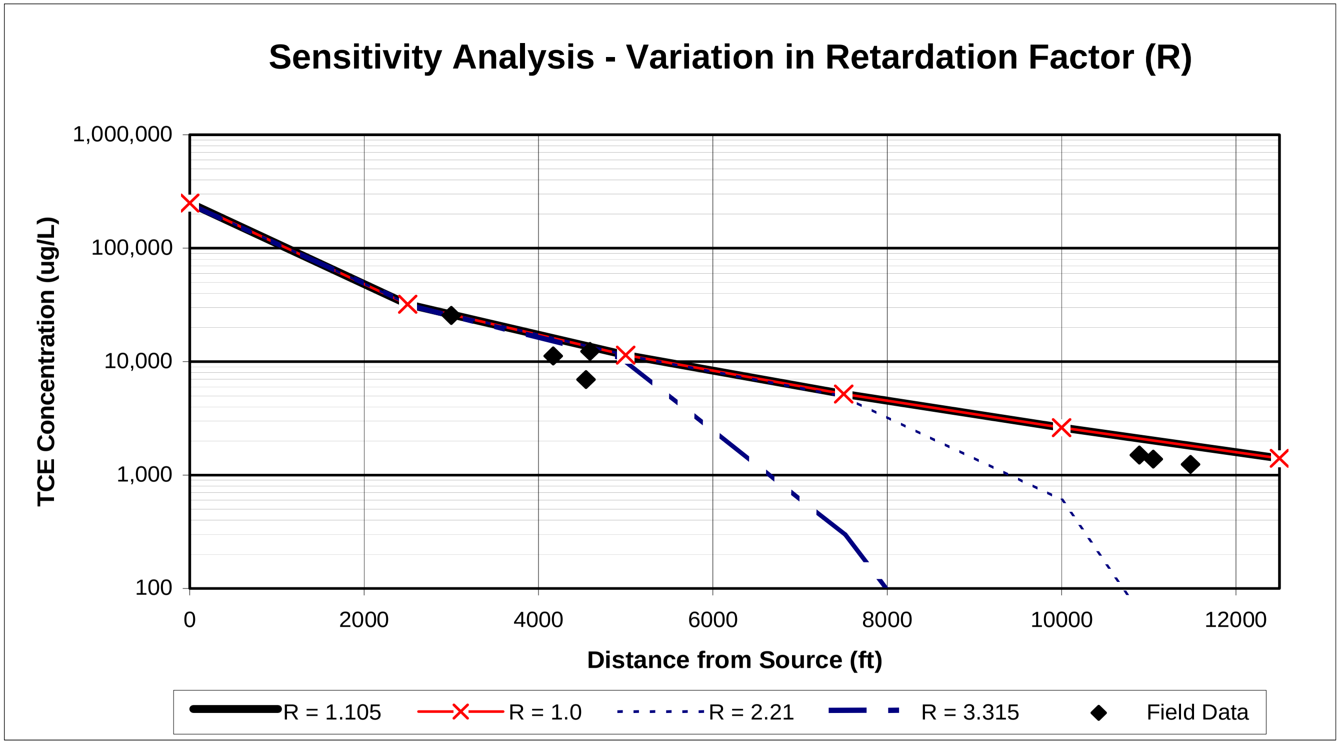
U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-03OR22980
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications
International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 16. Modeled TCE concentration profiles with varying degradation rates (λ).

FIGURE No.Fig16.ppt
DATE 01-30-06



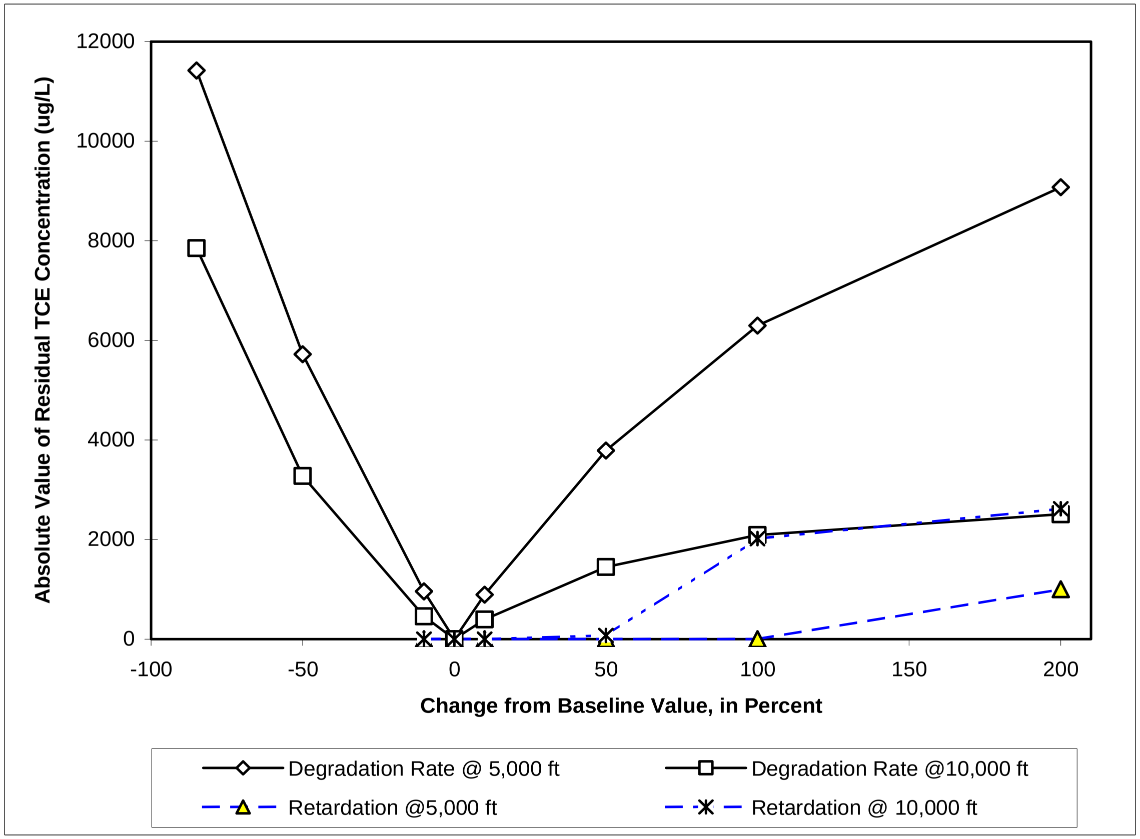
U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-03OR22980
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 17. Modeled TCE concentration profiles with varying retardation factors (R).

FIGURE No.Fig17.ppt
DATE 01-30-06



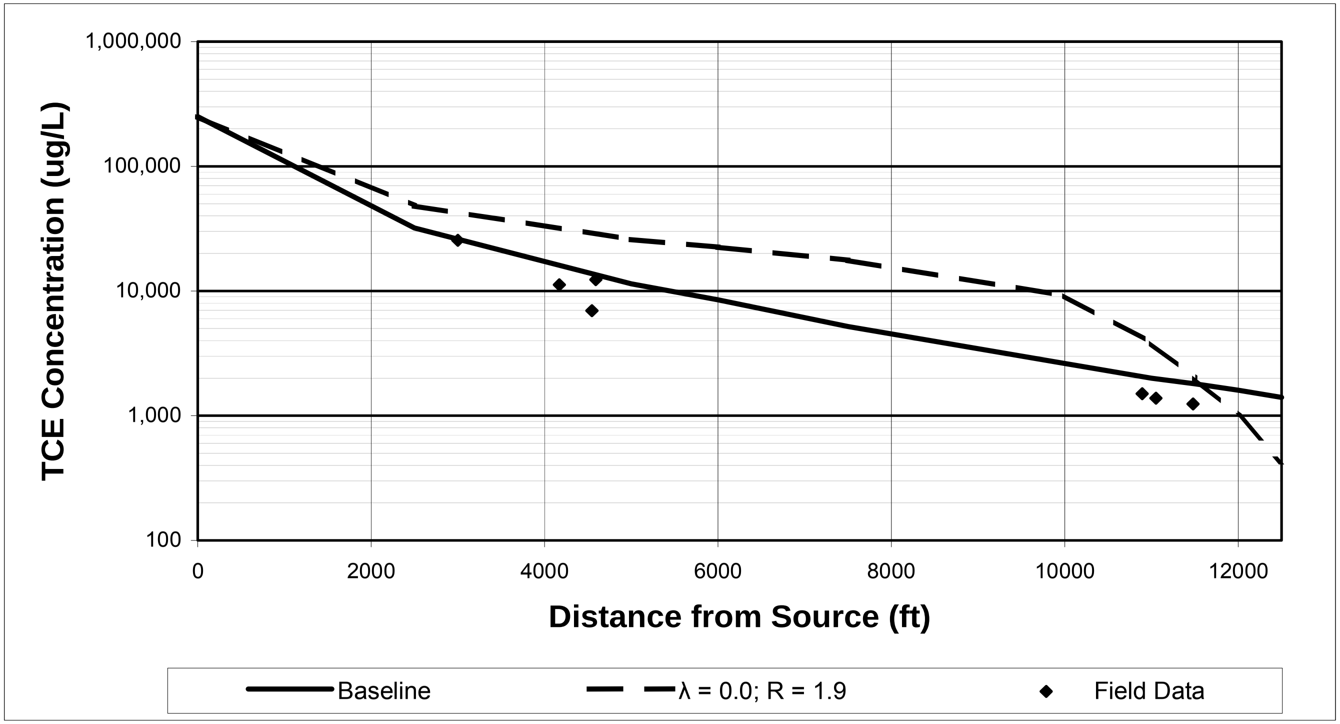
U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-03OR22980
Oak Ridge, Tennessee ● Paducah, Kentucky ● Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 18. Sensitivity analysis plot for degradation rate (λ) and retardation factor (R) showing the absolute difference in TCE concentrations at 5,000 ft and 10,000 ft from the source.

FIGURE No.Fig18.ppt
DATE 01-30-06



U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-03OR22980
Oak Ridge, Tennessee ● Paducah, Kentucky ● Portsmouth, Ohio

Science Applications
International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 19. Comparison of calibrated TCE plume concentrations to a scenario with a degradation rate (λ) set to 0 yr^{-1} and retardation (R) set to 1.9.

FIGURE No.Fig19.ppt
DATE 01-30-06

APPENDIX

SUMMARY OF THE NORTHWEST PLUME INVESTIGATIONS

"Characterization of the Northwest Plume Utilizing a Driven Discrete-Depth Sampling System"

KY/ER-22, Martin Marietta Energy Systems, Inc.,
Paducah, Kentucky, April 1993

"Final Report on Drive-Point Profiling of the Northwest Plume and Analysis of Related Data"

KY/ER-66, Martin Marietta Energy Systems, Inc.,
Paducah, Kentucky, April 1995

Deleted: 41¶

Deleted: Att F3-

Deleted: Page Break

THIS PAGE INTENTIONALLY LEFT BLANK.

Deleted: 41¶

Deleted: Att F3-

Deleted: Page Break

ATTACHMENT F.3.1

FIGURES

TABLE

Deleted: 41¶

Deleted: Att F3-

Deleted: Page Break

THIS PAGE INTENTIONALLY LEFT BLANK.

Deleted: 41¶

Deleted: Att F3-

Formatted

Deleted: Page Break

SUMMARY OF THE NORTHWEST PLUME INVESTIGATIONS

"Characterization of the Northwest Plume Utilizing a Driven Discrete-Depth Sampling System,"
KY/ER-22, Martin Marietta Energy Systems, Inc., Paducah, Kentucky, April 1993

"Final Report on Drive-Point Profiling of the Northwest Plume and Analysis of Related Data,"
KY/ER-66, Martin Marietta Energy Systems, Inc., Paducah, Kentucky, April 1995

INTRODUCTION

The DOE executed a two-phased investigation of the Northwest Plume to support the design of the hydraulic containment system for the Record of Decision for the Northwest Plume (DOE 1993). (The Northwest Plume hydraulic containment system consists of two well fields, with extraction wells and monitoring wells at each [LMES 1996]. Data collected from the monitoring wells prior to operation of the extraction wells are used in the derivation of the TCE degradation rate coefficient.) *Characterization of the Northwest Plume Utilizing a Driven Discrete-Depth Sampling System* (DOE 1993b) reports the results of the first phase of the investigation (September and October of 1992). The second phase of investigation (August 1993 through March 1994) is summarized in *Final Report on Drive-Point Sampling of the Northwest Plume and Analysis of Related Data* (DOE 1995). The two-phased investigation, collectively, characterized five transects of the Northwest Plume with groundwater analyses from 37 temporary soil borings in the RGA and from existing monitoring wells. The transects defined the 3-dimensional extent of the core of the Northwest Plume over a distance of approximately 1.2 miles (6,300 ft), as measured along the axis of the Northwest Plume from inside the northwest corner of the PGDP industrial complex to near the Northwest Plume north well field.

Deleted: degradation factor

The Phase I investigation collected 45 discrete-depth RGA groundwater samples from 15 drive-point boreholes, along transects B-B', C-C', and D-D' (Figure A.1). Phase II activities consisted of 35 discrete-depth RGA samples from 17 drive-point boreholes, primarily located along transects A-A', C-C', and E-E', and from an upgradient area to transect A-A'. Besides the drive-point boreholes, the Phase II investigation completed six augered boreholes and sampled groundwater using a Hydropunch™ sampler from the middle of the RGA to locate the northern limit of the high concentration zone of the Northwest Plume. The high concentration zone was defined by TCE concentrations greater than 1 mg/L.

METHODLOGY

The primary sample system for both phases of the investigation was a hydraulic hammer-drive system coupled with a discrete-depth sampler, similar in concept to a GeoProbe™ system. However, the larger drive rods, bigger hammers, and greater hydraulic pressures used in the Northwest Plume investigation provided a sampler system with the ability to penetrate deeper.

A Holegator (TBD-II) drilling platform was used for auger drilling and subsequent emplacement of the driven discrete-depth sampler system. This rig could hammer and drill simultaneously as down pressure and torque were applied to the drive and drill stem. The drive-point sampler consisted of a retractable sample screen attached to a modified cone-penetrometer point (Figure A.2). Adapting subs, containing a Teflon check ball assembly, connected the sampler to the drive rods.

Deleted: 41¶

Deleted: Att F3-

Formatted

To advance the drive rods (AWJ rods), the Holegator rig drilled a pilot hole with 4 3/8 in. (outside diameter) hollow-stem augers to the contact between the clay (HU3) and the sand (HU4) overlying the gravel (HU5) interval of the RGA. A wooden plug placed in the bottom of the lead auger kept out heaving sands. The discrete-depth sampler then was driven through the wooden plug and into the aquifer.

Upon reaching the desired depth, the drill crew retracted the drive rod assembly 1 ft to expose the screen and collect a groundwater sample. After sampling at depth was complete, the rods were driven to the next depth of interest. Driving automatically closed the exposed screen. The field crew repeated this procedure until each depth of interest was sampled or until the screen clogged. Groundwater samples typically were collected every 10 ft through the RGA, corresponding to a sample in the upper, middle, and lower RGA. At several locations, the field crew collected four samples in the RGA. The design of the driven discrete-depth sampler allowed collection of *in situ* samples with no need to remove the rods from the hole between sampling events.

The Northwest Plume investigation collected samples for field parameters (pH, temperature, and specific conductance) and for laboratory analyses of the volatile organic compounds TCE, dichloroethene, dichloroethane, and vinyl chloride and the radionuclide ^{99}Tc. A portable gas chromatograph provided next-day analysis of the volatile organic compounds. Technetium-99 and duplicate TCE samples were sent to an on-site laboratory (C-710 Technical Services Facility) for analysis.

RESULTS

The five transects and upgradient and downgradient samples characterized TCE and ^{99}Tc levels in the Northwest Plume from inside the northwest corner of the PGDP industrial complex, upgradient of the south containment well field, downgradient to near the north containment well field, a distance of 1.2 miles (6,300 ft) along the axis of the Northwest Plume. Table A.1 provides the analyses for TCE and ^{99}Tc in groundwater samples from temporary soil borings of the Northwest Plume investigation.

The combined data of the previous CERCLA Site Investigation (CH2M HILL 1991 and 1992), routine residential well sampling, and the Northwest Plume investigation well defined the extent of the Northwest Plume (Figure A.3 and A.4). *Final Report on Drive-Point Profiling of the Northwest Plume and Analysis of Related Data* (MMES 1995) summarizes the Northwest Plume investigation analyses as a series of 6 plume maps (TCE and ^{99}Tc maps for the top, middle, and bottom of the RGA) and as 10 contaminant cross-sections of the Northwest Plume (5 cross-sections each for TCE and ^{99}Tc).

The following are the primary conclusions of the report.

1. The Northwest Plume originates from the PGDP's C-400 Cleaning Facility, located near the center of the industrial complex.

2. Burial grounds located at the northwest corner of the PGDP industrial complex also are sources to the Northwest Plume.

3. Trace levels of the TCE intermediate dechlorination products, 1,1-dichloroethene and *cis*-1,2-dichloroethene, occur throughout the Northwest Plume. It appears, however, that degradation of TCE takes place only in the UCRS and only in limited areas.

Deleted: 41¶

Deleted: Att F3-

Formatted

4. The Northwest Plume affects an area of approximately 2 square miles (1,300 acres), with contaminants detected as far as 3 miles (16,000 ft) downgradient of the PGDP industrial complex.

5. Contaminant loading from the Northwest Plume to the Ohio River is minimal.

Deleted: 41¶

Deleted: Att F3-

Deleted: Page Break

THIS PAGE INTENTIONALLY LEFT BLANK.

Formatted

Deleted: Page Break

Table A.1. Analyses of the Northwest Plume investigation

TRANSECT	BORING	DEPTH (ft)	TCE (µg/L) FIELD GC	TCE (µg/L) PGDP GC/MS	^{99}Tc (pCi/L)	SAMPLE DATE	PHASE I/ PHASE II
UPGRADIENT	J48	63	144	--	122±26	2/26/94	II
	J49	67	13	40	42±22	2/14/94	II
	J50	69	0	<5	5±58	2/11/94	II
A-A'	J40	65	0	<5	10±8	3/1/94	II
		73	55	90	34±24	3/2/94	II
		83	223	330	124±26	3/2/94	II
		93	295	260	143±30	3/2/94	II
	J42	65	171	140	44±24	3/19/94	II
		75	152	160	60±24	3/19/94	II
		85	447	500	193±30	3/19/94	II
		96	547	590	305±34	3/19/94	II
	J43	65	4,438	5,000	1,235±58	3/12/94	II
		75	7,185	7,300	1,954±71	3/12/94	II
		85	10,518	8,000	3,040±87	3/12/94	II
	J44	64	1,362	1,700	748±46	3/16/94	II
		74	5,494	4,800	1163±56	3/16/94	II
		84	9,719	11,000	2130±71	3/17/94	II
		94	10,355	11,000	3034±88	3/16/94	II
B-B'	J28	63	5	11	25±20	10/13/92	I
		73	36	110	54±22	10/13/92	I
		83	48	330	129±25	10/15/92	I
		104	2	2	10±26	10/15/92	I
	J29	62	3	<20	8±1	10/10/92	I
		72	261	440	230±18	10/11/92	I
		82	601	750	347±24	10/11/92	I
		92	300	360	253±19	10/11/92	I
	J30	66	1,495	1,000	1,454±63	10/4/92	I
		73	926	3,400	248±32	10/6/92	I
		87	1,662	3,700	326±35	10/7/92	I
		92	17	37	77±8	10/8/92	I
	J33	63	--	530	423±40	10/18/92	I
		74	1,706	8,600	3,952±106	10/18/92	I
		83	1,889	7,600	231±33	10/19/92	I
		91	1,376	4,500	666±48	10/19/92	I
	J34	61	1,398	2,600	1,504±68	10/23/92	I
		71	1,852	5,400	1,884±75	10/23/92	I
		81	1,628	8,100	2,134±79	10/23/92	I
	J36	67	1,564	4,100	4,616±115	10/27/92	I
		77	1,862	8,200	2,625±119	10/27/92	I
		86	2,048	16,000	3,714±141	10/27/92	I
		92	2,187	16,000	4,800±117	10/27/92	I
	J38	66	6	3	26±23	10/24/92	I
		76	5	2	38±24	10/24/92	I
		83	<1	<1	2±7	10/24/92	I

Deleted: 41¶

Deleted: Att F3-

Deleted: Page Break

Table A.1. Analyses of the Northwest Plume investigation (continued)

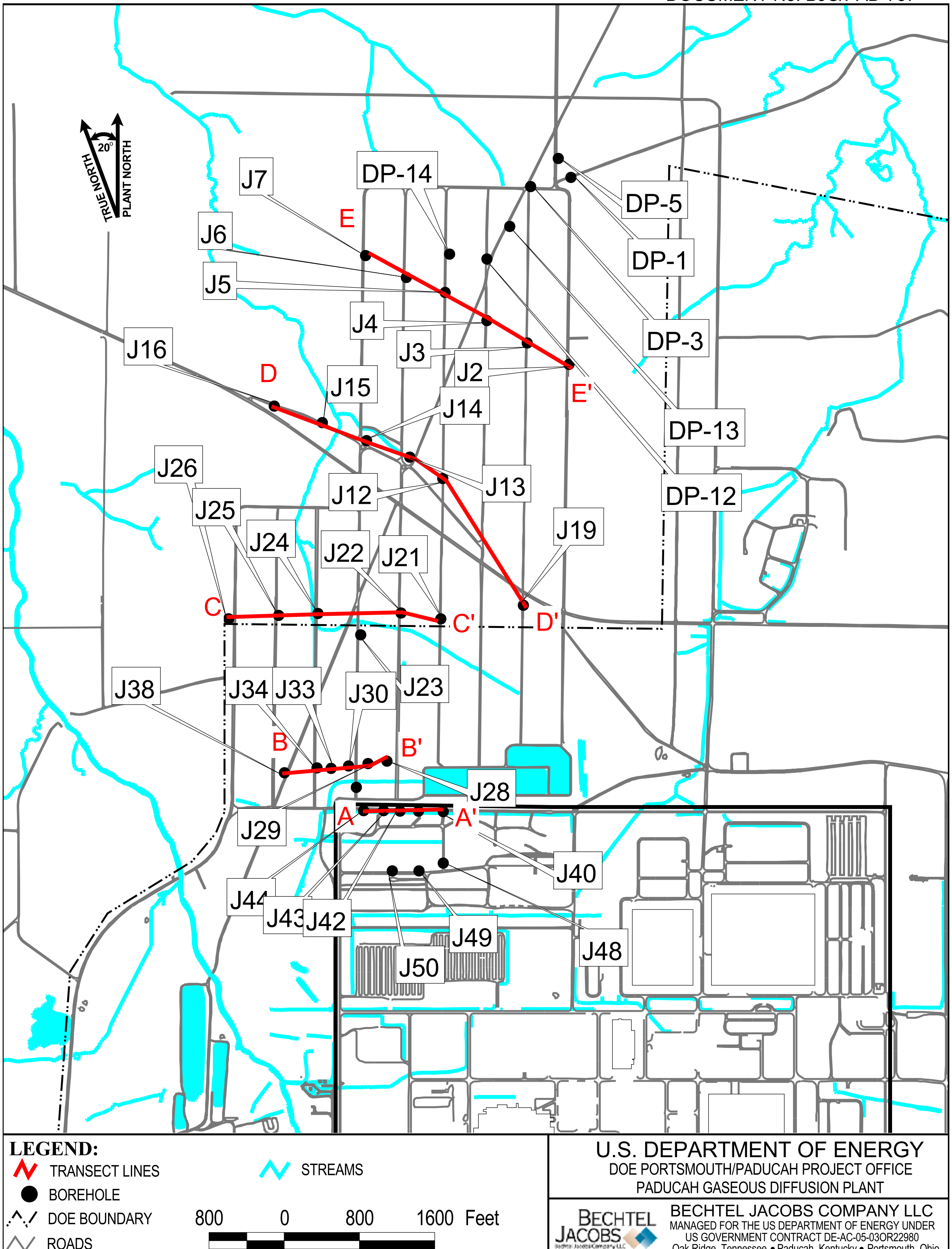
TRANSECT	BORING	DEPTH (ft)	TCE (μg/L) FIELD GC	TCE (μg/L) PGDP GC/MS	^{99}Tc (pCi/L)	SAMPLE DATE	PHASE I/ PHASE II
C-C'	J19	75	0	0	64±24	9/20/93	II
	J21	69	2	11	425±39	9/17/93	II
		78	<1	0.7J	31±21	9/17/93	II
	J22	69	55	54	97±25	9/16/93	II
		78	0	0	29±22	9/16/93	II
	J23	72	64	--	42±22	9/20/92	I
		80	17	--	15±25	9/20/92	I
	J24	63	238	210	95±27	10/25/92	I
		70	156	130	66±26	1/11/94	II
	J25	63	5,206	4,400	2,935±91	1/12/94	II
		80	5,594	4,800	902±54	1/13/94	II
	J26	70	6	--	0±0	9/11/92	I
		79	<1	--	0±0	9/12/92	I
		89	<1	--	0±0	9/12/92	I
		99	<1	--	0±0	9/13/92	I
D-D'	J12	63	5	--	78±25	9/24/92	I
		71	2	--	60±23	9/26/92	I
		83	3	2	69±23	9/26/92	I
	J13	64	78	48	40±23	10/1/92	I
		74	31	42	24±22	10/1/92	I
		84	4	4	0±0	10/3/92	I
	J14	80	2,024	--	890±53	9/23/92	I
		95	19	--	2±19	9/23/92	I
	J15	62	167	270	279±33	9/29/92	I
		72	158	200	160±28	9/29/92	I
	J16	59	5	--	0±0	9/27/92	I
		68	4	3	0±0	9/27/92	I
E-E'	J3	82	0	0	221±31	9/13/93	II
		88	0	0	69±24	9/13/93	II
	J4	69	0	--	49±21	9/10/93	II
		79	<1	0	30±20	9/10/93	II
		88	<1	0	20±19	9/10/93	II
	J5	74	60	160	113±24	9/9/93	II
	J6	76	149	180	259±33	9/14/93	II
		85	289	380E	294±35	9/14/93	II
	J7	75	<1	3J	13±20	9/15/93	II
DOWN-GRADIENT	D1	73	403	--	--	8/3/93	II
		82	101	--	--	8/3/93	II
	D3	79	244	--	--	8/6/93	II
	D5	82	368	--	--	8/4/93	II
	D12	79	69	--	--	8/5/93	II
	D13	72	681	--	--	8/5/93	II
	D14	70	269	--	--	8/1/93	II

Deleted: ¶

Deleted: 41¶

Deleted: Att F3-

DOCUMENT No. BJC/PAD-757



U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-03OR22980
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Fig. A.1. Northwest Plume investigation.

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

FIGURE No. White_paper_2006.apr
DATE 01-20-06

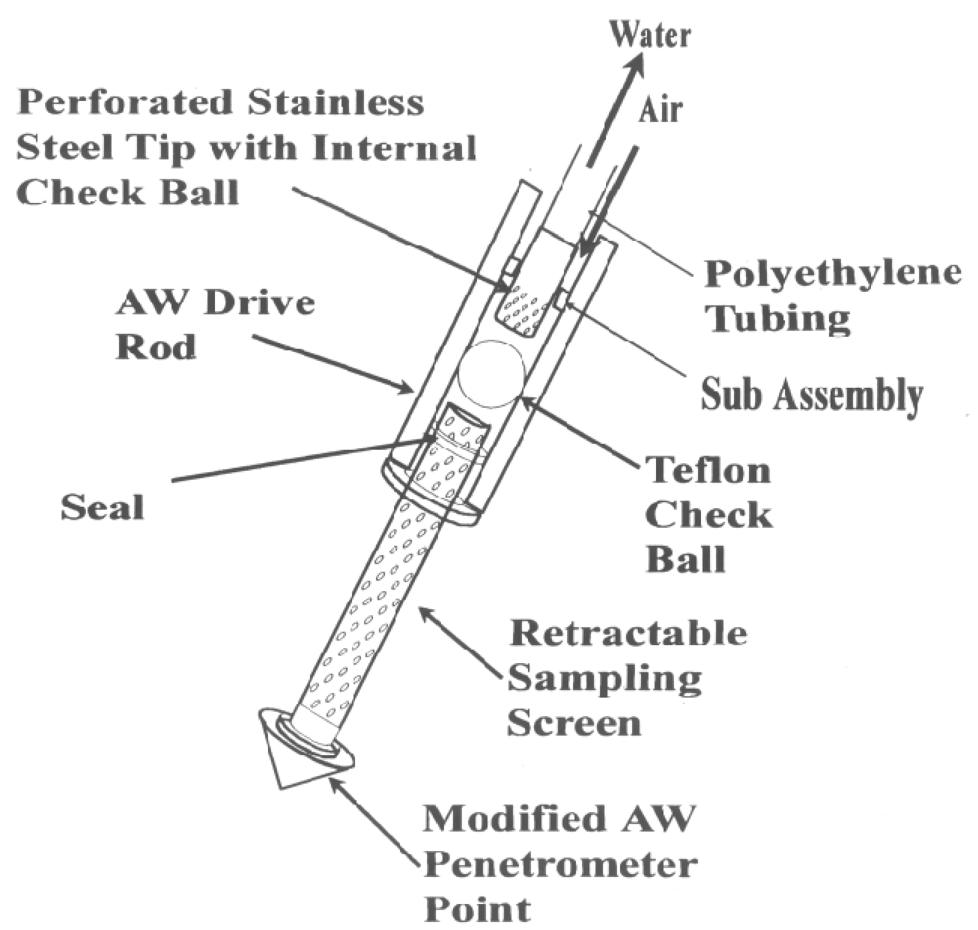


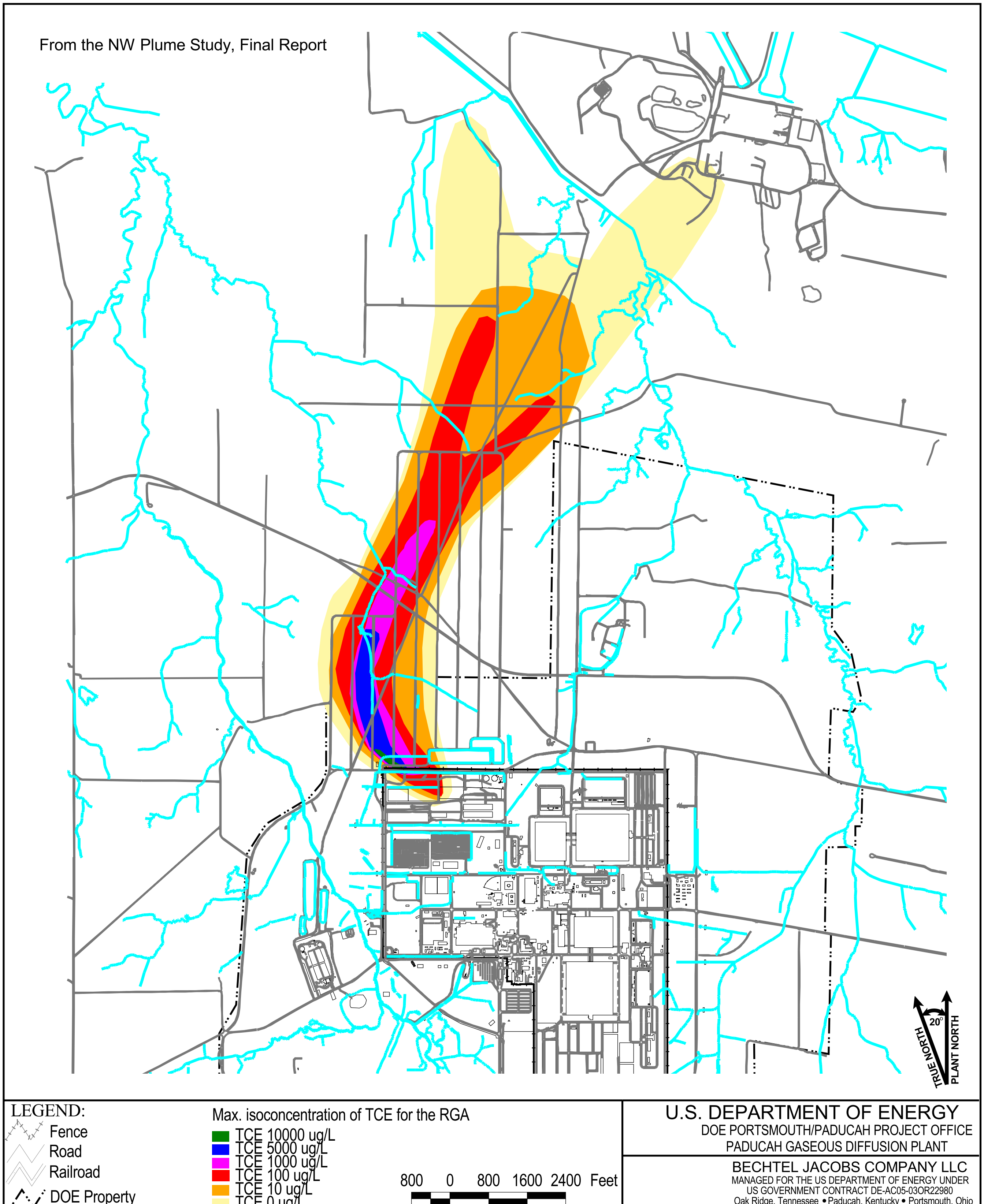
Fig. A.2. Schematic diagram of the drive-point profiling system.

U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-03OR22980
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

FIGURE No. FigA-02_Draft.ppt
DATE 01-23-06



U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC05-03OR22980
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Fig. A.3. Maximum TCE concentration contours (Year 1995) for the Northwest Plume.

Science Applications
International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

FIGURE No. TCE_1995.apr
DATE 03-09-06

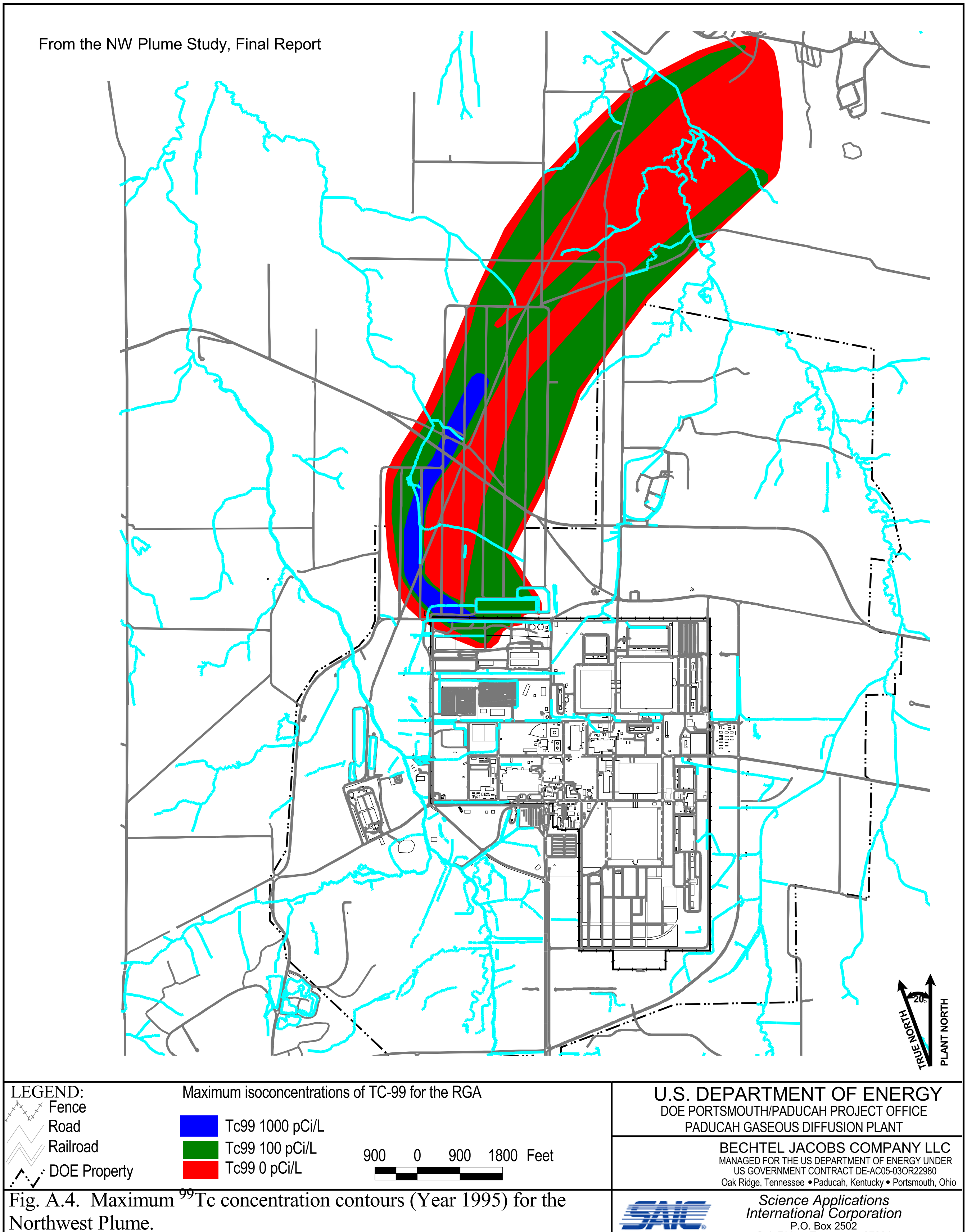


Fig. A.4. Maximum ^{99}Tc concentration contours (Year 1995) for the Northwest Plume.

APPENDIX F
ATTACHMENT 4

PROBABILISTIC MODELING INPUT AND OUTPUT TABLES

THIS PAGE INTENTIONALLY LEFT BLANK.

Table F.4.1. SWMU 1 SESOIL Input Parameters Used in Probabilistic Modeling

Run (#)	Layer 1 Conc (mg/kg)	Layer 2 Conc (mg/kg)	Layer 3 Conc (mg/kg)	Layer 4 Conc (mg/kg)	Layer 5 Conc (mg/kg)	Layer 6 Conc (mg/kg)	Organic Carbon (%)	Degradation Rate (/hr)	Vertical Hydraulic Conductivity (m/hr)	Intrinsic Permeability (cm2)
001	0.39	5.11	2.57	1.57	11.44	1.50	0.08	1.23E-05	8.61E-04	2.44E-10
002	0.30	3.09	19.42	1.35	12.36	1.79	0.09	1.50E-05	6.02E-04	1.70E-10
003	2.29	5.03	0.21	1.53	2.58	1.16	0.08	8.56E-06	5.33E-04	1.51E-10
004	0.80	4.84	11.46	1.85	11.04	1.13	0.06	1.66E-05	7.38E-04	2.09E-10
005	0.11	0.87	3.97	5.09	7.65	1.27	0.13	1.09E-05	2.85E-04	8.07E-11
006	14.64	33.13	3.32	7.31	6.08	1.40	0.11	7.32E-06	3.47E-04	9.84E-11
007	1.29	7.01	42.91	49.06	2.80	0.69	0.09	8.01E-06	3.51E-04	9.95E-11
008	14.72	134.91	48.97	1.12	1.15	0.46	0.10	1.08E-05	9.02E-04	2.55E-10
009	1.23	3.74	11.18	10.71	16.31	3.70	0.07	1.46E-05	8.75E-04	2.48E-10
010	0.95	1.37	10.07	3.10	7.57	1.22	0.05	1.85E-05	4.20E-04	1.19E-10
011	0.58	3.57	25.42	31.25	61.23	4.18	0.06	1.45E-05	2.09E-04	5.91E-11
012	0.56	8.57	24.59	15.48	1.70	0.39	0.06	1.42E-05	6.59E-04	1.87E-10
013	0.33	1.42	3.50	1.41	2.54	0.48	0.08	1.45E-05	7.87E-04	2.23E-10
014	0.17	2.24	4.95	12.20	12.92	2.59	0.05	2.41E-05	6.35E-04	1.80E-10
015	0.42	4.33	29.58	1.20	5.19	0.65	0.10	1.39E-05	6.43E-04	1.82E-10
016	1.80	5.14	8.54	10.41	25.38	2.80	0.04	7.11E-06	3.16E-04	8.94E-11
017	0.16	0.58	18.82	1.10	0.68	0.14	0.07	1.86E-05	7.18E-04	2.03E-10
018	3.72	15.01	4.87	8.99	17.86	1.75	0.06	2.26E-05	5.37E-04	1.52E-10
019	0.23	2.65	1.58	62.05	15.65	2.56	0.17	8.00E-06	8.23E-04	2.33E-10
020	1.27	8.61	6.56	0.79	5.01	0.88	0.16	1.41E-05	2.69E-04	7.63E-11
021	1.20	5.49	101.65	3.05	0.56	0.23	0.03	1.30E-05	2.81E-04	7.95E-11
022	0.51	4.46	1.48	4.98	3.42	0.59	0.08	9.11E-06	4.10E-04	1.16E-10
023	3.58	13.69	62.91	1.44	1.43	0.61	0.06	8.27E-06	1.38E-04	3.90E-11
024	0.48	0.29	2.64	3.63	1.86	0.88	0.03	8.42E-06	9.77E-04	2.77E-10
025	1.21	4.97	2.77	17.20	26.36	2.67	0.10	1.22E-05	5.22E-04	1.48E-10
026	1.00	4.58	12.06	1.53	9.09	1.72	0.03	1.80E-05	3.07E-04	8.69E-11
027	0.08	0.42	1.07	0.55	0.45	0.54	0.09	7.19E-06	6.43E-04	1.82E-10
028	0.08	0.52	2.39	14.53	15.91	3.07	0.04	8.79E-06	3.80E-04	1.08E-10
029	1.18	8.77	23.47	0.58	6.25	1.31	0.19	1.65E-05	9.52E-04	2.70E-10
030	1.20	2.01	0.71	1.66	1.31	0.61	0.12	1.67E-05	8.54E-04	2.42E-10
031	0.54	1.59	1.00	4.13	16.07	3.24	0.07	1.05E-05	5.51E-04	1.56E-10
032	5.85	17.57	1.36	6.58	14.23	2.36	0.06	7.23E-06	5.93E-04	1.68E-10
033	0.22	1.04	0.13	12.57	10.47	3.53	0.04	1.32E-05	5.45E-04	1.54E-10
034	0.09	3.44	3.12	2.24	58.09	6.65	0.05	1.04E-05	2.20E-04	6.23E-11
035	9.42	28.53	7.20	1.43	3.16	0.45	0.09	1.14E-05	5.15E-04	1.46E-10
036	1.71	9.75	4.40	2.27	3.24	1.65	0.27	1.49E-05	4.16E-04	1.18E-10
037	0.81	1.83	21.20	33.88	1.07	0.21	0.06	2.42E-05	2.50E-04	7.09E-11
038	0.75	3.71	6.19	2.50	12.64	1.68	0.07	2.31E-05	9.68E-04	2.74E-10
039	1.40	15.71	3.79	12.32	27.33	3.51	0.10	8.89E-06	5.88E-04	1.66E-10
040	0.28	2.84	0.41	0.13	0.17	0.05	0.06	9.01E-06	8.88E-04	2.52E-10
041	1.49	2.29	2.85	48.06	25.36	3.47	0.08	1.34E-05	9.33E-04	2.64E-10
042	8.00	17.00	47.79	7.30	2.26	1.21	0.07	1.66E-05	8.65E-04	2.45E-10
043	0.14	1.23	0.64	2.62	25.77	4.47	0.07	1.27E-05	7.92E-04	2.24E-10
044	0.01	0.06	2.49	1.93	2.94	0.91	0.06	8.80E-06	4.39E-04	1.24E-10
045	0.84	3.05	2.51	2.24	24.34	3.85	0.12	7.58E-06	1.99E-04	5.63E-11
046	17.88	43.92	29.61	4.88	9.02	1.24	0.14	1.34E-05	7.84E-04	2.22E-10
047	0.80	13.21	4.89	7.38	3.82	1.05	0.05	2.30E-05	7.05E-04	2.00E-10
048	2.15	15.52	8.29	12.92	2.22	0.48	0.07	8.20E-06	6.20E-04	1.76E-10
049	0.20	0.89	10.53	2.13	4.23	0.70	0.13	1.10E-05	3.56E-04	1.01E-10
050	4.97	5.29	13.13	51.13	16.11	1.96	0.03	1.12E-05	7.07E-04	2.00E-10

Table F.4.1. SWMU 1 SESOIL Input Parameters Used in Probabilistic Modeling

Run (#)	Layer 1 Conc (mg/kg)	Layer 2 Conc (mg/kg)	Layer 3 Conc (mg/kg)	Layer 4 Conc (mg/kg)	Layer 5 Conc (mg/kg)	Layer 6 Conc (mg/kg)	Organic Carbon (%)	Degradation Rate (/hr)	Vertical Hydraulic Conductivity (m/hr)	Intrinsic Permeability (cm2)
051	0.10	1.20	4.28	1.04	39.93	4.35	0.05	1.04E-05	2.15E-04	6.07E-11
052	1.78	21.68	23.80	6.40	6.95	1.10	0.03	1.00E-05	9.87E-04	2.80E-10
053	2.60	8.21	5.98	1.27	0.24	0.16	0.07	2.23E-05	8.11E-04	2.30E-10
054	10.26	100.21	6.18	1.15	0.48	0.20	0.11	8.42E-06	3.78E-04	1.07E-10
055	0.79	43.23	14.75	5.03	40.90	2.63	0.03	1.27E-05	5.39E-04	1.52E-10
056	0.03	0.45	0.78	0.45	0.32	0.13	0.03	1.76E-05	3.40E-04	9.64E-11
057	1.19	20.65	20.51	2.72	0.50	0.07	0.14	1.07E-05	8.75E-04	2.48E-10
058	0.06	0.38	0.67	2.73	3.89	1.77	0.10	1.11E-05	6.63E-04	1.88E-10
059	0.05	0.75	5.35	0.87	1.97	0.55	0.03	2.04E-05	6.60E-04	1.87E-10
060	0.05	1.01	24.27	41.95	24.58	3.73	0.04	1.61E-05	1.22E-04	3.45E-11
061	3.32	38.27	6.00	114.58	75.02	6.23	0.04	2.00E-05	8.27E-04	2.34E-10
062	0.05	1.02	1.00	2.96	7.64	0.99	0.22	7.87E-06	9.60E-04	2.72E-10
063	4.52	43.36	3.72	6.19	1.99	0.37	0.09	9.55E-06	6.54E-04	1.85E-10
064	0.04	0.37	0.71	0.92	10.42	1.26	0.08	9.52E-06	4.44E-04	1.26E-10
065	1.11	11.04	37.96	5.37	4.54	0.41	0.06	1.74E-05	1.64E-04	4.64E-11
066	0.11	1.25	7.89	5.07	29.37	6.53	0.14	1.89E-05	6.71E-04	1.90E-10
067	9.11	140.97	18.00	2.83	3.61	0.88	0.03	9.23E-06	3.73E-04	1.06E-10
068	0.22	1.30	0.92	0.78	0.99	0.70	0.06	7.99E-06	5.80E-04	1.64E-10
069	0.12	1.81	7.04	5.46	10.32	1.18	0.06	8.54E-06	5.90E-04	1.67E-10
070	0.46	1.62	3.27	0.88	0.44	0.28	0.06	7.33E-06	5.66E-04	1.60E-10
071	0.21	1.44	0.74	0.94	0.90	0.25	0.04	1.76E-05	5.96E-04	1.69E-10
072	0.00	0.06	0.41	6.52	1.86	0.63	0.03	8.39E-06	8.64E-04	2.45E-10
073	0.04	0.16	6.77	1.95	2.09	0.31	0.10	2.02E-05	8.74E-04	2.47E-10
074	0.19	1.73	7.86	1.73	0.13	0.12	0.09	9.82E-06	5.09E-04	1.44E-10
075	0.05	0.25	1.69	0.88	4.93	2.69	0.06	9.23E-06	7.80E-04	2.21E-10
076	0.03	0.09	0.55	2.08	2.25	0.59	0.06	1.20E-05	3.41E-04	9.65E-11
077	0.37	5.01	5.99	4.75	2.68	0.81	0.07	7.35E-06	1.69E-04	4.78E-11
078	0.82	4.65	18.85	3.83	2.89	0.54	0.10	1.38E-05	4.86E-04	1.38E-10
079	0.27	1.10	5.58	5.76	30.47	3.01	0.03	7.25E-06	4.38E-04	1.24E-10
080	21.35	69.43	1.51	1.36	1.69	0.43	0.05	1.36E-05	6.46E-04	1.83E-10
081	0.11	0.79	0.74	1.86	2.82	0.66	0.08	7.70E-06	7.35E-04	2.08E-10
082	0.70	1.26	20.70	1.46	0.87	0.18	0.17	7.55E-06	5.91E-04	1.67E-10
083	0.39	5.17	21.13	25.37	1.11	0.50	0.10	1.75E-05	9.89E-05	2.80E-11
084	0.22	8.18	3.02	11.61	5.76	0.58	0.05	2.21E-05	7.33E-04	2.08E-10
085	1.92	7.32	9.96	3.83	7.22	1.03	0.08	1.22E-05	4.80E-04	1.36E-10
086	0.92	9.04	20.61	28.49	2.72	0.82	0.28	9.86E-06	6.47E-04	1.83E-10
087	0.02	0.10	10.45	8.45	17.20	3.22	0.06	1.82E-05	4.24E-04	1.20E-10
088	0.16	0.87	1.31	5.05	2.37	1.22	0.03	1.30E-05	1.29E-04	3.66E-11
089	0.04	0.28	3.49	6.95	7.11	1.49	0.10	7.98E-06	8.04E-04	2.28E-10
090	0.80	4.37	7.40	1.81	1.31	0.25	0.07	1.05E-05	6.26E-04	1.77E-10
091	0.40	1.68	11.10	0.97	1.47	0.34	0.05	1.95E-05	8.38E-04	2.37E-10
092	35.81	188.22	11.99	2.41	5.74	1.67	0.05	2.07E-05	9.25E-04	2.62E-10
093	0.12	0.28	0.77	1.92	0.62	0.33	0.08	1.80E-05	5.94E-04	1.68E-10
094	0.30	2.40	1.31	21.26	36.51	6.00	0.08	7.91E-06	6.82E-04	1.93E-10
095	0.11	0.37	1.14	0.20	0.94	0.17	0.04	9.41E-06	4.44E-04	1.26E-10
096	0.85	3.79	8.13	0.69	0.46	0.23	0.06	2.20E-05	4.50E-04	1.27E-10
097	2.03	11.66	16.06	32.89	59.21	4.34	0.03	2.43E-05	4.54E-04	1.29E-10
098	9.69	96.13	76.82	0.85	2.57	0.40	0.14	1.02E-05	5.26E-04	1.49E-10
099	9.13	59.93	5.63	0.63	11.05	1.33	0.03	2.04E-05	1.01E-03	2.87E-10
100	0.37	0.96	4.04	1.98	6.19	1.52	0.07	1.59E-05	4.22E-04	1.20E-10

Table F.4.2. C-720 SESOIL Input Parameters Used in Probabilistic Modeling

Run (#)	Layer 1 Conc (mg/kg)	Layer 2 Conc (mg/kg)	Layer 3 Conc (mg/kg)	Layer 4 Conc (mg/kg)	Layer 5 Conc (mg/kg)	Layer 6 Conc (mg/kg)	Organic Carbon (%)	Degradation Rate (/hr)	Vertical Hydraulic Conductivity (m/hr)	Intrinsic Permeability (cm2)
001	1.16	0.08	0.50	0.11	0.06	0.02	0.07	1.45E-05	2.09E-04	5.91E-11
002	0.46	0.02	0.45	0.16	0.09	0.01	0.06	1.42E-05	6.59E-04	1.87E-10
003	0.53	0.28	3.43	0.05	0.02	0.01	0.06	1.45E-05	7.87E-04	2.23E-10
004	0.07	4.79	16.34	0.14	0.07	0.04	0.05	2.41E-05	6.35E-04	1.80E-10
005	2.12	1.33	3.12	0.31	0.14	0.14	0.19	1.39E-05	6.43E-04	1.82E-10
006	0.36	0.04	0.05	0.01	0.00	0.02	0.10	7.85E-06	3.16E-04	8.94E-11
007	0.52	0.17	1.34	0.07	0.03	0.01	0.09	2.18E-05	1.07E-04	3.04E-11
008	0.08	0.36	1.23	0.04	0.01	0.02	0.07	8.00E-06	6.04E-04	1.71E-10
009	0.32	0.06	4.13	0.08	0.03	0.05	0.11	7.35E-06	2.69E-04	7.63E-11
010	0.22	0.41	4.09	0.03	0.01	0.00	0.03	1.41E-05	6.43E-04	1.82E-10
011	0.21	0.13	0.53	0.03	0.01	0.00	0.03	1.30E-05	2.81E-04	7.95E-11
012	0.04	0.54	0.91	0.03	0.01	0.01	0.05	9.11E-06	4.10E-04	1.16E-10
013	0.07	0.81	5.38	0.15	0.07	0.01	0.07	8.27E-06	1.38E-04	3.90E-11
014	1.40	0.03	2.05	0.03	0.01	0.01	0.13	8.42E-06	9.77E-04	2.77E-10
015	0.28	0.08	4.05	0.15	0.09	0.02	0.21	8.23E-06	5.22E-04	1.48E-10
016	4.11	0.02	0.31	0.18	0.12	0.13	0.05	1.22E-05	9.21E-04	2.61E-10
017	1.53	3.53	17.26	0.08	0.03	0.00	0.03	1.80E-05	3.07E-04	8.69E-11
018	0.12	0.24	0.55	0.08	0.03	0.04	0.05	7.19E-06	6.43E-04	1.82E-10
019	0.20	0.06	0.22	0.09	0.03	0.01	0.11	8.79E-06	3.80E-04	1.08E-10
020	0.06	0.11	0.34	0.49	0.21	0.09	0.19	1.65E-05	9.52E-04	2.70E-10
021	1.65	0.03	0.49	0.13	0.04	0.01	0.12	1.67E-05	8.54E-04	2.42E-10
022	3.73	0.20	9.97	0.09	0.03	0.01	0.07	1.05E-05	5.51E-04	1.56E-10
023	2.00	0.07	5.51	0.02	0.01	0.00	0.06	7.23E-06	5.93E-04	1.68E-10
024	1.52	0.07	1.92	0.17	0.06	0.03	0.04	1.32E-05	5.45E-04	1.54E-10
025	0.02	0.03	0.03	0.31	0.21	0.01	0.05	1.04E-05	2.20E-04	6.23E-11
026	0.04	0.42	24.68	0.03	0.02	0.05	0.09	1.14E-05	5.15E-04	1.46E-10
027	0.38	0.03	1.25	0.37	0.21	0.05	0.27	1.49E-05	4.16E-04	1.18E-10
028	0.22	0.01	0.02	0.20	0.11	0.08	0.06	2.42E-05	2.50E-04	7.09E-11
029	0.23	0.05	0.65	0.07	0.04	0.01	0.06	2.31E-05	9.68E-04	2.74E-10
030	1.27	0.02	0.99	0.48	0.22	0.03	0.04	8.89E-06	5.88E-04	1.66E-10
031	0.06	0.21	0.57	0.10	0.05	0.04	0.07	9.01E-06	8.88E-04	2.52E-10
032	0.98	0.40	2.04	0.06	0.02	0.02	0.08	1.34E-05	9.33E-04	2.64E-10
033	0.08	0.53	7.60	0.07	0.04	0.04	0.07	1.66E-05	8.65E-04	2.45E-10
034	0.17	0.86	25.39	0.13	0.06	0.04	0.06	1.27E-05	7.92E-04	2.24E-10
035	0.76	0.12	2.35	0.03	0.01	0.01	0.06	8.80E-06	4.39E-04	1.24E-10
036	0.11	0.11	9.77	0.01	0.00	0.01	0.12	7.58E-06	1.99E-04	5.63E-11
037	0.05	0.16	4.00	0.03	0.02	0.01	0.03	1.34E-05	7.84E-04	2.22E-10
038	0.00	0.31	1.06	0.09	0.05	0.02	0.05	2.30E-05	7.05E-04	2.00E-10
039	0.00	1.88	1.16	0.14	0.08	0.01	0.07	8.20E-06	6.20E-04	1.76E-10
040	0.01	0.08	6.83	0.48	0.22	0.02	0.13	1.10E-05	3.56E-04	1.01E-10
041	0.50	0.21	0.94	0.14	0.05	0.02	0.03	1.12E-05	7.07E-04	2.00E-10
042	0.07	0.39	4.25	0.06	0.02	0.03	0.09	1.04E-05	2.15E-04	6.07E-11
043	0.32	0.27	2.48	0.02	0.01	0.01	0.15	1.00E-05	9.87E-04	2.80E-10
044	4.63	0.05	5.69	0.19	0.09	0.01	0.07	2.23E-05	8.11E-04	2.30E-10
045	1.15	0.43	1.57	0.04	0.02	0.01	0.04	8.42E-06	3.78E-04	1.07E-10
046	0.37	0.01	0.25	0.03	0.02	0.04	0.13	1.27E-05	5.39E-04	1.52E-10
047	0.83	0.01	0.68	0.07	0.03	0.05	0.03	1.76E-05	3.40E-04	9.64E-11
048	1.68	0.05	1.68	0.08	0.03	0.02	0.14	1.07E-05	8.75E-04	2.48E-10
049	0.04	0.15	0.59	0.08	0.04	0.02	0.04	1.11E-05	6.63E-04	1.88E-10
050	0.32	0.44	0.98	0.07	0.03	0.01	0.03	2.04E-05	6.60E-04	1.87E-10

Table F.4.2. C-720 SESOIL Input Parameters Used in Probabilistic Modeling (continued)

Run (#)	Layer 1 Conc (mg/kg)	Layer 2 Conc (mg/kg)	Layer 3 Conc (mg/kg)	Layer 4 Conc (mg/kg)	Layer 5 Conc (mg/kg)	Layer 6 Conc (mg/kg)	Organic Carbon (%)	Degradation Rate (/hr)	Vertical Hydraulic Conductivity (m/hr)	Intrinsic Permeability (cm2)
051	0.44	0.07	1.61	0.20	0.08	0.01	0.04	1.61E-05	1.22E-04	3.45E-11
052	1.02	0.64	1.31	0.02	0.01	0.01	0.04	2.00E-05	8.27E-04	2.34E-10
053	0.02	1.02	1.11	0.17	0.10	0.09	0.09	9.55E-06	9.60E-04	2.72E-10
054	0.85	0.03	0.61	0.02	0.01	0.00	0.06	9.52E-06	4.44E-04	1.26E-10
055	0.10	0.89	1.66	0.05	0.02	0.04	0.06	1.74E-05	1.64E-04	4.64E-11
056	3.81	0.08	0.80	0.08	0.03	0.01	0.14	1.89E-05	6.71E-04	1.90E-10
057	0.01	3.34	16.81	0.06	0.02	0.02	0.15	9.23E-06	3.73E-04	1.06E-10
058	0.05	1.11	2.62	0.37	0.17	0.08	0.08	7.99E-06	5.80E-04	1.64E-10
059	0.35	0.03	9.34	0.59	0.40	0.02	0.07	8.54E-06	5.90E-04	1.67E-10
060	0.07	0.88	2.34	0.18	0.08	0.15	0.06	7.33E-06	5.66E-04	1.60E-10
061	0.06	0.26	27.19	0.02	0.01	0.01	0.11	1.76E-05	5.96E-04	1.69E-10
062	0.23	0.26	1.64	0.03	0.02	0.01	0.15	8.39E-06	8.64E-04	2.45E-10
063	4.24	0.01	0.15	0.41	0.22	0.12	0.04	2.02E-05	8.74E-04	2.47E-10
064	1.07	0.84	2.59	0.01	0.01	0.01	0.09	9.82E-06	5.09E-04	1.44E-10
065	0.02	4.98	2.07	0.02	0.01	0.02	0.07	9.23E-06	7.80E-04	2.21E-10
066	0.27	0.02	0.08	0.01	0.01	0.01	0.06	1.20E-05	3.41E-04	9.65E-11
067	0.03	2.75	48.25	0.49	0.21	0.09	0.06	7.35E-06	1.69E-04	4.78E-11
068	0.73	0.13	1.33	0.02	0.01	0.02	0.05	1.38E-05	4.86E-04	1.38E-10
069	0.05	1.02	3.81	0.04	0.02	0.03	0.17	7.25E-06	4.38E-04	1.24E-10
070	0.02	0.20	8.23	0.02	0.01	0.01	0.05	1.36E-05	6.46E-04	1.83E-10
071	4.13	0.02	0.45	0.08	0.04	0.01	0.06	7.70E-06	7.35E-04	2.08E-10
072	0.01	0.48	0.77	0.02	0.01	0.00	0.03	7.55E-06	5.91E-04	1.67E-10
073	0.50	0.03	0.39	0.07	0.03	0.01	0.10	1.75E-05	9.89E-05	2.80E-11
074	0.24	0.01	1.39	0.24	0.09	0.10	0.08	2.21E-05	7.33E-04	2.08E-10
075	0.05	1.35	6.84	0.05	0.02	0.05	0.06	1.22E-05	4.80E-04	1.36E-10
076	0.41	0.30	4.67	0.16	0.08	0.02	0.06	9.86E-06	6.47E-04	1.83E-10
077	0.29	0.24	0.88	0.09	0.04	0.10	0.35	1.95E-05	4.24E-04	1.20E-10
078	1.03	0.03	0.58	0.02	0.01	0.02	0.05	1.30E-05	3.06E-04	8.66E-11
079	0.08	0.39	45.04	0.22	0.13	0.06	0.05	7.98E-06	8.04E-04	2.28E-10
080	0.44	0.22	2.25	0.15	0.07	0.04	0.06	1.05E-05	6.26E-04	1.77E-10
081	0.02	0.15	2.63	0.05	0.03	0.01	0.09	1.95E-05	8.38E-04	2.37E-10
082	0.15	1.81	30.72	0.05	0.02	0.00	0.05	2.07E-05	9.25E-04	2.62E-10
083	0.00	4.77	18.65	0.10	0.04	0.02	0.08	1.80E-05	5.94E-04	1.68E-10
084	0.02	5.80	19.27	0.04	0.02	0.01	0.06	7.91E-06	6.82E-04	1.93E-10
085	2.18	0.08	2.67	0.19	0.09	0.05	0.12	9.41E-06	4.44E-04	1.26E-10
086	0.10	0.37	12.81	0.17	0.09	0.03	0.08	2.20E-05	4.50E-04	1.27E-10
087	0.31	0.64	1.56	0.01	0.00	0.02	0.17	2.43E-05	4.54E-04	1.29E-10
088	2.00	0.24	8.02	0.09	0.05	0.02	0.14	1.02E-05	5.26E-04	1.49E-10
089	0.24	0.01	0.43	0.22	0.12	0.03	0.03	2.04E-05	1.01E-03	2.87E-10
090	0.19	0.13	1.86	0.08	0.04	0.05	0.07	1.59E-05	4.22E-04	1.20E-10
091	0.09	0.01	0.85	0.11	0.06	0.19	0.08	1.30E-05	1.02E-04	2.89E-11
092	0.03	0.24	1.67	0.23	0.10	0.02	0.07	8.53E-06	4.35E-04	1.23E-10
093	0.51	0.08	5.77	0.10	0.05	0.03	0.03	9.67E-06	6.87E-04	1.95E-10
094	0.12	0.15	0.56	0.06	0.02	0.01	0.14	8.99E-06	6.68E-04	1.89E-10
095	0.02	0.93	1.59	0.18	0.10	0.04	0.10	1.36E-05	3.34E-04	9.46E-11
096	0.03	0.23	3.70	0.20	0.11	0.01	0.06	7.23E-06	4.72E-04	1.34E-10
097	0.42	0.30	2.91	0.05	0.01	0.01	0.09	7.78E-06	7.38E-04	2.09E-10
098	0.25	0.65	1.44	0.21	0.11	0.07	0.11	8.95E-06	1.02E-03	2.89E-10
099	0.18	0.46	1.49	0.03	0.01	0.01	0.09	7.93E-06	2.67E-04	7.57E-11
100	0.04	0.17	1.06	0.28	0.15	0.11	0.09	2.04E-05	6.45E-04	1.83E-10

Table F.4.3. SWMU1 and C-720 area AT123D Input Parameters Used in Probabilistic Modeling

Run (#)	Hydraulic Conductivity (m/hr)	Effective Porosity (%)	Aquifer Depth (m)	Organic Carbon (%)	Hydraulic Gradient (m/m)	Degradation Rate (/hr)	Groundwater Concentration[b] (ug/L)
001	5.23	29.92	4.89	0.0334	2.34E-03	2.17E-05	6.86E+02
002	2.80	29.32	7.14	0.0310	2.29E-03	2.15E-05	7.25E+01
003	2.25	29.83	13.31	0.0142	1.99E-03	2.06E-05	2.06E+03
004	2.35	35.59	3.38	0.0376	5.79E-04	9.80E-06	1.19E+04
005	3.05	30.45	15.28	0.0424	1.42E-03	1.70E-05	5.40E+02
006	3.42	30.74	14.54	0.1126	2.60E-03	2.25E-05	9.35E+03
007	2.19	30.09	8.25	0.0138	2.22E-03	2.12E-05	6.76E+01
008	1.95	27.30	7.12	0.0708	3.28E-03	2.39E-05	9.04E+02
009	1.47	35.80	7.10	0.0103	3.28E-03	2.38E-05	4.16E+03
010	2.15	33.57	8.80	0.0292	9.69E-04	1.32E-05	1.03E+02
011	2.17	40.90	5.95	0.0065	1.33E-03	1.53E-05	7.92E+03
012	1.21	22.39	15.68	0.1066	3.53E-03	2.42E-05	1.48E+02
013	6.40	36.33	11.53	0.0384	1.09E-03	1.44E-05	1.58E+02
014	8.73	38.80	14.34	0.0605	4.90E-04	1.00E-05	1.09E+01
015	8.91	28.65	9.86	0.0388	3.01E-04	8.52E-06	3.11E+03
016	3.83	25.39	15.63	0.0262	8.52E-04	1.18E-05	9.67E+02
017	2.80	29.58	14.51	0.0189	1.57E-03	1.80E-05	9.47E+02
018	2.76	30.69	11.30	0.0053	2.60E-03	2.22E-05	9.14E+02
019	5.90	33.01	16.36	0.0137	9.58E-04	1.30E-05	1.28E+03
020	2.22	38.18	12.30	0.0116	1.31E-03	1.58E-05	3.14E+02
021	1.17	22.61	10.31	0.0510	1.65E-03	1.78E-05	8.91E+03
022	4.45	36.82	12.05	0.0194	6.19E-04	1.07E-05	1.10E+02
023	5.62	35.32	6.27	0.0269	1.95E-03	2.08E-05	4.81E+01
024	3.22	30.18	12.42	0.0231	5.43E-04	1.02E-05	7.59E+02
025	3.40	34.20	11.81	0.1200	2.64E-03	2.25E-05	8.38E+01
026	2.29	28.86	9.32	0.0156	1.65E-03	1.80E-05	7.94E+01
027	4.32	37.36	13.09	0.0185	2.82E-03	2.28E-05	1.61E+03
028	2.54	24.89	14.59	0.0100	1.23E-03	1.50E-05	3.80E+02
029	4.93	32.23	6.95	0.0178	3.56E-04	8.41E-06	2.14E+04
030	8.86	30.09	11.34	0.0240	3.15E-03	2.38E-05	1.07E+02
031	5.15	33.54	6.58	0.0122	1.87E-03	1.99E-05	1.55E+03
032	4.22	26.76	9.80	0.0036	4.43E-04	9.14E-06	6.42E+01
033	1.67	37.82	3.46	0.0350	1.40E-03	1.59E-05	2.55E+03
034	1.51	24.94	10.19	0.0756	2.56E-03	2.22E-05	1.97E+02
035	3.90	28.89	4.40	0.0134	1.65E-03	1.81E-05	3.55E+02
036	4.58	29.44	10.36	0.0091	1.72E-03	1.82E-05	7.06E+01
037	7.55	29.19	6.21	0.0155	1.00E-03	1.38E-05	6.51E+01
038	0.97	32.40	7.25	0.0049	3.84E-03	2.44E-05	4.67E+00
039	13.14	36.72	16.24	0.0466	1.63E-04	7.20E-06	1.82E+03
040	4.64	32.99	7.03	0.0163	1.69E-03	1.91E-05	6.62E+01
041	3.75	35.42	13.07	0.0058	7.81E-04	1.08E-05	7.50E+02
042	5.82	26.87	11.64	0.0290	1.38E-03	1.73E-05	3.70E+02
043	5.14	27.98	7.16	0.0472	1.27E-03	1.72E-05	2.49E+02
044	8.31	28.33	13.04	0.0986	1.89E-03	2.05E-05	1.50E+03
045	2.09	32.78	6.16	0.0954	9.20E-04	1.23E-05	2.90E+01
046	2.78	27.93	14.22	0.0056	2.30E-03	2.16E-05	9.04E+01
047	1.01	23.38	9.95	0.0393	1.75E-03	1.80E-05	4.77E+01
048	2.63	31.34	14.70	0.0256	1.46E-03	1.65E-05	8.27E+01
049	1.35	41.78	8.95	0.0834	1.22E-03	1.38E-05	2.65E+02
050	2.45	34.32	18.50	0.0168	1.97E-03	2.04E-05	2.31E+03
051	4.05	32.89	13.16	0.0133	6.87E-04	1.09E-05	6.77E+02

Table F.4.3. SWMU1 and C-720 area AT123D Input Parameters Used in Probabilistic Modeling[a] (continued)

Run (#)	Hydraulic Conductivity (m/hr)	Effective Porosity (%)	Aquifer Depth (m)	Organic Carbon (%)	Hydraulic Gradient (m/m)	Degradation Rate (/hr)	Groundwater Concentration[b] (ug/L)
052	6.47	42.90	5.77	0.0121	1.23E-03	1.57E-05	2.38E+01
053	1.57	30.40	15.57	0.0164	9.16E-04	1.16E-05	7.67E+01
054	6.18	32.62	11.90	0.0103	1.36E-03	1.64E-05	4.29E+01
055	2.67	34.54	17.05	0.0172	2.31E-03	2.17E-05	3.69E+01
056	2.01	27.97	9.17	0.0140	1.85E-03	1.93E-05	3.88E+03
057	4.59	32.20	14.29	0.0063	1.50E-03	1.78E-05	5.25E+03
058	5.56	35.35	12.44	0.0076	1.53E-03	1.82E-05	6.34E+01
059	13.64	37.01	12.06	0.0168	3.33E-04	8.62E-06	3.82E+01
060	5.79	32.79	9.64	0.0058	4.47E-04	8.98E-06	2.92E+00
061	5.49	24.25	12.71	0.0126	5.52E-04	1.03E-05	9.16E+01
062	14.84	34.72	9.20	0.0297	4.16E-04	9.09E-06	8.00E+01
063	1.39	42.69	8.36	0.0347	1.75E-03	1.85E-05	8.30E+02
064	1.99	38.97	10.82	0.0485	1.01E-03	1.31E-05	2.24E+03
065	1.80	28.66	15.69	0.0360	7.14E-04	1.10E-05	1.71E+02
066	1.27	22.04	18.09	0.0537	3.17E-03	2.38E-05	4.96E+02
067	17.58	29.98	5.92	0.0450	2.09E-04	7.92E-06	2.13E+03
068	5.83	29.18	10.66	0.0122	1.97E-03	2.11E-05	2.27E+02
069	2.39	26.22	6.86	0.0069	2.02E-03	2.06E-05	3.88E+01
070	6.95	36.72	8.34	0.0098	6.65E-04	1.11E-05	8.99E+03
071	2.00	43.10	10.92	0.1052	1.41E-03	1.55E-05	2.17E+03
072	7.53	28.21	11.87	0.0688	4.51E-04	9.34E-06	4.52E+02
073	3.54	39.76	12.70	0.0253	4.33E-04	8.86E-06	7.84E+02
074	5.24	37.21	12.69	0.0352	1.67E-03	1.88E-05	2.20E+02
075	3.71	27.47	7.76	0.0134	6.36E-04	1.12E-05	1.48E+02
076	6.36	29.28	13.98	0.0160	2.34E-03	2.19E-05	5.17E+00
077	5.67	23.57	11.02	0.0373	6.08E-04	1.03E-05	4.03E+02
078	1.43	28.84	12.19	0.0264	4.95E-04	9.43E-06	6.81E+03
079	15.03	37.25	7.11	0.1009	1.70E-04	7.55E-06	3.30E+02
080	9.42	28.31	9.44	0.0492	1.19E-03	1.44E-05	2.35E+02
081	1.27	24.91	11.55	0.0107	3.98E-03	2.45E-05	1.18E+04
082	2.33	25.90	11.48	0.0156	8.44E-04	1.15E-05	1.13E+02
083	3.10	29.54	14.01	0.0064	2.29E-03	2.16E-05	2.53E+04
084	6.99	29.13	15.43	0.0107	1.05E-03	1.40E-05	5.37E+02
085	3.83	31.74	7.08	0.0092	1.21E-03	1.46E-05	2.67E+01
086	4.16	33.71	15.76	0.0080	3.08E-03	2.37E-05	3.07E+02
087	3.32	36.00	14.80	0.0257	4.53E-04	9.25E-06	1.84E+04
088	8.60	25.92	15.36	0.0540	9.24E-04	1.35E-05	5.35E+02
089	3.54	32.43	14.81	0.0364	1.81E-03	2.01E-05	1.44E+03
090	3.23	28.40	8.57	0.0887	1.54E-03	1.86E-05	1.63E+04
091	3.28	41.91	13.46	0.0127	8.69E-04	1.26E-05	4.08E+03
092	3.49	36.31	7.96	0.0034	7.75E-04	1.11E-05	2.98E+02
093	17.43	31.75	9.91	0.0713	1.68E-04	7.53E-06	4.72E+02
094	1.77	29.83	8.21	0.0144	2.52E-03	2.18E-05	1.93E+02
095	2.37	36.51	12.72	0.0269	2.80E-03	2.28E-05	1.30E+03
096	10.37	31.76	11.46	0.0205	3.98E-04	9.31E-06	4.71E+02
097	12.63	35.15	9.39	0.0502	9.68E-04	1.37E-05	3.16E+03
098	2.73	26.17	10.30	0.2283	2.08E-03	2.10E-05	3.36E+02
099	14.23	37.78	7.26	0.0397	1.18E-03	1.57E-05	1.62E+02
100	1.58	25.65	12.09	0.0370	3.10E-03	2.35E-05	1.42E+02

[a] These parameters were also used for developing the secondary source release rates for SWMU 4.

[b] Required for SWMU 4 only.

Table F.4.4. Probabilistic Modeling Results for SWMU 1 (variable degradation scenario) - Plant Boundary POE (conc in mg/L)

Run	0 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	30 yrs	35 yrs	40 yrs	45 yrs
1	0.00E+00	2.82E-02	1.53E-02	7.99E-03	4.04E-03	2.01E-03	9.96E-04	4.92E-04	2.43E-04	1.20E-04
2	0.00E+00	3.32E-02	2.45E-02	1.32E-02	6.66E-03	3.27E-03	1.58E-03	7.63E-04	3.67E-04	1.76E-04
3	0.00E+00	9.36E-03	1.19E-02	9.14E-03	6.25E-03	4.05E-03	2.57E-03	1.61E-03	1.01E-03	6.29E-04
4	0.00E+00	5.53E-03	1.18E-01	9.24E-02	4.71E-02	2.15E-02	9.48E-03	4.12E-03	1.78E-03	7.65E-04
5	0.00E+00	0.00E+00	1.04E-02	6.93E-03	4.31E-03	2.66E-03	1.63E-03	1.00E-03	6.16E-04	3.78E-04
6	0.00E+00	0.00E+00	1.19E-02	1.36E-02	1.24E-02	9.28E-03	6.65E-03	4.68E-03	3.26E-03	2.26E-03
7	0.00E+00	0.00E+00	4.43E-02	5.37E-02	4.10E-02	2.85E-02	1.95E-02	1.32E-02	8.86E-03	5.96E-03
8	0.00E+00	3.20E-02	1.20E-01	1.32E-01	8.11E-02	4.50E-02	2.41E-02	1.27E-02	6.66E-03	3.48E-03
9	0.00E+00	1.00E-01	5.60E-02	2.64E-02	1.20E-02	5.42E-03	2.42E-03	1.08E-03	4.83E-04	2.15E-04
10	0.00E+00	6.12E-05	2.99E-02	1.69E-02	7.90E-03	3.56E-03	1.59E-03	7.02E-04	3.10E-04	1.37E-04
11	0.00E+00	0.00E+00	2.81E-02	4.34E-02	2.40E-02	1.31E-02	7.17E-03	3.91E-03	2.13E-03	1.16E-03
12	0.00E+00	2.36E-02	4.60E-02	3.15E-02	1.63E-02	8.06E-03	3.91E-03	1.89E-03	9.08E-04	4.36E-04
13	0.00E+00	1.11E-02	7.85E-03	4.08E-03	1.98E-03	9.39E-04	4.39E-04	2.05E-04	9.52E-05	4.42E-05
14	0.00E+00	4.13E-02	2.96E-02	1.03E-02	3.48E-03	1.17E-03	3.92E-04	1.31E-04	4.40E-05	1.47E-05
15	0.00E+00	1.48E-02	5.28E-02	4.49E-02	2.56E-02	1.34E-02	6.79E-03	3.41E-03	1.70E-03	8.47E-04
16	0.00E+00	0.00E+00	7.87E-02	5.66E-02	3.98E-02	2.78E-02	1.93E-02	1.34E-02	9.34E-03	6.49E-03
17	0.00E+00	7.71E-03	1.41E-02	9.18E-03	4.06E-03	1.70E-03	6.95E-04	2.82E-04	1.14E-04	4.60E-05
18	0.00E+00	3.46E-02	1.78E-02	7.22E-03	2.76E-03	1.03E-03	3.80E-04	1.40E-04	5.13E-05	1.88E-05
19	0.00E+00	1.13E-01	1.29E-01	8.37E-02	5.18E-02	3.18E-02	1.94E-02	1.18E-02	7.20E-03	4.38E-03
20	0.00E+00	0.00E+00	3.16E-03	5.30E-03	3.59E-03	2.12E-03	1.20E-03	6.66E-04	3.67E-04	2.00E-04
21	0.00E+00	0.00E+00	2.72E-02	4.82E-02	4.61E-02	2.89E-02	1.68E-02	9.59E-03	5.44E-03	3.07E-03
22	0.00E+00	7.37E-06	2.22E-02	1.78E-02	1.20E-02	7.75E-03	4.93E-03	3.12E-03	1.97E-03	1.24E-03
23	0.00E+00	0.00E+00	0.00E+00	3.38E-03	4.15E-03	4.14E-03	3.05E-03	2.18E-03	1.54E-03	1.08E-03
24	0.00E+00	3.70E-02	6.61E-02	4.04E-02	2.23E-02	1.20E-02	6.39E-03	3.40E-03	1.81E-03	9.59E-04
25	0.00E+00	3.40E-02	2.93E-02	1.62E-02	8.90E-03	4.87E-03	2.66E-03	1.45E-03	7.93E-04	4.33E-04
26	0.00E+00	0.00E+00	1.52E-02	8.07E-03	3.94E-03	1.87E-03	8.81E-04	4.12E-04	1.93E-04	8.99E-05
27	0.00E+00	2.45E-03	2.06E-03	1.47E-03	9.78E-04	6.36E-04	4.09E-04	2.62E-04	1.67E-04	1.07E-04
28	0.00E+00	5.66E-03	6.37E-02	4.04E-02	2.57E-02	1.63E-02	1.04E-02	6.64E-03	4.23E-03	2.70E-03
29	0.00E+00	1.64E-02	7.53E-02	5.90E-02	3.18E-02	1.49E-02	6.64E-03	2.90E-03	1.25E-03	5.39E-04
30	0.00E+00	1.43E-03	8.33E-04	4.12E-04	1.87E-04	8.19E-05	3.53E-05	1.51E-05	6.42E-06	2.73E-06
31	0.00E+00	3.62E-02	1.99E-02	1.12E-02	6.33E-03	3.61E-03	2.06E-03	1.18E-03	6.75E-04	3.86E-04
32	0.00E+00	5.42E-02	1.72E-01	1.33E-01	9.23E-02	6.09E-02	3.93E-02	2.52E-02	1.61E-02	1.02E-02
33	0.00E+00	9.50E-03	7.34E-02	3.99E-02	2.06E-02	1.06E-02	5.48E-03	2.83E-03	1.47E-03	7.58E-04
34	0.00E+00	0.00E+00	4.29E-02	2.88E-02	1.79E-02	1.12E-02	7.07E-03	4.47E-03	2.83E-03	1.79E-03
35	0.00E+00	1.07E-02	1.77E-02	2.00E-02	1.42E-02	8.56E-03	4.95E-03	2.81E-03	1.58E-03	8.90E-04
36	0.00E+00	0.00E+00	3.98E-03	2.68E-03	1.62E-03	9.04E-04	4.87E-04	2.56E-04	1.33E-04	6.89E-05
37	0.00E+00	0.00E+00	4.70E-03	3.20E-03	1.39E-03	5.39E-04	2.05E-04	7.76E-05	2.93E-05	1.10E-05
38	0.00E+00	6.42E-02	2.56E-02	8.72E-03	2.86E-03	9.21E-04	2.95E-04	9.42E-05	3.01E-05	9.60E-06
39	0.00E+00	8.27E-03	1.98E-01	1.44E-01	9.19E-02	5.71E-02	3.51E-02	2.14E-02	1.30E-02	7.91E-03
40	0.00E+00	1.76E-03	3.58E-03	3.20E-03	1.96E-03	1.12E-03	6.21E-04	3.42E-04	1.88E-04	1.03E-04
41	0.00E+00	2.69E-01	2.42E-01	1.16E-01	5.43E-02	2.53E-02	1.18E-02	5.50E-03	2.56E-03	1.19E-03
42	0.00E+00	3.75E-02	5.34E-02	3.09E-02	1.40E-02	6.05E-03	2.56E-03	1.07E-03	4.50E-04	1.88E-04
43	0.00E+00	8.66E-02	3.86E-02	1.82E-02	8.87E-03	4.36E-03	2.15E-03	1.07E-03	5.27E-04	2.61E-04
44	0.00E+00	4.67E-03	3.42E-03	2.22E-03	1.42E-03	9.04E-04	5.74E-04	3.64E-04	2.31E-04	1.46E-04
45	0.00E+00	0.00E+00	2.04E-09	2.17E-02	2.00E-02	1.42E-02	1.00E-02	7.07E-03	5.01E-03	3.55E-03
46	0.00E+00	4.25E-02	5.40E-02	4.59E-02	2.64E-02	1.39E-02	7.06E-03	3.54E-03	1.76E-03	8.71E-04
47	0.00E+00	2.21E-02	4.49E-02	2.22E-02	8.39E-03	2.98E-03	1.03E-03	3.56E-04	1.22E-04	4.17E-05
48	0.00E+00	2.46E-02	5.64E-02	5.15E-02	3.44E-02	2.18E-02	1.35E-02	8.25E-03	5.04E-03	3.07E-03
49	0.00E+00	0.00E+00	4.50E-03	1.35E-02	1.13E-02	7.44E-03	4.64E-03	2.84E-03	1.72E-03	1.04E-03
50	0.00E+00	1.47E-01	1.41E-01	7.91E-02	4.25E-02	2.25E-02	1.18E-02	6.21E-03	3.26E-03	1.71E-03

Table F.4.4. Probabilistic Modeling Results for SWMU 1 (variable degradation scenario) - Plant Boundary POE (conc in mg/L) (continued)

Run	0 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	30 yrs	35 yrs	40 yrs	45 yrs
51	0.00E+00	0.00E+00	3.61E-02	3.28E-02	2.03E-02	1.28E-02	8.05E-03	5.09E-03	3.23E-03	2.04E-03
52	0.00E+00	7.04E-02	8.30E-02	4.94E-02	2.61E-02	1.33E-02	6.71E-03	3.37E-03	1.69E-03	8.47E-04
53	0.00E+00	2.21E-03	1.89E-02	1.93E-02	9.37E-03	3.54E-03	1.25E-03	4.33E-04	1.49E-04	5.08E-05
54	0.00E+00	0.00E+00	9.62E-03	1.96E-02	2.41E-02	1.96E-02	1.36E-02	9.16E-03	6.08E-03	4.01E-03
55	0.00E+00	1.02E-01	8.27E-02	4.89E-02	2.69E-02	1.44E-02	7.62E-03	4.02E-03	2.11E-03	1.11E-03
56	0.00E+00	2.09E-06	1.15E-03	6.60E-04	3.27E-04	1.56E-04	7.39E-05	3.48E-05	1.63E-05	7.64E-06
57	0.00E+00	1.12E-02	3.01E-02	3.03E-02	1.87E-02	1.06E-02	5.81E-03	3.13E-03	1.68E-03	9.00E-04
58	0.00E+00	1.43E-02	7.76E-03	4.22E-03	2.30E-03	1.26E-03	6.90E-04	3.78E-04	2.07E-04	1.14E-04
59	0.00E+00	1.21E-02	9.06E-03	3.93E-03	1.56E-03	5.99E-04	2.28E-04	8.66E-05	3.28E-05	1.24E-05
60	0.00E+00	0.00E+00	0.00E+00	1.64E-02	1.08E-02	5.74E-03	3.03E-03	1.60E-03	8.38E-04	4.40E-04
61	0.00E+00	7.74E-01	4.24E-01	1.64E-01	6.13E-02	2.27E-02	8.34E-03	3.07E-03	1.13E-03	4.14E-04
62	0.00E+00	3.10E-02	2.08E-02	1.25E-02	7.56E-03	4.56E-03	2.76E-03	1.67E-03	1.01E-03	6.08E-04
63	0.00E+00	3.11E-03	3.97E-02	6.10E-02	5.24E-02	3.38E-02	2.04E-02	1.21E-02	7.03E-03	4.08E-03
64	0.00E+00	6.41E-06	3.37E-02	2.34E-02	1.39E-02	8.40E-03	5.11E-03	3.13E-03	1.91E-03	1.17E-03
65	0.00E+00	0.00E+00	0.00E+00	7.31E-03	9.02E-03	6.50E-03	3.58E-03	1.82E-03	9.12E-04	4.53E-04
66	0.00E+00	7.44E-02	4.02E-02	1.62E-02	6.60E-03	2.70E-03	1.10E-03	4.53E-04	1.86E-04	7.62E-05
67	0.00E+00	1.27E-03	6.50E-02	1.12E-01	1.06E-01	7.23E-02	4.67E-02	2.96E-02	1.87E-02	1.17E-02
68	0.00E+00	4.09E-03	3.22E-03	2.23E-03	1.45E-03	9.26E-04	5.84E-04	3.66E-04	2.29E-04	1.43E-04
69	0.00E+00	5.08E-02	4.01E-02	2.54E-02	1.57E-02	9.56E-03	5.81E-03	3.53E-03	2.14E-03	1.30E-03
70	0.00E+00	3.85E-03	7.74E-03	7.64E-03	5.41E-03	3.60E-03	2.34E-03	1.51E-03	9.73E-04	6.24E-04
71	0.00E+00	8.02E-04	5.32E-03	3.09E-03	1.46E-03	6.50E-04	2.84E-04	1.23E-04	5.28E-05	2.27E-05
72	0.00E+00	3.49E-02	3.42E-02	1.96E-02	1.09E-02	6.07E-03	3.37E-03	1.87E-03	1.04E-03	5.76E-04
73	0.00E+00	2.36E-03	2.79E-02	1.99E-02	8.78E-03	3.43E-03	1.29E-03	4.77E-04	1.75E-04	6.44E-05
74	0.00E+00	1.53E-03	3.90E-03	4.45E-03	3.06E-03	1.93E-03	1.18E-03	7.17E-04	4.33E-04	2.61E-04
75	0.00E+00	5.00E-02	3.93E-02	2.17E-02	1.21E-02	6.79E-03	3.81E-03	2.14E-03	1.20E-03	6.72E-04
76	0.00E+00	4.04E-07	1.60E-03	9.15E-04	5.25E-04	3.01E-04	1.73E-04	9.95E-05	5.72E-05	3.29E-05
77	0.00E+00	0.00E+00	2.40E-05	7.31E-03	6.12E-03	4.57E-03	3.34E-03	2.42E-03	1.75E-03	1.26E-03
78	0.00E+00	0.00E+00	1.54E-02	4.81E-02	5.16E-02	3.64E-02	2.14E-02	1.17E-02	6.21E-03	3.26E-03
79	0.00E+00	7.03E-04	1.31E-01	9.54E-02	6.29E-02	4.16E-02	2.77E-02	1.84E-02	1.23E-02	8.16E-03
80	0.00E+00	9.70E-03	2.50E-02	2.74E-02	1.60E-02	8.35E-03	4.22E-03	2.11E-03	1.05E-03	5.18E-04
81	0.00E+00	1.80E-02	1.20E-02	7.46E-03	4.57E-03	2.78E-03	1.68E-03	1.02E-03	6.17E-04	3.73E-04
82	0.00E+00	5.23E-04	2.51E-02	3.89E-02	3.71E-02	2.66E-02	1.81E-02	1.20E-02	7.91E-03	5.18E-03
83	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.31E-04	4.26E-04	2.24E-04	1.13E-04	5.67E-05	2.82E-05
84	0.00E+00	2.89E-02	1.62E-02	6.21E-03	2.24E-03	7.93E-04	2.78E-04	9.71E-05	3.39E-05	1.18E-05
85	0.00E+00	1.39E-02	2.60E-02	1.71E-02	1.01E-02	5.69E-03	3.16E-03	1.75E-03	9.62E-04	5.29E-04
86	0.00E+00	7.85E-03	1.50E-02	1.49E-02	1.05E-02	6.68E-03	4.14E-03	2.53E-03	1.53E-03	9.28E-04
87	0.00E+00	3.97E-07	7.05E-02	4.99E-02	2.35E-02	1.06E-02	4.73E-03	2.12E-03	9.45E-04	4.22E-04
88	0.00E+00	0.00E+00	0.00E+00	1.05E-03	6.26E-04	3.71E-04	2.19E-04	1.29E-04	7.63E-05	4.49E-05
89	0.00E+00	4.01E-02	2.76E-02	1.67E-02	9.94E-03	5.90E-03	3.50E-03	2.07E-03	1.23E-03	7.27E-04
90	0.00E+00	7.42E-03	1.37E-02	1.18E-02	7.32E-03	4.26E-03	2.43E-03	1.37E-03	7.68E-04	4.30E-04
91	0.00E+00	1.18E-02	2.32E-02	1.34E-02	5.53E-03	2.13E-03	8.01E-04	2.99E-04	1.11E-04	4.14E-05
92	0.00E+00	7.62E-02	2.19E-01	1.89E-01	8.09E-02	3.01E-02	1.07E-02	3.77E-03	1.32E-03	4.61E-04
93	0.00E+00	1.76E-03	5.90E-03	2.97E-03	1.33E-03	5.78E-04	2.49E-04	1.07E-04	4.56E-05	1.95E-05
94	0.00E+00	1.79E-01	1.21E-01	7.24E-02	4.39E-02	2.68E-02	1.64E-02	1.00E-02	6.13E-03	3.75E-03
95	0.00E+00	1.94E-03	2.19E-03	1.47E-03	9.34E-04	5.78E-04	3.55E-04	2.17E-04	1.32E-04	8.06E-05
96	0.00E+00	1.04E-03	3.95E-03	3.14E-03	1.46E-03	5.90E-04	2.31E-04	8.94E-05	3.44E-05	1.32E-05
97	0.00E+00	6.65E-02	2.78E-02	9.99E-03	3.55E-03	1.25E-03	4.42E-04	1.56E-04	5.48E-05	1.93E-05
98	0.00E+00	7.05E-04	3.06E-02	5.11E-02	5.11E-02	3.46E-02	2.16E-02	1.32E-02	7.92E-03	4.73E-03
99	0.00E+00	3.20E-02	2.86E-02	1.23E-02	4.46E-03	1.54E-03	5.23E-04	1.77E-04	5.96E-05	2.01E-05
100	0.00E+00	3.93E-03	8.88E-03	4.50E-03	2.23E-03	1.10E-03	5.36E-04	2.61E-04	1.27E-04	6.20E-05

Table F.4.4. Probabilistic Modeling Results for SWMU 1 (variable degradation scenario) - Plant Boundary POE (conc in mg/L) (continued)

Run	50 yrs	55 yrs	60 yrs	65 yrs	70 yrs	75 yrs	80 yrs	85 yrs	90 yrs	95 yrs
1	5.92E-05	2.92E-05	1.44E-05	7.10E-06	3.50E-06	1.73E-06	8.53E-07	4.21E-07	2.07E-07	1.02E-07
2	8.46E-05	4.06E-05	1.95E-05	9.36E-06	4.50E-06	2.16E-06	1.04E-06	4.97E-07	2.39E-07	1.14E-07
3	3.92E-04	2.44E-04	1.52E-04	9.47E-05	5.90E-05	3.67E-05	2.29E-05	1.42E-05	8.87E-06	5.52E-06
4	3.29E-04	1.42E-04	6.09E-05	2.62E-05	1.13E-05	4.84E-06	2.08E-06	8.94E-07	3.84E-07	1.64E-07
5	2.32E-04	1.42E-04	8.71E-05	5.34E-05	3.27E-05	2.01E-05	1.23E-05	7.55E-06	4.63E-06	2.84E-06
6	1.56E-03	1.08E-03	7.46E-04	5.15E-04	3.56E-04	2.46E-04	1.70E-04	1.17E-04	8.08E-05	5.58E-05
7	4.00E-03	2.68E-03	1.80E-03	1.21E-03	8.10E-04	5.44E-04	3.65E-04	2.45E-04	1.64E-04	1.10E-04
8	1.82E-03	9.51E-04	4.96E-04	2.59E-04	1.35E-04	7.06E-05	3.68E-05	1.92E-05	1.00E-05	5.24E-06
9	9.61E-05	4.28E-05	1.91E-05	8.52E-06	3.80E-06	1.69E-06	7.56E-07	3.37E-07	1.50E-07	6.67E-08
10	6.03E-05	2.66E-05	1.17E-05	5.17E-06	2.28E-06	1.00E-06	4.43E-07	1.95E-07	8.58E-08	3.76E-08
11	6.33E-04	3.45E-04	1.88E-04	1.02E-04	5.58E-05	3.04E-05	1.66E-05	9.03E-06	4.92E-06	2.68E-06
12	2.10E-04	1.01E-04	4.83E-05	2.32E-05	1.11E-05	5.35E-06	2.57E-06	1.23E-06	5.92E-07	2.84E-07
13	2.05E-05	9.54E-06	4.43E-06	2.06E-06	9.55E-07	4.44E-07	2.06E-07	9.55E-08	4.42E-08	2.04E-08
14	4.93E-06	1.65E-06	5.53E-07	1.85E-07	6.18E-08	2.05E-08	6.69E-09	2.16E-09	8.03E-10	3.04E-10
15	4.21E-04	2.09E-04	1.04E-04	5.16E-05	2.56E-05	1.27E-05	6.32E-06	3.14E-06	1.56E-06	7.75E-07
16	4.51E-03	3.13E-03	2.17E-03	1.51E-03	1.05E-03	7.28E-04	5.05E-04	3.51E-04	2.44E-04	1.69E-04
17	1.86E-05	7.49E-06	3.02E-06	1.22E-06	4.91E-07	1.98E-07	7.97E-08	3.19E-08	1.27E-08	5.00E-09
18	6.89E-06	2.52E-06	9.25E-07	3.39E-07	1.24E-07	4.53E-08	1.65E-08	5.95E-09	2.12E-09	7.50E-10
19	2.67E-03	1.63E-03	9.89E-04	6.02E-04	3.66E-04	2.23E-04	1.36E-04	8.27E-05	5.03E-05	3.06E-05
20	1.09E-04	5.95E-05	3.24E-05	1.76E-05	9.58E-06	5.21E-06	2.83E-06	1.54E-06	8.36E-07	4.55E-07
21	1.73E-03	9.79E-04	5.52E-04	3.11E-04	1.76E-04	9.91E-05	5.59E-05	3.15E-05	1.78E-05	1.00E-05
22	7.78E-04	4.89E-04	3.07E-04	1.93E-04	1.22E-04	7.64E-05	4.80E-05	3.02E-05	1.90E-05	1.19E-05
23	7.55E-04	5.28E-04	3.70E-04	2.58E-04	1.81E-04	1.26E-04	8.83E-05	6.17E-05	4.32E-05	3.02E-05
24	5.09E-04	2.71E-04	1.44E-04	7.63E-05	4.05E-05	2.15E-05	1.14E-05	6.07E-06	3.22E-06	1.71E-06
25	2.36E-04	1.29E-04	7.03E-05	3.83E-05	2.09E-05	1.14E-05	6.23E-06	3.40E-06	1.85E-06	1.01E-06
26	4.19E-05	1.96E-05	9.12E-06	4.25E-06	1.98E-06	9.25E-07	4.31E-07	2.01E-07	9.37E-08	4.36E-08
27	6.79E-05	4.33E-05	2.76E-05	1.76E-05	1.12E-05	7.15E-06	4.56E-06	2.91E-06	1.85E-06	1.18E-06
28	1.72E-03	1.10E-03	7.02E-04	4.48E-04	2.86E-04	1.82E-04	1.16E-04	7.42E-05	4.73E-05	3.02E-05
29	2.31E-04	9.88E-05	4.23E-05	1.81E-05	7.73E-06	3.30E-06	1.41E-06	6.04E-07	2.58E-07	1.10E-07
30	1.16E-06	4.92E-07	2.09E-07	8.88E-08	3.77E-08	1.60E-08	6.75E-09	2.84E-09	1.18E-09	4.93E-10
31	2.21E-04	1.26E-04	7.23E-05	4.14E-05	2.37E-05	1.35E-05	7.75E-06	4.43E-06	2.54E-06	1.45E-06
32	6.52E-03	4.15E-03	2.64E-03	1.68E-03	1.07E-03	6.81E-04	4.33E-04	2.76E-04	1.75E-04	1.12E-04
33	3.92E-04	2.03E-04	1.05E-04	5.43E-05	2.81E-05	1.45E-05	7.52E-06	3.89E-06	2.01E-06	1.04E-06
34	1.13E-03	7.18E-04	4.55E-04	2.88E-04	1.82E-04	1.16E-04	7.32E-05	4.64E-05	2.94E-05	1.86E-05
35	4.99E-04	2.80E-04	1.57E-04	8.78E-05	4.92E-05	2.76E-05	1.54E-05	8.65E-06	4.84E-06	2.71E-06
36	3.54E-05	1.82E-05	9.31E-06	4.77E-06	2.44E-06	1.25E-06	6.37E-07	3.26E-07	1.67E-07	8.51E-08
37	4.14E-06	1.56E-06	5.86E-07	2.20E-07	8.28E-08	3.11E-08	1.16E-08	4.33E-09	1.59E-09	5.75E-10
38	3.06E-06	9.77E-07	3.11E-07	9.91E-08	3.14E-08	9.77E-09	3.04E-09	1.04E-09	4.25E-10	2.90E-10
39	4.80E-03	2.92E-03	1.77E-03	1.07E-03	6.52E-04	3.96E-04	2.40E-04	1.46E-04	8.86E-05	5.38E-05
40	5.63E-05	3.08E-05	1.69E-05	9.23E-06	5.05E-06	2.76E-06	1.51E-06	8.28E-07	4.53E-07	2.48E-07
41	5.55E-04	2.58E-04	1.20E-04	5.60E-05	2.61E-05	1.21E-05	5.65E-06	2.63E-06	1.22E-06	5.70E-07
42	7.87E-05	3.29E-05	1.38E-05	5.75E-06	2.40E-06	1.00E-06	4.19E-07	1.75E-07	7.31E-08	3.04E-08
43	1.29E-04	6.41E-05	3.17E-05	1.57E-05	7.79E-06	3.86E-06	1.91E-06	9.48E-07	4.69E-07	2.32E-07
44	9.28E-05	5.88E-05	3.73E-05	2.36E-05	1.50E-05	9.48E-06	6.01E-06	3.81E-06	2.42E-06	1.53E-06
45	2.51E-03	1.78E-03	1.26E-03	8.94E-04	6.33E-04	4.49E-04	3.18E-04	2.25E-04	1.60E-04	1.13E-04
46	4.31E-04	2.13E-04	1.05E-04	5.19E-05	2.56E-05	1.27E-05	6.25E-06	3.08E-06	1.52E-06	7.52E-07
47	1.43E-05	4.87E-06	1.66E-06	5.69E-07	1.94E-07	6.59E-08	2.22E-08	7.35E-09	2.49E-09	1.00E-09
48	1.87E-03	1.14E-03	6.95E-04	4.24E-04	2.58E-04	1.57E-04	9.58E-05	5.83E-05	3.55E-05	2.16E-05
49	6.23E-04	3.74E-04	2.25E-04	1.35E-04	8.10E-05	4.86E-05	2.92E-05	1.75E-05	1.05E-05	6.31E-06
50	8.97E-04	4.70E-04	2.47E-04	1.29E-04	6.79E-05	3.56E-05	1.87E-05	9.81E-06	5.14E-06	2.70E-06

Table F.4.4. Probabilistic Modeling Results for SWMU 1 (variable degradation scenario) - Plant Boundary POE (conc in mg/L) (continued)

Run	50 yrs	55 yrs	60 yrs	65 yrs	70 yrs	75 yrs	80 yrs	85 yrs	90 yrs	95 yrs
51	1.30E-03	8.21E-04	5.21E-04	3.30E-04	2.09E-04	1.33E-04	8.41E-05	5.33E-05	3.38E-05	2.14E-05
52	4.24E-04	2.13E-04	1.07E-04	5.34E-05	2.67E-05	1.34E-05	6.71E-06	3.36E-06	1.69E-06	8.45E-07
53	1.73E-05	5.91E-06	2.02E-06	6.87E-07	2.34E-07	7.91E-08	2.65E-08	8.75E-09	3.03E-09	1.14E-09
54	2.63E-03	1.73E-03	1.13E-03	7.43E-04	4.87E-04	3.19E-04	2.09E-04	1.37E-04	8.97E-05	5.88E-05
55	5.84E-04	3.07E-04	1.61E-04	8.47E-05	4.45E-05	2.34E-05	1.23E-05	6.46E-06	3.39E-06	1.78E-06
56	3.58E-06	1.67E-06	7.84E-07	3.67E-07	1.72E-07	8.04E-08	3.75E-08	1.74E-08	8.05E-09	3.69E-09
57	4.81E-04	2.57E-04	1.37E-04	7.31E-05	3.90E-05	2.08E-05	1.11E-05	5.93E-06	3.16E-06	1.69E-06
58	6.22E-05	3.41E-05	1.87E-05	1.03E-05	5.62E-06	3.08E-06	1.69E-06	9.26E-07	5.08E-07	2.78E-07
59	4.70E-06	1.78E-06	6.72E-07	2.54E-07	9.60E-08	3.61E-08	1.34E-08	4.92E-09	1.77E-09	7.70E-10
60	2.31E-04	1.21E-04	6.37E-05	3.35E-05	1.76E-05	9.22E-06	4.84E-06	2.54E-06	1.33E-06	7.00E-07
61	1.52E-04	5.58E-05	2.05E-05	7.52E-06	2.76E-06	1.01E-06	3.72E-07	1.36E-07	4.97E-08	1.79E-08
62	3.67E-04	2.22E-04	1.34E-04	8.11E-05	4.90E-05	2.96E-05	1.79E-05	1.08E-05	6.53E-06	3.94E-06
63	2.36E-03	1.37E-03	7.91E-04	4.57E-04	2.64E-04	1.53E-04	8.85E-05	5.11E-05	2.96E-05	1.71E-05
64	7.19E-04	4.41E-04	2.71E-04	1.66E-04	1.02E-04	6.24E-05	3.83E-05	2.35E-05	1.44E-05	8.84E-06
65	2.24E-04	1.11E-04	5.47E-05	2.70E-05	1.33E-05	6.59E-06	3.25E-06	1.61E-06	7.93E-07	3.91E-07
66	3.13E-05	1.28E-05	5.27E-06	2.16E-06	8.87E-07	3.64E-07	1.49E-07	6.11E-08	2.50E-08	1.01E-08
67	7.36E-03	4.62E-03	2.89E-03	1.81E-03	1.14E-03	7.13E-04	4.47E-04	2.80E-04	1.76E-04	1.10E-04
68	8.97E-05	5.61E-05	3.51E-05	2.19E-05	1.37E-05	8.57E-06	5.36E-06	3.35E-06	2.10E-06	1.31E-06
69	7.88E-04	4.78E-04	2.90E-04	1.76E-04	1.07E-04	6.46E-05	3.92E-05	2.38E-05	1.44E-05	8.74E-06
70	4.00E-04	2.57E-04	1.65E-04	1.05E-04	6.76E-05	4.33E-05	2.78E-05	1.78E-05	1.14E-05	7.32E-06
71	9.78E-06	4.20E-06	1.81E-06	7.77E-07	3.34E-07	1.43E-07	6.15E-08	2.62E-08	1.11E-08	4.61E-09
72	3.20E-04	1.78E-04	9.86E-05	5.47E-05	3.04E-05	1.69E-05	9.36E-06	5.19E-06	2.88E-06	1.60E-06
73	2.36E-05	8.65E-06	3.17E-06	1.16E-06	4.25E-07	1.55E-07	5.64E-08	2.03E-08	7.25E-09	2.78E-09
74	1.57E-04	9.42E-05	5.67E-05	3.41E-05	2.05E-05	1.23E-05	7.39E-06	4.44E-06	2.67E-06	1.60E-06
75	3.77E-04	2.12E-04	1.19E-04	6.66E-05	3.74E-05	2.10E-05	1.18E-05	6.61E-06	3.71E-06	2.08E-06
76	1.89E-05	1.09E-05	6.24E-06	3.59E-06	2.07E-06	1.19E-06	6.82E-07	3.92E-07	2.26E-07	1.30E-07
77	9.04E-04	6.50E-04	4.67E-04	3.36E-04	2.41E-04	1.73E-04	1.25E-04	8.95E-05	6.43E-05	4.62E-05
78	1.70E-03	8.84E-04	4.59E-04	2.39E-04	1.24E-04	6.43E-05	3.34E-05	1.73E-05	9.00E-06	4.67E-06
79	5.43E-03	3.62E-03	2.41E-03	1.60E-03	1.07E-03	7.11E-04	4.74E-04	3.15E-04	2.10E-04	1.40E-04
80	2.56E-04	1.27E-04	6.27E-05	3.10E-05	1.53E-05	7.59E-06	3.76E-06	1.86E-06	9.19E-07	4.55E-07
81	2.26E-04	1.36E-04	8.25E-05	4.99E-05	3.02E-05	1.83E-05	1.10E-05	6.67E-06	4.04E-06	2.44E-06
82	3.38E-03	2.20E-03	1.43E-03	9.33E-04	6.07E-04	3.95E-04	2.57E-04	1.67E-04	1.09E-04	7.08E-05
83	1.40E-05	6.95E-06	3.45E-06	1.71E-06	8.47E-07	4.20E-07	2.08E-07	1.03E-07	5.11E-08	2.53E-08
84	4.12E-06	1.44E-06	5.01E-07	1.74E-07	6.06E-08	2.10E-08	7.14E-09	2.40E-09	8.39E-10	3.34E-10
85	2.91E-04	1.60E-04	8.77E-05	4.82E-05	2.64E-05	1.45E-05	7.98E-06	4.38E-06	2.41E-06	1.32E-06
86	5.60E-04	3.37E-04	2.03E-04	1.22E-04	7.32E-05	4.40E-05	2.64E-05	1.59E-05	9.55E-06	5.74E-06
87	1.89E-04	8.43E-05	3.76E-05	1.68E-05	7.51E-06	3.35E-06	1.50E-06	6.69E-07	2.98E-07	1.33E-07
88	2.65E-05	1.56E-05	9.20E-06	5.42E-06	3.19E-06	1.88E-06	1.11E-06	6.54E-07	3.85E-07	2.27E-07
89	4.31E-04	2.55E-04	1.51E-04	8.95E-05	5.30E-05	3.14E-05	1.86E-05	1.10E-05	6.52E-06	3.86E-06
90	2.41E-04	1.35E-04	7.56E-05	4.23E-05	2.37E-05	1.33E-05	7.43E-06	4.16E-06	2.33E-06	1.30E-06
91	1.54E-05	5.72E-06	2.13E-06	7.90E-07	2.93E-07	1.09E-07	4.00E-08	1.46E-08	5.21E-09	1.99E-09
92	1.61E-04	5.61E-05	1.96E-05	6.82E-06	2.38E-06	8.29E-07	2.89E-07	1.00E-07	3.46E-08	1.17E-08
93	8.33E-06	3.56E-06	1.52E-06	6.49E-07	2.77E-07	1.18E-07	5.01E-08	2.11E-08	8.85E-09	3.65E-09
94	2.30E-03	1.41E-03	8.62E-04	5.28E-04	3.23E-04	1.98E-04	1.21E-04	7.44E-05	4.55E-05	2.79E-05
95	4.91E-05	2.99E-05	1.82E-05	1.11E-05	6.78E-06	4.13E-06	2.52E-06	1.53E-06	9.35E-07	5.70E-07
96	5.05E-06	1.94E-06	7.41E-07	2.84E-07	1.09E-07	4.14E-08	1.57E-08	5.89E-09	2.19E-09	8.70E-10
97	6.80E-06	2.40E-06	8.44E-07	2.97E-07	1.05E-07	3.68E-08	1.29E-08	4.48E-09	1.53E-09	5.19E-10
98	2.82E-03	1.68E-03	9.96E-04	5.91E-04	3.51E-04	2.08E-04	1.24E-04	7.35E-05	4.36E-05	2.59E-05
99	6.77E-06	2.28E-06	7.69E-07	2.59E-07	8.72E-08	2.93E-08	9.74E-09	3.20E-09	1.01E-09	3.87E-10
100	3.02E-05	1.47E-05	7.16E-06	3.49E-06	1.70E-06	8.27E-07	4.03E-07	1.96E-07	9.54E-08	4.64E-08

Table F.4.5. Probabilistic Modeling Results for SWMU 1 (variable degradation scenario) - Property Boundary POE (conc in mg/L)

Run	0 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	30 yrs	35 yrs	40 yrs	45 yrs
1	0.00E+00	2.15E-03	3.97E-03	2.12E-03	1.08E-03	5.42E-04	2.69E-04	1.33E-04	6.58E-05	3.25E-05
2	0.00E+00	0.00E+00	3.27E-03	2.43E-03	1.30E-03	6.53E-04	3.20E-04	1.55E-04	7.46E-05	3.59E-05
3	0.00E+00	0.00E+00	2.87E-04	8.14E-04	6.42E-04	4.47E-04	2.92E-04	1.86E-04	1.17E-04	7.32E-05
4	0.00E+00	0.00E+00	0.00E+00	8.81E-10	9.68E-06	4.58E-04	2.42E-03	4.09E-03	3.67E-03	2.31E-03
5	0.00E+00	0.00E+00	0.00E+00	3.34E-04	5.59E-04	3.54E-04	2.19E-04	1.35E-04	8.27E-05	5.08E-05
6	0.00E+00	0.00E+00	1.14E-04	9.32E-04	1.06E-03	9.34E-04	6.96E-04	4.98E-04	3.50E-04	2.44E-04
7	0.00E+00	0.00E+00	8.47E-05	3.41E-03	4.32E-03	3.46E-03	2.42E-03	1.65E-03	1.12E-03	7.53E-04
8	0.00E+00	3.60E-09	2.95E-03	1.03E-02	1.13E-02	7.08E-03	3.93E-03	2.11E-03	1.11E-03	5.83E-04
9	0.00E+00	0.00E+00	3.83E-03	4.51E-03	2.20E-03	1.01E-03	4.56E-04	2.04E-04	9.13E-05	4.07E-05
10	0.00E+00	0.00E+00	0.00E+00	3.50E-06	3.32E-04	8.35E-04	6.16E-04	3.12E-04	1.43E-04	6.42E-05
11	0.00E+00	0.00E+00	0.00E+00	1.87E-07	7.21E-04	2.52E-03	1.78E-03	9.92E-04	5.42E-04	2.96E-04
12	0.00E+00	0.00E+00	1.65E-04	1.58E-03	1.58E-03	8.93E-04	4.50E-04	2.20E-04	1.06E-04	5.13E-05
13	0.00E+00	6.36E-10	1.02E-03	8.09E-04	4.24E-04	2.07E-04	9.79E-05	4.58E-05	2.13E-05	9.93E-06
14	0.00E+00	0.00E+00	3.61E-05	3.10E-03	2.23E-03	8.05E-04	2.73E-04	9.19E-05	3.08E-05	1.03E-05
15	0.00E+00	0.00E+00	4.90E-07	1.22E-03	4.23E-03	4.13E-03	2.59E-03	1.39E-03	7.14E-04	3.60E-04
16	0.00E+00	0.00E+00	2.43E-06	5.58E-03	5.93E-03	4.22E-03	2.95E-03	2.06E-03	1.43E-03	9.95E-04
17	0.00E+00	0.00E+00	2.91E-04	9.74E-04	7.81E-04	3.66E-04	1.55E-04	6.35E-05	2.58E-05	1.04E-05
18	0.00E+00	0.00E+00	2.72E-03	1.26E-03	5.01E-04	1.90E-04	7.07E-05	2.61E-05	9.58E-06	3.51E-06
19	0.00E+00	0.00E+00	9.89E-03	1.36E-02	9.03E-03	5.60E-03	3.43E-03	2.10E-03	1.28E-03	7.79E-04
20	0.00E+00	0.00E+00	0.00E+00	6.64E-08	8.39E-05	2.06E-04	1.58E-04	9.69E-05	5.56E-05	3.11E-05
21	0.00E+00	0.00E+00	0.00E+00	1.67E-06	2.74E-04	9.52E-04	1.22E-03	9.62E-04	5.96E-04	3.46E-04
22	0.00E+00	0.00E+00	0.00E+00	6.88E-05	9.69E-04	1.19E-03	8.72E-04	5.76E-04	3.70E-04	2.35E-04
23	0.00E+00	0.00E+00	0.00E+00	3.00E-04	5.58E-04	6.38E-04	5.53E-04	4.01E-04	2.84E-04	2.00E-04
24	0.00E+00	0.00E+00	2.59E-09	8.30E-05	1.53E-03	2.64E-03	2.00E-03	1.17E-03	6.37E-04	3.42E-04
25	0.00E+00	0.00E+00	2.21E-03	2.13E-03	1.18E-03	6.47E-04	3.54E-04	1.93E-04	1.06E-04	5.76E-05
26	0.00E+00	0.00E+00	2.44E-06	1.05E-03	7.38E-04	3.71E-04	1.78E-04	8.39E-05	3.94E-05	1.84E-05
27	0.00E+00	3.19E-07	2.23E-04	1.71E-04	1.17E-04	7.71E-05	4.98E-05	3.19E-05	2.04E-05	1.30E-05
28	0.00E+00	0.00E+00	1.16E-04	5.19E-03	3.72E-03	2.36E-03	1.50E-03	9.57E-04	6.10E-04	3.89E-04
29	0.00E+00	0.00E+00	0.00E+00	2.69E-05	1.49E-03	4.46E-03	4.61E-03	3.01E-03	1.56E-03	7.26E-04
30	0.00E+00	2.81E-04	1.73E-04	8.77E-05	4.04E-05	1.78E-05	7.67E-06	3.28E-06	1.40E-06	5.94E-07
31	0.00E+00	3.98E-08	4.00E-03	2.21E-03	1.25E-03	7.09E-04	4.04E-04	2.31E-04	1.32E-04	7.56E-05
32	0.00E+00	0.00E+00	1.50E-07	1.86E-03	1.08E-02	1.13E-02	8.34E-03	5.65E-03	3.69E-03	2.38E-03
33	0.00E+00	0.00E+00	0.00E+00	4.57E-05	1.73E-03	3.04E-03	2.02E-03	1.07E-03	5.55E-04	2.87E-04
34	0.00E+00	0.00E+00	0.00E+00	3.48E-04	1.57E-03	1.01E-03	6.31E-04	3.97E-04	2.51E-04	1.59E-04
35	0.00E+00	0.00E+00	2.28E-03	3.50E-03	3.66E-03	2.47E-03	1.47E-03	8.47E-04	4.81E-04	2.71E-04
36	0.00E+00	0.00E+00	2.11E-04	3.71E-04	2.43E-04	1.42E-04	7.82E-05	4.18E-05	2.19E-05	1.14E-05
37	0.00E+00	0.00E+00	1.05E-04	7.61E-04	4.60E-04	1.87E-04	7.21E-05	2.74E-05	1.04E-05	3.90E-06
38	0.00E+00	0.00E+00	1.28E-03	2.11E-03	7.67E-04	2.56E-04	8.31E-05	2.67E-05	8.53E-06	2.73E-06
39	0.00E+00	0.00E+00	0.00E+00	1.17E-05	1.95E-03	8.55E-03	9.82E-03	7.15E-03	4.59E-03	2.85E-03
40	0.00E+00	6.61E-07	2.70E-04	4.58E-04	3.55E-04	2.13E-04	1.21E-04	6.68E-05	3.68E-05	2.02E-05
41	0.00E+00	0.00E+00	1.75E-04	1.56E-02	1.73E-02	8.88E-03	4.18E-03	1.95E-03	9.09E-04	4.23E-04
42	0.00E+00	6.56E-05	4.94E-03	4.97E-03	2.50E-03	1.11E-03	4.75E-04	2.00E-04	8.40E-05	3.52E-05
43	0.00E+00	2.00E-07	9.52E-03	4.47E-03	2.12E-03	1.03E-03	5.06E-04	2.50E-04	1.24E-04	6.13E-05
44	0.00E+00	0.00E+00	4.50E-04	2.98E-04	1.92E-04	1.22E-04	7.77E-05	4.93E-05	3.13E-05	1.98E-05
45	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.18E-10	6.84E-06	1.77E-04	5.05E-04	5.66E-04	4.48E-04
46	0.00E+00	8.82E-08	3.97E-03	4.64E-03	3.50E-03	1.95E-03	1.02E-03	5.16E-04	2.58E-04	1.28E-04
47	0.00E+00	0.00E+00	1.03E-08	1.21E-04	8.66E-04	8.24E-04	4.00E-04	1.54E-04	5.50E-05	1.91E-05
48	0.00E+00	0.00E+00	1.89E-04	2.86E-03	3.69E-03	2.74E-03	1.78E-03	1.11E-03	6.84E-04	4.19E-04
49	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.85E-10	4.02E-07	1.09E-05	4.79E-05	8.19E-05	8.33E-05
50	0.00E+00	0.00E+00	5.24E-03	9.72E-03	5.81E-03	3.14E-03	1.67E-03	8.79E-04	4.62E-04	2.42E-04

Table F.4.5. Probabilistic Modeling Results for SWMU 1 (variable degradation scenario) - Property Boundary POE (conc in mg/L) (continued)

Run	0 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	30 yrs	35 yrs	40 yrs	45 yrs
51	0.00E+00	0.00E+00	0.00E+00	1.12E-05	1.79E-03	2.32E-03	1.50E-03	9.38E-04	5.91E-04	3.74E-04
52	0.00E+00	6.10E-06	1.09E-02	1.25E-02	7.45E-03	3.94E-03	2.01E-03	1.01E-03	5.08E-04	2.55E-04
53	0.00E+00	0.00E+00	0.00E+00	3.20E-07	4.87E-05	3.07E-04	5.10E-04	4.08E-04	2.10E-04	8.55E-05
54	0.00E+00	0.00E+00	3.89E-04	1.39E-03	2.35E-03	2.56E-03	1.91E-03	1.31E-03	8.77E-04	5.81E-04
55	0.00E+00	0.00E+00	6.20E-03	6.04E-03	3.60E-03	1.98E-03	1.06E-03	5.62E-04	2.96E-04	1.56E-04
56	0.00E+00	0.00E+00	1.13E-06	7.77E-05	5.59E-05	2.86E-05	1.38E-05	6.57E-06	3.09E-06	1.45E-06
57	0.00E+00	8.11E-08	1.47E-03	3.02E-03	2.66E-03	1.61E-03	9.03E-04	4.93E-04	2.66E-04	1.43E-04
58	0.00E+00	1.77E-08	1.19E-03	6.48E-04	3.52E-04	1.93E-04	1.05E-04	5.77E-05	3.16E-05	1.73E-05
59	0.00E+00	0.00E+00	3.06E-04	1.27E-03	6.74E-04	2.78E-04	1.09E-04	4.15E-05	1.58E-05	5.98E-06
60	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.39E-05	8.86E-04	1.01E-03	5.73E-04	3.04E-04	1.60E-04
61	0.00E+00	0.00E+00	2.64E-02	6.11E-02	2.61E-02	9.88E-03	3.67E-03	1.35E-03	4.98E-04	1.83E-04
62	0.00E+00	0.00E+00	3.14E-03	2.99E-03	1.80E-03	1.09E-03	6.57E-04	3.97E-04	2.40E-04	1.45E-04
63	0.00E+00	0.00E+00	0.00E+00	2.14E-06	1.43E-04	5.67E-04	8.81E-04	8.27E-04	5.78E-04	3.59E-04
64	0.00E+00	0.00E+00	0.00E+00	2.47E-08	3.33E-05	3.46E-04	5.60E-04	4.40E-04	2.78E-04	1.69E-04
65	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.22E-07	2.40E-05	1.13E-04	1.73E-04	1.52E-04
66	0.00E+00	0.00E+00	1.57E-03	2.65E-03	1.07E-03	4.35E-04	1.78E-04	7.28E-05	2.98E-05	1.22E-05
67	0.00E+00	0.00E+00	4.33E-06	4.32E-03	1.34E-02	1.89E-02	1.58E-02	1.06E-02	6.84E-03	4.33E-03
68	0.00E+00	7.04E-06	4.15E-04	3.02E-04	2.01E-04	1.29E-04	8.18E-05	5.14E-05	3.22E-05	2.01E-05
69	0.00E+00	0.00E+00	5.11E-03	4.28E-03	2.71E-03	1.67E-03	1.02E-03	6.20E-04	3.76E-04	2.28E-04
70	0.00E+00	0.00E+00	7.74E-05	7.52E-04	9.26E-04	7.17E-04	4.88E-04	3.20E-04	2.07E-04	1.33E-04
71	0.00E+00	0.00E+00	0.00E+00	2.68E-07	2.37E-05	7.54E-05	6.80E-05	3.80E-05	1.80E-05	8.01E-06
72	0.00E+00	0.00E+00	7.73E-05	2.85E-03	2.83E-03	1.66E-03	9.28E-04	5.16E-04	2.87E-04	1.59E-04
73	0.00E+00	0.00E+00	0.00E+00	2.77E-09	5.52E-06	1.35E-04	4.74E-04	6.05E-04	4.36E-04	2.27E-04
74	0.00E+00	0.00E+00	1.93E-04	3.89E-04	3.94E-04	2.64E-04	1.65E-04	1.01E-04	6.14E-05	3.70E-05
75	0.00E+00	0.00E+00	2.38E-05	3.01E-03	3.42E-03	1.96E-03	1.09E-03	6.12E-04	3.43E-04	1.92E-04
76	0.00E+00	0.00E+00	2.27E-04	1.31E-04	7.48E-05	4.29E-05	2.47E-05	1.42E-05	8.15E-06	4.68E-06
77	0.00E+00	0.00E+00	0.00E+00	3.96E-06	6.36E-04	6.97E-04	5.37E-04	3.96E-04	2.88E-04	2.08E-04
78	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.51E-09	7.26E-07	1.35E-05	7.40E-05	1.91E-04
79	0.00E+00	0.00E+00	0.00E+00	3.65E-06	1.15E-03	6.43E-03	8.09E-03	6.13E-03	4.13E-03	2.74E-03
80	0.00E+00	2.56E-05	2.11E-03	3.61E-03	2.79E-03	1.52E-03	7.79E-04	3.91E-04	1.94E-04	9.64E-05
81	0.00E+00	1.51E-08	1.23E-03	8.24E-04	5.13E-04	3.14E-04	1.91E-04	1.16E-04	7.00E-05	4.23E-05
82	0.00E+00	0.00E+00	5.91E-10	8.27E-05	1.01E-03	1.97E-03	2.20E-03	1.75E-03	1.22E-03	8.19E-04
83	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.86E-05	5.43E-05	3.46E-05	1.78E-05	8.96E-06	4.47E-06
84	0.00E+00	1.61E-05	3.00E-03	1.40E-03	5.23E-04	1.87E-04	6.61E-05	2.31E-05	8.08E-06	2.82E-06
85	0.00E+00	0.00E+00	6.52E-04	3.13E-03	2.25E-03	1.35E-03	7.67E-04	4.28E-04	2.37E-04	1.31E-04
86	0.00E+00	0.00E+00	1.36E-03	1.60E-03	1.31E-03	8.51E-04	5.33E-04	3.28E-04	1.99E-04	1.21E-04
87	0.00E+00	0.00E+00	0.00E+00	4.35E-10	1.08E-05	3.95E-04	1.36E-03	1.52E-03	9.88E-04	5.03E-04
88	0.00E+00	0.00E+00	0.00E+00	9.24E-05	1.11E-04	6.62E-05	3.92E-05	2.32E-05	1.37E-05	8.05E-06
89	0.00E+00	3.51E-09	2.92E-03	2.18E-03	1.32E-03	7.85E-04	4.66E-04	2.76E-04	1.64E-04	9.70E-05
90	0.00E+00	0.00E+00	1.14E-04	8.41E-04	9.33E-04	6.31E-04	3.75E-04	2.15E-04	1.22E-04	6.84E-05
91	0.00E+00	0.00E+00	8.31E-08	1.82E-04	8.75E-04	8.39E-04	4.30E-04	1.77E-04	6.79E-05	2.55E-05
92	0.00E+00	0.00E+00	1.14E-05	3.82E-03	1.40E-02	1.52E-02	8.09E-03	3.20E-03	1.17E-03	4.13E-04
93	0.00E+00	0.00E+00	3.81E-09	7.46E-05	4.50E-04	3.70E-04	1.84E-04	8.18E-05	3.55E-05	1.53E-05
94	0.00E+00	0.00E+00	7.08E-03	9.66E-03	5.79E-03	3.50E-03	2.13E-03	1.30E-03	7.98E-04	4.89E-04
95	0.00E+00	0.00E+00	1.08E-04	1.52E-04	1.03E-04	6.54E-05	4.05E-05	2.49E-05	1.52E-05	9.27E-06
96	0.00E+00	0.00E+00	1.35E-05	3.85E-04	3.99E-04	2.33E-04	9.89E-05	3.93E-05	1.53E-05	5.89E-06
97	0.00E+00	5.59E-09	6.40E-03	2.37E-03	8.48E-04	3.00E-04	1.06E-04	3.73E-05	1.32E-05	4.63E-06
98	0.00E+00	0.00E+00	2.74E-07	4.14E-04	1.40E-03	1.99E-03	1.78E-03	1.19E-03	7.40E-04	4.49E-04
99	0.00E+00	4.34E-03	5.28E-03	3.01E-03	1.15E-03	4.02E-04	1.37E-04	4.65E-05	1.57E-05	5.30E-06
100	0.00E+00	0.00E+00	2.94E-04	6.01E-04	3.07E-04	1.52E-04	7.48E-05	3.66E-05	1.78E-05	8.69E-06

Table F.4.5. Probabilistic Modeling Results for SWMU 1 (variable degradation scenario) - Property Boundary POE (conc in mg/L) (continued)

Run	50 yrs	55 yrs	60 yrs	65 yrs	70 yrs	75 yrs	80 yrs	85 yrs	90 yrs	95 yrs
1	1.60E-05	7.90E-06	3.90E-06	1.92E-06	9.49E-07	4.68E-07	2.31E-07	1.14E-07	5.62E-08	2.77E-08
2	1.72E-05	8.27E-06	3.97E-06	1.91E-06	9.15E-07	4.39E-07	2.11E-07	1.01E-07	4.86E-08	2.33E-08
3	4.57E-05	2.85E-05	1.77E-05	1.10E-05	6.88E-06	4.28E-06	2.67E-06	1.66E-06	1.03E-06	6.44E-07
4	1.20E-03	5.60E-04	2.50E-04	1.09E-04	4.74E-05	2.04E-05	8.79E-06	3.78E-06	1.63E-06	6.99E-07
5	3.12E-05	1.91E-05	1.17E-05	7.18E-06	4.40E-06	2.70E-06	1.66E-06	1.01E-06	6.22E-07	3.82E-07
6	1.69E-04	1.17E-04	8.07E-05	5.57E-05	3.85E-05	2.66E-05	1.84E-05	1.27E-05	8.74E-06	6.04E-06
7	5.06E-04	3.40E-04	2.28E-04	1.53E-04	1.03E-04	6.88E-05	4.62E-05	3.10E-05	2.08E-05	1.39E-05
8	3.05E-04	1.59E-04	8.32E-05	4.34E-05	2.27E-05	1.18E-05	6.18E-06	3.22E-06	1.68E-06	8.79E-07
9	1.82E-05	8.11E-06	3.61E-06	1.61E-06	7.19E-07	3.21E-07	1.43E-07	6.37E-08	2.84E-08	1.27E-08
10	2.85E-05	1.26E-05	5.55E-06	2.45E-06	1.08E-06	4.76E-07	2.10E-07	9.26E-08	4.08E-08	1.80E-08
11	1.61E-04	8.79E-05	4.79E-05	2.61E-05	1.42E-05	7.75E-06	4.23E-06	2.30E-06	1.25E-06	6.84E-07
12	2.47E-05	1.18E-05	5.69E-06	2.73E-06	1.31E-06	6.30E-07	3.02E-07	1.45E-07	6.97E-08	3.35E-08
13	4.61E-06	2.14E-06	9.95E-07	4.62E-07	2.14E-07	9.96E-08	4.62E-08	2.15E-08	9.95E-09	4.61E-09
14	3.46E-06	1.16E-06	3.88E-07	1.30E-07	4.35E-08	1.45E-08	4.85E-09	1.61E-09	5.26E-10	1.71E-10
15	1.80E-04	8.95E-05	4.45E-05	2.21E-05	1.10E-05	5.46E-06	2.71E-06	1.35E-06	6.69E-07	3.32E-07
16	6.91E-04	4.80E-04	3.33E-04	2.31E-04	1.61E-04	1.12E-04	7.75E-05	5.38E-05	3.74E-05	2.60E-05
17	4.22E-06	1.70E-06	6.87E-07	2.77E-07	1.12E-07	4.51E-08	1.82E-08	7.31E-09	2.94E-09	1.17E-09
18	1.29E-06	4.72E-07	1.73E-07	6.34E-08	2.32E-08	8.50E-09	3.11E-09	1.13E-09	4.05E-10	1.44E-10
19	4.74E-04	2.89E-04	1.76E-04	1.07E-04	6.51E-05	3.96E-05	2.41E-05	1.47E-05	8.94E-06	5.44E-06
20	1.71E-05	9.39E-06	5.13E-06	2.79E-06	1.52E-06	8.27E-07	4.50E-07	2.44E-07	1.33E-07	7.22E-08
21	1.97E-04	1.12E-04	6.31E-05	3.56E-05	2.01E-05	1.13E-05	6.39E-06	3.61E-06	2.04E-06	1.15E-06
22	1.48E-04	9.33E-05	5.87E-05	3.69E-05	2.32E-05	1.46E-05	9.17E-06	5.76E-06	3.62E-06	2.28E-06
23	1.40E-04	9.84E-05	6.88E-05	4.81E-05	3.36E-05	2.35E-05	1.64E-05	1.15E-05	8.04E-06	5.62E-06
24	1.82E-04	9.67E-05	5.14E-05	2.73E-05	1.45E-05	7.69E-06	4.09E-06	2.17E-06	1.15E-06	6.12E-07
25	3.14E-05	1.72E-05	9.36E-06	5.11E-06	2.79E-06	1.52E-06	8.29E-07	4.53E-07	2.47E-07	1.35E-07
26	8.58E-06	4.00E-06	1.87E-06	8.71E-07	4.06E-07	1.89E-07	8.84E-08	4.12E-08	1.92E-08	8.96E-09
27	8.31E-06	5.30E-06	3.38E-06	2.15E-06	1.37E-06	8.75E-07	5.58E-07	3.55E-07	2.27E-07	1.44E-07
28	2.48E-04	1.58E-04	1.01E-04	6.45E-05	4.11E-05	2.62E-05	1.67E-05	1.07E-05	6.82E-06	4.35E-06
29	3.23E-04	1.41E-04	6.08E-05	2.61E-05	1.12E-05	4.79E-06	2.05E-06	8.77E-07	3.75E-07	1.60E-07
30	2.53E-07	1.07E-07	4.55E-08	1.93E-08	8.21E-09	3.48E-09	1.47E-09	6.21E-10	2.59E-10	1.08E-10
31	4.33E-05	2.47E-05	1.42E-05	8.10E-06	4.64E-06	2.65E-06	1.52E-06	8.69E-07	4.97E-07	2.84E-07
32	1.52E-03	9.68E-04	6.17E-04	3.93E-04	2.50E-04	1.59E-04	1.01E-04	6.44E-05	4.10E-05	2.61E-05
33	1.48E-04	7.67E-05	3.97E-05	2.05E-05	1.06E-05	5.49E-06	2.84E-06	1.47E-06	7.60E-07	3.93E-07
34	1.00E-04	6.35E-05	4.02E-05	2.55E-05	1.61E-05	1.02E-05	6.47E-06	4.10E-06	2.60E-06	1.65E-06
35	1.52E-04	8.53E-05	4.78E-05	2.68E-05	1.50E-05	8.40E-06	4.70E-06	2.64E-06	1.48E-06	8.27E-07
36	5.86E-06	3.01E-06	1.54E-06	7.90E-07	4.04E-07	2.07E-07	1.06E-07	5.40E-08	2.76E-08	1.41E-08
37	1.47E-06	5.52E-07	2.08E-07	7.81E-08	2.94E-08	1.10E-08	4.14E-09	1.55E-09	5.74E-10	2.10E-10
38	8.70E-07	2.77E-07	8.85E-08	2.82E-08	8.99E-09	2.86E-09	8.99E-10	2.79E-10	8.89E-11	3.36E-11
39	1.75E-03	1.07E-03	6.49E-04	3.94E-04	2.39E-04	1.45E-04	8.82E-05	5.35E-05	3.25E-05	1.97E-05
40	1.10E-05	6.05E-06	3.31E-06	1.81E-06	9.91E-07	5.43E-07	2.97E-07	1.63E-07	8.90E-08	4.87E-08
41	1.97E-04	9.17E-05	4.27E-05	1.99E-05	9.26E-06	4.31E-06	2.01E-06	9.34E-07	4.35E-07	2.03E-07
42	1.47E-05	6.15E-06	2.57E-06	1.07E-06	4.49E-07	1.88E-07	7.84E-08	3.28E-08	1.37E-08	5.70E-09
43	3.03E-05	1.50E-05	7.44E-06	3.69E-06	1.83E-06	9.05E-07	4.48E-07	2.22E-07	1.10E-07	5.45E-08
44	1.26E-05	7.96E-06	5.05E-06	3.20E-06	2.03E-06	1.28E-06	8.14E-07	5.16E-07	3.27E-07	2.07E-07
45	3.23E-04	2.29E-04	1.62E-04	1.14E-04	8.11E-05	5.74E-05	4.07E-05	2.89E-05	2.05E-05	1.45E-05
46	6.33E-05	3.13E-05	1.55E-05	7.64E-06	3.77E-06	1.86E-06	9.20E-07	4.54E-07	2.24E-07	1.11E-07
47	6.57E-06	2.25E-06	7.71E-07	2.64E-07	9.01E-08	3.08E-08	1.05E-08	3.59E-09	1.22E-09	4.08E-10
48	2.55E-04	1.56E-04	9.49E-05	5.78E-05	3.52E-05	2.15E-05	1.31E-05	7.96E-06	4.85E-06	2.95E-06
49	6.42E-05	4.32E-05	2.72E-05	1.67E-05	1.01E-05	6.12E-06	3.68E-06	2.21E-06	1.33E-06	7.98E-07
50	1.27E-04	6.67E-05	3.50E-05	1.84E-05	9.63E-06	5.05E-06	2.65E-06	1.39E-06	7.29E-07	3.83E-07

Table F.4.5. Probabilistic Modeling Results for SWMU 1 (variable degradation scenario) - Property Boundary POE (conc in mg/L)
(continued)

Run	50 yrs	55 yrs	60 yrs	65 yrs	70 yrs	75 yrs	80 yrs	85 yrs	90 yrs	95 yrs
51	2.37E-04	1.50E-04	9.51E-05	6.03E-05	3.82E-05	2.42E-05	1.54E-05	9.73E-06	6.17E-06	3.91E-06
52	1.28E-04	6.40E-05	3.21E-05	1.61E-05	8.05E-06	4.03E-06	2.02E-06	1.01E-06	5.07E-07	2.54E-07
53	3.13E-05	1.10E-05	3.78E-06	1.29E-06	4.42E-07	1.51E-07	5.14E-08	1.75E-08	5.96E-09	2.02E-09
54	3.82E-04	2.51E-04	1.65E-04	1.08E-04	7.08E-05	4.64E-05	3.04E-05	1.99E-05	1.30E-05	8.55E-06
55	8.19E-05	4.30E-05	2.26E-05	1.19E-05	6.24E-06	3.28E-06	1.72E-06	9.06E-07	4.76E-07	2.50E-07
56	6.80E-07	3.19E-07	1.49E-07	6.99E-08	3.27E-08	1.53E-08	7.17E-09	3.35E-09	1.56E-09	7.22E-10
57	7.63E-05	4.08E-05	2.18E-05	1.16E-05	6.20E-06	3.31E-06	1.76E-06	9.42E-07	5.02E-07	2.68E-07
58	9.50E-06	5.21E-06	2.86E-06	1.57E-06	8.58E-07	4.71E-07	2.58E-07	1.41E-07	7.75E-08	4.25E-08
59	2.27E-06	8.58E-07	3.24E-07	1.23E-07	4.65E-08	1.76E-08	6.62E-09	2.48E-09	9.14E-10	3.31E-10
60	8.41E-05	4.42E-05	2.32E-05	1.22E-05	6.39E-06	3.36E-06	1.76E-06	9.25E-07	4.86E-07	2.55E-07
61	6.72E-05	2.47E-05	9.06E-06	3.33E-06	1.22E-06	4.49E-07	1.65E-07	6.05E-08	2.22E-08	8.11E-09
62	8.75E-05	5.28E-05	3.19E-05	1.93E-05	1.17E-05	7.05E-06	4.26E-06	2.57E-06	1.55E-06	9.39E-07
63	2.14E-04	1.25E-04	7.28E-05	4.22E-05	2.44E-05	1.41E-05	8.18E-06	4.73E-06	2.74E-06	1.58E-06
64	1.03E-04	6.27E-05	3.84E-05	2.35E-05	1.44E-05	8.84E-06	5.43E-06	3.33E-06	2.04E-06	1.25E-06
65	9.98E-05	5.57E-05	2.89E-05	1.45E-05	7.22E-06	3.58E-06	1.77E-06	8.74E-07	4.32E-07	2.13E-07
66	5.02E-06	2.06E-06	8.45E-07	3.47E-07	1.42E-07	5.84E-08	2.40E-08	9.83E-09	4.03E-09	1.65E-09
67	2.73E-03	1.71E-03	1.07E-03	6.74E-04	4.23E-04	2.65E-04	1.66E-04	1.04E-04	6.53E-05	4.09E-05
68	1.26E-05	7.88E-06	4.93E-06	3.08E-06	1.93E-06	1.20E-06	7.53E-07	4.71E-07	2.94E-07	1.84E-07
69	1.39E-04	8.40E-05	5.10E-05	3.09E-05	1.87E-05	1.14E-05	6.89E-06	4.18E-06	2.53E-06	1.54E-06
70	8.57E-05	5.50E-05	3.52E-05	2.26E-05	1.45E-05	9.29E-06	5.95E-06	3.82E-06	2.45E-06	1.57E-06
71	3.49E-06	1.51E-06	6.50E-07	2.80E-07	1.20E-07	5.18E-08	2.23E-08	9.57E-09	4.11E-09	1.76E-09
72	8.84E-05	4.90E-05	2.72E-05	1.51E-05	8.39E-06	4.65E-06	2.58E-06	1.43E-06	7.96E-07	4.42E-07
73	9.88E-05	3.92E-05	1.49E-05	5.54E-06	2.04E-06	7.50E-07	2.75E-07	1.01E-07	3.69E-08	1.35E-08
74	2.23E-05	1.34E-05	8.06E-06	4.85E-06	2.91E-06	1.75E-06	1.05E-06	6.32E-07	3.80E-07	2.28E-07
75	1.08E-04	6.05E-05	3.40E-05	1.91E-05	1.07E-05	6.00E-06	3.37E-06	1.89E-06	1.06E-06	5.95E-07
76	2.69E-06	1.55E-06	8.90E-07	5.12E-07	2.94E-07	1.69E-07	9.72E-08	5.59E-08	3.21E-08	1.85E-08
77	1.50E-04	1.08E-04	7.76E-05	5.58E-05	4.01E-05	2.88E-05	2.07E-05	1.49E-05	1.07E-05	7.68E-06
78	3.00E-04	3.33E-04	2.89E-04	2.10E-04	1.35E-04	7.98E-05	4.47E-05	2.43E-05	1.29E-05	6.78E-06
79	1.82E-03	1.21E-03	8.08E-04	5.38E-04	3.58E-04	2.38E-04	1.59E-04	1.06E-04	7.04E-05	4.69E-05
80	4.77E-05	2.36E-05	1.17E-05	5.78E-06	2.86E-06	1.41E-06	7.00E-07	3.46E-07	1.71E-07	8.47E-08
81	2.56E-05	1.55E-05	9.36E-06	5.66E-06	3.42E-06	2.07E-06	1.25E-06	7.58E-07	4.58E-07	2.77E-07
82	5.41E-04	3.55E-04	2.32E-04	1.51E-04	9.86E-05	6.42E-05	4.18E-05	2.72E-05	1.77E-05	1.15E-05
83	2.22E-06	1.10E-06	5.48E-07	2.72E-07	1.35E-07	6.68E-08	3.31E-08	1.64E-08	8.13E-09	4.03E-09
84	9.83E-07	3.42E-07	1.19E-07	4.16E-08	1.45E-08	5.03E-09	1.74E-09	5.90E-10	1.96E-10	7.30E-11
85	7.18E-05	3.95E-05	2.17E-05	1.19E-05	6.54E-06	3.59E-06	1.97E-06	1.08E-06	5.95E-07	3.27E-07
86	7.28E-05	4.39E-05	2.64E-05	1.59E-05	9.54E-06	5.74E-06	3.45E-06	2.07E-06	1.24E-06	7.48E-07
87	2.34E-04	1.06E-04	4.73E-05	2.11E-05	9.45E-06	4.22E-06	1.88E-06	8.42E-07	3.76E-07	1.68E-07
88	4.74E-06	2.80E-06	1.65E-06	9.71E-07	5.72E-07	3.37E-07	1.99E-07	1.17E-07	6.90E-08	4.07E-08
89	5.74E-05	3.40E-05	2.01E-05	1.19E-05	7.07E-06	4.18E-06	2.48E-06	1.47E-06	8.69E-07	5.15E-07
90	3.84E-05	2.15E-05	1.20E-05	6.74E-06	3.77E-06	2.11E-06	1.18E-06	6.62E-07	3.71E-07	2.08E-07
91	9.54E-06	3.55E-06	1.32E-06	4.91E-07	1.82E-07	6.78E-08	2.52E-08	9.34E-09	3.46E-09	1.27E-09
92	1.45E-04	5.06E-05	1.77E-05	6.16E-06	2.15E-06	7.50E-07	2.61E-07	9.12E-08	3.18E-08	1.10E-08
93	6.54E-06	2.80E-06	1.20E-06	5.11E-07	2.18E-07	9.32E-08	3.98E-08	1.70E-08	7.23E-09	3.06E-09
94	2.99E-04	1.83E-04	1.12E-04	6.87E-05	4.21E-05	2.58E-05	1.58E-05	9.68E-06	5.93E-06	3.63E-06
95	5.65E-06	3.44E-06	2.10E-06	1.28E-06	7.79E-07	4.75E-07	2.90E-07	1.76E-07	1.08E-07	6.55E-08
96	2.26E-06	8.67E-07	3.32E-07	1.27E-07	4.87E-08	1.86E-08	7.12E-09	2.71E-09	1.02E-09	3.82E-10
97	1.63E-06	5.75E-07	2.03E-07	7.13E-08	2.51E-08	8.84E-09	3.11E-09	1.09E-09	3.74E-10	1.26E-10
98	2.70E-04	1.61E-04	9.59E-05	5.70E-05	3.39E-05	2.01E-05	1.19E-05	7.09E-06	4.21E-06	2.50E-06
99	1.79E-06	6.02E-07	2.03E-07	6.83E-08	2.30E-08	7.74E-09	2.59E-09	8.53E-10	2.75E-10	9.29E-11
100	4.23E-06	2.06E-06	1.00E-06	4.89E-07	2.38E-07	1.16E-07	5.65E-08	2.75E-08	1.34E-08	6.52E-09

Table F.4.6. Probabilistic Modeling Results for SWMU 1 (variable degradation scenario) - Ohio River POE (conc in mg/L)

Run	0 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	30 yrs	35 yrs	40 yrs	45 yrs
1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.20E-10	1.12E-05	2.90E-05	1.58E-05	8.11E-06	4.08E-06
2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.07E-12	9.65E-09	3.63E-07
3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.27E-12	3.05E-09
7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.20E-13
8	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.11E-12	3.91E-09
9	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
13	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.51E-11	1.63E-08
14	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
16	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
17	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.17E-12	3.96E-08	9.79E-07	9.54E-07
19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.48E-12	2.38E-08
20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
21	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
23	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.16E-09	6.38E-07	1.71E-06
24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.65E-12	3.33E-09
26	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
27	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.77E-10	2.86E-07	4.57E-07	3.39E-07	2.29E-07
28	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
29	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
30	0.00E+00	0.00E+00	7.70E-11	1.31E-05	7.61E-06	3.75E-06	1.70E-06	7.45E-07	3.21E-07	1.37E-07
31	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.68E-07	1.08E-05	8.85E-06	4.97E-06
32	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
33	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
34	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
35	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.19E-10	3.76E-07	3.09E-06
36	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.05E-12	1.21E-07	1.33E-06	1.10E-06
37	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.56E-08	2.89E-06	6.61E-06
38	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
39	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E-12	8.88E-09	2.24E-07	5.56E-07
41	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
42	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.14E-07	8.55E-06	1.93E-05	1.49E-05
43	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.40E-12	7.15E-08	3.09E-06
44	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.48E-07	2.96E-06	2.02E-06	1.30E-06	8.29E-07
45	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
46	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.85E-12	3.36E-08	1.10E-06	2.13E-06
47	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
48	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
49	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table F.4.6. Probabilistic Modeling Results for SWMU 1 (variable degradation scenario) - Ohio River POE (conc in mg/L)
(continued)

Run	0 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	30 yrs	35 yrs	40 yrs	45 yrs
51	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
52	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.16E-08	2.18E-06
53	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
54	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.18E-12	5.24E-08	1.81E-06	5.57E-06
55	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.39E-13	2.11E-09
56	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.43E-09	2.78E-07	1.82E-06
58	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.13E-10	2.96E-07	1.96E-06	1.37E-06
59	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
60	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
61	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
62	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.34E-09
63	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
64	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
65	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
66	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
67	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
68	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.73E-11	1.66E-06	3.21E-06	2.32E-06	1.54E-06	9.87E-07
69	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.29E-10	1.63E-07
70	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
71	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
72	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
73	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
74	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.27E-11	1.30E-08	1.56E-07
75	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
76	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.68E-08	2.92E-06	1.72E-06	9.85E-07	5.65E-07	3.25E-07
77	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
78	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
79	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
80	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.25E-08	1.66E-05	4.97E-05	6.01E-05	3.90E-05
81	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.11E-12	2.52E-09	5.15E-08
82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
83	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.14E-11
84	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.75E-09	3.65E-06	1.36E-05	7.75E-06
85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
86	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.08E-07	4.45E-06	5.23E-06	4.23E-06	2.77E-06
87	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.28E-09	2.54E-07
89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.67E-11	1.62E-08
90	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
91	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
93	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
94	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
95	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.06E-11
96	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.71E-10	1.18E-05	8.96E-05	4.08E-05	1.47E-05
98	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
99	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.59E-07	1.10E-04	1.24E-04	6.46E-05	2.43E-05	8.50E-06
100	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.16E-12

Table F.4.6. Probabilistic Modeling Results for SWMU 1 (variable degradation scenario) - Ohio River POE (conc in mg/L)
(continued)

Run	50 yrs	55 yrs	60 yrs	65 yrs	70 yrs	75 yrs	80 yrs	85 yrs	90 yrs	95 yrs
1	2.03E-06	1.00E-06	4.96E-07	2.45E-07	1.21E-07	5.96E-08	2.94E-08	1.45E-08	7.15E-09	3.53E-09
2	7.51E-07	5.03E-07	2.65E-07	1.32E-07	6.43E-08	3.11E-08	1.50E-08	7.20E-09	3.46E-09	1.66E-09
3	6.39E-12	7.44E-10	7.38E-09	1.52E-08	1.45E-08	1.07E-08	7.14E-09	4.60E-09	2.90E-09	1.82E-09
4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	0.00E+00	0.00E+00	9.45E-13	1.34E-10	2.33E-09	8.70E-09	1.16E-08	9.01E-09	5.78E-09	3.57E-09
6	4.63E-08	9.05E-08	9.83E-08	8.36E-08	6.24E-08	4.46E-08	3.13E-08	2.18E-08	1.51E-08	1.04E-08
7	4.68E-10	2.34E-08	1.23E-07	1.99E-07	1.89E-07	1.41E-07	9.77E-08	6.65E-08	4.49E-08	3.02E-08
8	9.07E-08	3.49E-07	5.03E-07	3.98E-07	2.38E-07	1.30E-07	6.95E-08	3.66E-08	1.92E-08	1.00E-08
9	4.51E-13	1.40E-10	3.14E-09	1.12E-08	1.21E-08	7.10E-09	3.39E-09	1.55E-09	6.95E-10	3.11E-10
10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.96E-15
12	0.00E+00	0.00E+00	7.19E-14	5.15E-12	6.52E-11	2.34E-10	3.52E-10	2.97E-10	1.79E-10	9.34E-11
13	4.05E-07	9.79E-07	7.51E-07	4.01E-07	1.96E-07	9.27E-08	4.34E-08	2.02E-08	9.40E-09	4.37E-09
14	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.64E-13	7.32E-11	2.97E-09	3.53E-08	1.55E-07	3.06E-07
15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.56E-11	1.02E-09	1.50E-08
16	0.00E+00	0.00E+00	1.35E-11	3.15E-09	9.37E-08	6.00E-07	1.28E-06	1.37E-06	1.07E-06	7.62E-07
17	1.78E-12	3.86E-10	7.44E-09	2.83E-08	3.84E-08	2.76E-08	1.39E-08	6.02E-09	2.49E-09	1.02E-09
18	4.11E-07	1.60E-07	5.99E-08	2.22E-08	8.16E-09	3.00E-09	1.10E-09	4.03E-10	1.48E-10	5.41E-11
19	1.89E-06	1.09E-05	1.45E-05	1.06E-05	6.71E-06	4.12E-06	2.52E-06	1.54E-06	9.36E-07	5.70E-07
20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.65E-16	3.58E-14
21	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.39E-13
23	2.00E-06	1.81E-06	1.34E-06	9.51E-07	6.70E-07	4.70E-07	3.29E-07	2.30E-07	1.61E-07	1.13E-07
24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	7.33E-08	1.43E-07	9.74E-08	5.42E-08	2.97E-08	1.63E-08	8.88E-09	4.84E-09	2.64E-09	1.44E-09
26	0.00E+00	7.07E-14	3.84E-11	1.61E-09	1.08E-08	1.99E-08	1.63E-08	9.07E-09	4.46E-09	2.12E-09
27	1.50E-07	9.67E-08	6.20E-08	3.96E-08	2.53E-08	1.61E-08	1.03E-08	6.55E-09	4.17E-09	2.66E-09
28	0.00E+00	2.71E-13	2.67E-10	1.35E-08	1.12E-07	2.57E-07	2.63E-07	1.86E-07	1.20E-07	7.64E-08
29	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
30	5.83E-08	2.48E-08	1.05E-08	4.47E-09	1.90E-09	8.06E-10	3.42E-10	1.45E-10	6.13E-11	2.58E-11
31	2.82E-06	1.61E-06	9.18E-07	5.25E-07	3.00E-07	1.72E-07	9.82E-08	5.62E-08	3.22E-08	1.84E-08
32	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.53E-11
33	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
34	0.00E+00	0.00E+00	0.00E+00	1.48E-14	2.56E-12	6.00E-11	3.31E-10	6.36E-10	6.18E-10	4.32E-10
35	4.90E-06	4.82E-06	3.35E-06	2.01E-06	1.16E-06	6.60E-07	3.72E-07	2.09E-07	1.17E-07	6.57E-08
36	6.87E-07	3.92E-07	2.13E-07	1.13E-07	5.90E-08	3.05E-08	1.57E-08	8.07E-09	4.14E-09	2.12E-09
37	4.21E-06	1.83E-06	7.09E-07	2.70E-07	1.02E-07	3.85E-08	1.45E-08	5.45E-09	2.05E-09	7.71E-10
38	0.00E+00	1.63E-14	4.89E-12	1.31E-10	6.44E-10	9.24E-10	5.84E-10	2.38E-10	8.17E-11	2.67E-11
39	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	6.04E-07	4.09E-07	2.39E-07	1.34E-07	7.41E-08	4.07E-08	2.23E-08	1.22E-08	6.69E-09	3.66E-09
41	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.32E-13	1.30E-10	4.33E-09	4.96E-08	2.37E-07
42	7.32E-06	3.22E-06	1.37E-06	5.79E-07	2.43E-07	1.02E-07	4.25E-08	1.78E-08	7.42E-09	3.10E-09
43	6.53E-06	3.78E-06	1.81E-06	8.79E-07	4.32E-07	2.13E-07	1.05E-07	5.22E-08	2.59E-08	1.28E-08
44	5.27E-07	3.34E-07	2.12E-07	1.34E-07	8.52E-08	5.40E-08	3.42E-08	2.17E-08	1.37E-08	8.71E-09
45	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
46	1.98E-06	1.27E-06	6.86E-07	3.53E-07	1.77E-07	8.84E-08	4.38E-08	2.17E-08	1.07E-08	5.30E-09
47	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
48	0.00E+00	0.00E+00	1.70E-12	2.06E-10	4.10E-09	2.19E-08	4.69E-08	5.50E-08	4.49E-08	3.07E-08
49	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	5.78E-12	1.24E-09	2.24E-08	7.33E-08	8.20E-08	5.41E-08	3.01E-08	1.60E-08	8.45E-09	4.44E-09

Table F.4.6. Probabilistic Modeling Results for SWMU 1 (variable degradation scenario) - Ohio River POE (conc in mg/L)
(continued)

Run	50 yrs	55 yrs	60 yrs	65 yrs	70 yrs	75 yrs	80 yrs	85 yrs	90 yrs	95 yrs
51	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.76E-12	9.56E-11	1.62E-09
52	1.19E-05	1.52E-05	1.03E-05	5.63E-06	2.90E-06	1.47E-06	7.39E-07	3.71E-07	1.86E-07	9.31E-08
53	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
54	8.80E-06	9.20E-06	7.00E-06	4.81E-06	3.23E-06	2.14E-06	1.41E-06	9.24E-07	6.06E-07	3.97E-07
55	8.35E-08	2.61E-07	2.31E-07	1.39E-07	7.69E-08	4.12E-08	2.18E-08	1.15E-08	6.04E-09	3.18E-09
56	0.00E+00	4.15E-14	9.27E-12	1.96E-10	7.77E-10	1.01E-09	7.01E-10	3.72E-10	1.81E-10	8.61E-11
57	3.01E-06	2.56E-06	1.58E-06	8.92E-07	4.88E-07	2.63E-07	1.41E-07	7.55E-08	4.03E-08	2.15E-08
58	7.48E-07	4.08E-07	2.23E-07	1.22E-07	6.70E-08	3.67E-08	2.01E-08	1.10E-08	6.05E-09	3.32E-09
59	0.00E+00	2.37E-12	1.24E-09	6.66E-08	6.44E-07	1.74E-06	1.90E-06	1.17E-06	5.36E-07	2.17E-07
60	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.42E-13	2.75E-11
61	0.00E+00	4.17E-10	1.26E-07	3.93E-06	2.37E-05	4.23E-05	3.29E-05	1.60E-05	6.35E-06	2.38E-06
62	1.46E-06	1.43E-05	2.33E-05	1.70E-05	1.04E-05	6.27E-06	3.78E-06	2.29E-06	1.38E-06	8.34E-07
63	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
64	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
65	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
66	3.97E-13	1.05E-10	1.91E-09	5.23E-09	4.31E-09	2.04E-09	8.41E-10	3.43E-10	1.40E-10	5.76E-11
67	0.00E+00	0.00E+00	0.00E+00	1.03E-11	3.00E-09	1.41E-07	1.81E-06	8.88E-06	2.20E-05	3.34E-05
68	6.24E-07	3.92E-07	2.45E-07	1.54E-07	9.60E-08	6.01E-08	3.76E-08	2.35E-08	1.47E-08	9.18E-09
69	9.48E-07	1.00E-06	6.60E-07	4.09E-07	2.50E-07	1.52E-07	9.23E-08	5.60E-08	3.40E-08	2.06E-08
70	0.00E+00	6.47E-12	1.66E-09	4.85E-08	2.99E-07	6.62E-07	7.90E-07	6.65E-07	4.72E-07	3.14E-07
71	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
72	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.49E-13	9.63E-11	3.96E-09	5.00E-08	2.44E-07	5.58E-07
73	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
74	2.99E-07	2.97E-07	2.07E-07	1.31E-07	8.02E-08	4.86E-08	2.94E-08	1.77E-08	1.06E-08	6.39E-09
75	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.86E-11	6.74E-10	8.25E-09	4.17E-08
76	1.87E-07	1.07E-07	6.17E-08	3.54E-08	2.04E-08	1.17E-08	6.73E-09	3.87E-09	2.23E-09	1.28E-09
77	0.00E+00	0.00E+00	0.00E+00	5.90E-11	6.06E-09	9.53E-08	3.83E-07	6.16E-07	5.97E-07	4.69E-07
78	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
79	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
80	2.08E-05	1.06E-05	5.28E-06	2.62E-06	1.30E-06	6.44E-07	3.19E-07	1.58E-07	7.80E-08	3.86E-08
81	7.89E-08	5.36E-08	3.32E-08	2.02E-08	1.23E-08	7.44E-09	4.50E-09	2.72E-09	1.65E-09	9.97E-10
82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.15E-14	7.70E-13
83	1.15E-08	3.30E-08	2.36E-08	1.30E-08	6.59E-09	3.30E-09	1.64E-09	8.16E-10	4.05E-10	2.01E-10
84	3.01E-06	1.09E-06	3.84E-07	1.35E-07	4.71E-08	1.64E-08	5.73E-09	2.00E-09	6.96E-10	2.43E-10
85	1.55E-10	2.82E-08	4.04E-07	1.07E-06	1.09E-06	7.31E-07	4.32E-07	2.44E-07	1.36E-07	7.51E-08
86	1.73E-06	1.07E-06	6.49E-07	3.93E-07	2.37E-07	1.43E-07	8.60E-08	5.17E-08	3.11E-08	1.87E-08
87	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
88	6.13E-07	4.01E-07	2.38E-07	1.41E-07	8.31E-08	4.90E-08	2.89E-08	1.70E-08	1.00E-08	5.91E-09
89	1.97E-07	3.00E-07	2.08E-07	1.25E-07	7.46E-08	4.43E-08	2.62E-08	1.55E-08	9.21E-09	5.45E-09
90	0.00E+00	2.47E-13	5.38E-11	1.33E-09	7.11E-09	1.39E-08	1.46E-08	1.07E-08	6.65E-09	3.87E-09
91	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.22E-15
92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.66E-12	1.31E-10	2.30E-09
93	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.02E-12
94	1.59E-10	1.29E-08	9.56E-08	1.51E-07	1.13E-07	6.96E-08	4.23E-08	2.58E-08	1.58E-08	9.66E-09
95	8.28E-10	4.12E-09	4.71E-09	3.32E-09	2.11E-09	1.31E-09	8.05E-10	4.92E-10	3.00E-10	1.83E-10
96	0.00E+00	3.89E-13	2.51E-10	1.51E-08	1.59E-07	4.79E-07	6.32E-07	4.87E-07	2.64E-07	1.17E-07
97	5.20E-06	1.84E-06	6.47E-07	2.28E-07	8.03E-08	2.83E-08	9.96E-09	3.51E-09	1.24E-09	4.35E-10
98	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.59E-15	1.96E-13	4.72E-12	3.78E-11	1.34E-10	2.66E-10
99	2.90E-06	9.82E-07	3.32E-07	1.12E-07	3.77E-08	1.27E-08	4.28E-09	1.44E-09	4.86E-10	1.63E-10
100	4.12E-10	5.70E-09	1.01E-08	6.64E-09	3.39E-09	1.67E-09	8.20E-10	4.01E-10	1.95E-10	9.51E-11

Table F.4.7. Probabilistic Modeling Results for C-720 Building Area (variable degradation scenario) - Plant Boundary POE (conc in mg/L)

Run	0 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	30 yrs	35 yrs	40 yrs	45 yrs
1	0.00E+00	0.00E+00	0.00E+00	6.07E-05	5.89E-05	4.61E-05	2.85E-05	1.64E-05	9.24E-06	5.13E-06
2	0.00E+00	0.00E+00	2.98E-04	3.75E-04	2.57E-04	1.40E-04	7.15E-05	3.55E-05	1.74E-05	8.47E-06
3	0.00E+00	0.00E+00	4.19E-04	1.37E-03	1.19E-03	6.68E-04	3.33E-04	1.60E-04	7.54E-05	3.53E-05
4	0.00E+00	0.00E+00	0.00E+00	9.88E-09	3.84E-05	1.03E-03	3.78E-03	5.19E-03	4.05E-03	2.22E-03
5	0.00E+00	0.00E+00	7.08E-07	7.04E-04	8.54E-04	7.18E-04	4.62E-04	2.61E-04	1.40E-04	7.38E-05
6	0.00E+00	0.00E+00	0.00E+00	1.73E-05	2.25E-05	2.44E-05	2.11E-05	1.59E-05	1.14E-05	7.99E-06
7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.95E-06	3.52E-06	1.98E-06	9.39E-07	4.15E-07
8	0.00E+00	0.00E+00	1.49E-04	5.26E-04	5.99E-04	4.55E-04	3.07E-04	1.99E-04	1.26E-04	7.98E-05
9	0.00E+00	0.00E+00	0.00E+00	1.09E-05	3.48E-04	4.23E-04	4.05E-04	3.19E-04	2.37E-04	1.72E-04
10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.06E-05	8.78E-04	1.35E-03	8.65E-04	4.53E-04	2.26E-04
11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.26E-09	2.74E-05	6.07E-05	4.02E-05	2.35E-05
12	0.00E+00	0.00E+00	1.46E-08	1.13E-04	2.06E-04	2.05E-04	1.50E-04	1.00E-04	6.49E-05	4.14E-05
13	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.96E-05	2.40E-04	2.40E-04	1.97E-04	1.45E-04	1.05E-04
14	0.00E+00	0.00E+00	9.63E-06	9.01E-04	1.98E-03	2.03E-03	1.44E-03	9.02E-04	5.37E-04	3.13E-04
15	0.00E+00	0.00E+00	0.00E+00	3.36E-05	9.83E-04	1.65E-03	1.74E-03	1.44E-03	1.04E-03	7.13E-04
16	0.00E+00	0.00E+00	6.18E-04	2.54E-03	2.93E-03	2.02E-03	1.11E-03	5.64E-04	2.79E-04	1.36E-04
17	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.52E-04	6.72E-04	3.27E-04	1.57E-04	7.42E-05
18	0.00E+00	0.00E+00	3.66E-04	5.11E-04	4.38E-04	3.07E-04	2.03E-04	1.31E-04	8.38E-05	5.33E-05
19	0.00E+00	0.00E+00	1.99E-10	1.08E-04	1.27E-04	1.10E-04	8.00E-05	5.48E-05	3.66E-05	2.41E-05
20	0.00E+00	0.00E+00	1.12E-07	2.56E-04	4.59E-04	2.68E-04	1.29E-04	5.88E-05	2.61E-05	1.14E-05
21	0.00E+00	0.00E+00	1.84E-09	3.82E-05	2.22E-04	2.81E-04	2.10E-04	1.15E-04	5.45E-05	2.45E-05
22	0.00E+00	0.00E+00	8.36E-10	3.98E-04	3.43E-03	5.20E-03	4.55E-03	3.06E-03	1.88E-03	1.11E-03
23	0.00E+00	0.00E+00	0.00E+00	1.96E-03	3.10E-03	2.19E-03	1.47E-03	9.60E-04	6.22E-04	4.01E-04
24	0.00E+00	0.00E+00	0.00E+00	7.74E-06	4.27E-04	1.14E-03	1.22E-03	8.73E-04	5.16E-04	2.84E-04
25	0.00E+00	0.00E+00	0.00E+00	1.67E-05	4.68E-05	3.13E-05	2.04E-05	1.31E-05	8.43E-06	5.39E-06
26	0.00E+00	0.00E+00	1.99E-05	4.51E-03	6.54E-03	5.54E-03	3.58E-03	2.14E-03	1.24E-03	7.10E-04
27	0.00E+00	0.00E+00	0.00E+00	9.35E-05	7.08E-05	4.67E-05	2.67E-05	1.46E-05	7.77E-06	4.08E-06
28	0.00E+00	0.00E+00	0.00E+00	3.53E-06	4.23E-05	1.81E-05	7.12E-06	2.75E-06	1.05E-06	4.00E-07
29	0.00E+00	0.00E+00	6.37E-10	2.72E-05	3.98E-04	6.42E-04	4.35E-04	1.94E-04	7.16E-05	2.43E-05
30	0.00E+00	1.88E-09	4.00E-04	3.76E-04	2.60E-04	1.65E-04	1.02E-04	6.17E-05	3.72E-05	2.23E-05
31	0.00E+00	1.04E-08	6.46E-04	6.82E-04	4.65E-04	2.80E-04	1.61E-04	9.13E-05	5.12E-05	2.86E-05
32	0.00E+00	0.00E+00	6.42E-07	7.09E-04	2.78E-03	3.14E-03	2.09E-03	1.12E-03	5.54E-04	2.67E-04
33	0.00E+00	0.00E+00	2.57E-09	1.73E-04	2.30E-03	3.79E-03	2.86E-03	1.52E-03	6.99E-04	3.06E-04
34	0.00E+00	0.00E+00	3.69E-04	6.35E-03	7.72E-03	5.12E-03	2.80E-03	1.45E-03	7.37E-04	3.70E-04
35	0.00E+00	0.00E+00	1.40E-04	1.18E-03	1.44E-03	1.17E-03	8.15E-04	5.41E-04	3.52E-04	2.27E-04
36	0.00E+00	0.00E+00	0.00E+00	2.05E-08	5.14E-04	5.87E-04	5.67E-04	4.46E-04	3.33E-04	2.43E-04
37	0.00E+00	1.16E-09	2.50E-03	3.07E-03	1.88E-03	9.76E-04	4.82E-04	2.33E-04	1.12E-04	5.38E-05
38	0.00E+00	0.00E+00	3.53E-05	2.65E-04	1.88E-04	8.17E-05	3.06E-05	1.09E-05	3.83E-06	1.33E-06
39	0.00E+00	0.00E+00	0.00E+00	5.03E-06	4.16E-04	1.63E-03	2.38E-03	2.20E-03	1.60E-03	1.06E-03
40	0.00E+00	0.00E+00	0.00E+00	7.48E-04	8.36E-04	7.10E-04	4.83E-04	3.08E-04	1.92E-04	1.18E-04
41	0.00E+00	0.00E+00	2.84E-06	6.86E-04	1.34E-03	1.13E-03	7.00E-04	3.93E-04	2.13E-04	1.14E-04
42	0.00E+00	0.00E+00	0.00E+00	7.73E-05	2.50E-04	2.45E-04	1.90E-04	1.29E-04	8.53E-05	5.54E-05
43	0.00E+00	0.00E+00	7.44E-04	1.58E-03	1.49E-03	9.76E-04	5.73E-04	3.22E-04	1.78E-04	9.75E-05
44	0.00E+00	1.42E-08	8.77E-04	7.51E-04	3.50E-04	1.34E-04	4.84E-05	1.70E-05	5.93E-06	2.06E-06
45	0.00E+00	0.00E+00	0.00E+00	4.32E-10	5.69E-06	1.30E-04	4.00E-04	5.67E-04	5.42E-04	4.19E-04
46	0.00E+00	0.00E+00	5.00E-05	1.03E-04	8.82E-05	5.90E-05	3.52E-05	2.00E-05	1.11E-05	6.09E-06
47	0.00E+00	0.00E+00	0.00E+00	3.35E-07	5.09E-05	9.98E-05	8.00E-05	4.69E-05	2.41E-05	1.18E-05
48	0.00E+00	0.00E+00	4.10E-05	7.84E-04	1.14E-03	9.73E-04	6.22E-04	3.62E-04	2.02E-04	1.11E-04
49	0.00E+00	0.00E+00	0.00E+00	8.33E-11	4.69E-07	1.45E-05	6.10E-05	9.88E-05	9.60E-05	7.00E-05
50	0.00E+00	0.00E+00	9.47E-05	3.29E-04	2.43E-04	1.13E-04	4.65E-05	1.83E-05	7.08E-06	2.72E-06

Table F.4.7. Probabilistic Modeling Results for C-720 Building Area (variable degradation scenario) - Plant Boundary POE (conc in mg/L) (continued)

Run	0 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	30 yrs	35 yrs	40 yrs	45 yrs
51	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.24E-11	1.75E-05	5.10E-05	3.80E-05	2.23E-05	1.22E-05
52	0.00E+00	0.00E+00	5.28E-04	8.37E-04	5.21E-04	2.25E-04	8.87E-05	3.38E-05	1.27E-05	4.76E-06
53	0.00E+00	0.00E+00	0.00E+00	1.15E-05	4.87E-04	1.46E-03	1.74E-03	1.35E-03	8.59E-04	4.98E-04
54	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.10E-04	2.24E-04	1.47E-04	9.31E-05	5.82E-05	3.61E-05
55	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.33E-05	2.97E-05	2.00E-05	1.09E-05	5.65E-06	2.86E-06
56	0.00E+00	0.00E+00	6.25E-06	2.48E-04	3.18E-04	2.48E-04	1.35E-04	6.25E-05	2.73E-05	1.16E-05
57	0.00E+00	0.00E+00	6.96E-11	1.69E-03	2.32E-03	2.31E-03	1.77E-03	1.23E-03	8.19E-04	5.37E-04
58	0.00E+00	0.00E+00	9.22E-04	1.45E-03	1.36E-03	9.77E-04	6.55E-04	4.27E-04	2.74E-04	1.75E-04
59	0.00E+00	0.00E+00	9.58E-05	5.34E-03	7.35E-03	6.02E-03	4.08E-03	2.61E-03	1.63E-03	1.01E-03
60	0.00E+00	0.00E+00	2.70E-08	7.97E-04	3.03E-03	3.49E-03	2.81E-03	1.97E-03	1.32E-03	8.70E-04
61	0.00E+00	0.00E+00	4.71E-05	6.48E-03	7.87E-03	5.36E-03	2.74E-03	1.28E-03	5.81E-04	2.59E-04
62	0.00E+00	0.00E+00	2.85E-04	1.10E-03	1.31E-03	1.02E-03	6.73E-04	4.21E-04	2.57E-04	1.55E-04
63	0.00E+00	0.00E+00	9.96E-10	2.94E-05	2.87E-04	3.91E-04	2.77E-04	1.37E-04	5.66E-05	2.17E-05
64	0.00E+00	0.00E+00	0.00E+00	1.33E-08	2.25E-05	2.28E-04	4.87E-04	5.67E-04	4.73E-04	3.30E-04
65	0.00E+00	0.00E+00	0.00E+00	1.75E-07	8.06E-05	8.82E-04	2.33E-03	3.04E-03	2.63E-03	1.82E-03
66	0.00E+00	0.00E+00	3.21E-13	2.21E-05	2.93E-05	2.63E-05	1.80E-05	1.12E-05	6.69E-06	3.94E-06
67	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.02E-03	8.60E-03	1.01E-02	9.12E-03	7.09E-03	5.30E-03
68	0.00E+00	0.00E+00	2.15E-04	2.83E-04	2.20E-04	1.29E-04	7.06E-05	3.75E-05	1.97E-05	1.03E-05
69	0.00E+00	0.00E+00	0.00E+00	6.82E-04	1.04E-03	1.14E-03	9.74E-04	7.32E-04	5.28E-04	3.73E-04
70	0.00E+00	0.00E+00	2.20E-04	3.41E-03	3.90E-03	2.55E-03	1.39E-03	7.23E-04	3.67E-04	1.85E-04
71	0.00E+00	0.00E+00	0.00E+00	2.21E-06	1.02E-04	3.90E-04	6.28E-04	6.14E-04	4.54E-04	2.99E-04
72	0.00E+00	0.00E+00	0.00E+00	2.47E-09	5.58E-04	1.17E-03	8.48E-04	5.58E-04	3.57E-04	2.26E-04
73	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.84E-14	1.62E-08	6.28E-07	2.11E-06
74	0.00E+00	0.00E+00	3.98E-04	2.94E-04	1.36E-04	5.33E-05	1.98E-05	7.16E-06	2.56E-06	9.14E-07
75	0.00E+00	0.00E+00	5.22E-09	7.72E-04	3.37E-03	3.83E-03	2.80E-03	1.71E-03	9.85E-04	5.54E-04
76	0.00E+00	0.00E+00	1.20E-03	1.46E-03	1.06E-03	6.61E-04	3.94E-04	2.31E-04	1.34E-04	7.72E-05
77	0.00E+00	0.00E+00	0.00E+00	3.27E-08	7.21E-05	5.44E-05	3.15E-05	1.67E-05	7.99E-06	3.66E-06
78	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.22E-09	2.59E-07	4.31E-06	1.95E-05	4.21E-05
79	0.00E+00	0.00E+00	3.91E-10	3.64E-04	1.36E-02	4.36E-02	5.43E-02	4.33E-02	2.85E-02	1.75E-02
80	0.00E+00	0.00E+00	8.18E-04	1.04E-03	7.83E-04	4.86E-04	2.85E-04	1.64E-04	9.29E-05	5.25E-05
81	0.00E+00	0.00E+00	5.37E-04	6.81E-04	3.97E-04	1.73E-04	6.96E-05	2.72E-05	1.05E-05	4.02E-06
82	0.00E+00	0.00E+00	0.00E+00	2.92E-05	1.11E-02	1.49E-02	6.82E-03	2.60E-03	9.43E-04	3.37E-04
83	0.00E+00	0.00E+00	2.16E-03	3.22E-03	2.33E-03	1.17E-03	5.40E-04	2.40E-04	1.05E-04	4.54E-05
84	0.00E+00	0.00E+00	7.41E-03	1.41E-02	1.30E-02	8.99E-03	5.79E-03	3.63E-03	2.25E-03	1.38E-03
85	0.00E+00	0.00E+00	7.80E-08	8.40E-04	1.21E-03	1.20E-03	8.96E-04	6.04E-04	3.92E-04	2.50E-04
86	0.00E+00	0.00E+00	5.68E-04	5.73E-04	3.47E-04	1.54E-04	6.31E-05	2.51E-05	9.81E-06	3.82E-06
87	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.66E-07	1.27E-05	5.28E-05	6.81E-05	5.14E-05	2.87E-05
88	0.00E+00	0.00E+00	4.08E-04	1.66E-03	1.90E-03	1.53E-03	1.02E-03	6.42E-04	3.95E-04	2.39E-04
89	0.00E+00	1.38E-09	5.60E-04	3.60E-04	1.47E-04	5.38E-05	1.89E-05	6.52E-06	2.24E-06	7.65E-07
90	0.00E+00	0.00E+00	1.40E-08	1.98E-04	2.43E-04	1.75E-04	9.82E-05	5.09E-05	2.57E-05	1.28E-05
91	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.79E-11	4.09E-06	1.86E-05	1.46E-05	8.99E-06
92	0.00E+00	0.00E+00	0.00E+00	4.85E-05	7.36E-04	1.04E-03	9.08E-04	6.56E-04	4.44E-04	2.94E-04
93	0.00E+00	0.00E+00	2.99E-07	1.15E-03	5.49E-03	6.67E-03	4.88E-03	3.00E-03	1.74E-03	9.90E-04
94	0.00E+00	0.00E+00	1.68E-05	2.27E-04	2.80E-04	2.33E-04	1.59E-04	1.02E-04	6.32E-05	3.87E-05
95	0.00E+00	0.00E+00	0.00E+00	1.35E-04	1.58E-04	1.26E-04	7.94E-05	4.62E-05	2.61E-05	1.45E-05
96	0.00E+00	0.00E+00	1.06E-06	1.50E-03	2.48E-03	2.38E-03	1.78E-03	1.25E-03	8.58E-04	5.81E-04
97	0.00E+00	0.00E+00	8.51E-04	1.42E-03	1.26E-03	8.67E-04	5.58E-04	3.49E-04	2.16E-04	1.33E-04
98	0.00E+00	0.00E+00	2.67E-05	5.64E-04	7.42E-04	5.68E-04	3.53E-04	2.05E-04	1.15E-04	6.40E-05
99	0.00E+00	0.00E+00	0.00E+00	1.20E-04	1.53E-04	1.50E-04	1.16E-04	8.44E-05	5.98E-05	4.19E-05
100	0.00E+00	0.00E+00	1.68E-04	3.38E-04	1.80E-04	7.91E-05	3.26E-05	1.31E-05	5.17E-06	2.04E-06

Table F.4.7. Probabilistic Modeling Results for C-720 Building Area (variable degradation scenario) - Plant Boundary POE (conc in mg/L) (continued)

Run	50 yrs	55 yrs	60 yrs	65 yrs	70 yrs	75 yrs	80 yrs	85 yrs	90 yrs	95 yrs
1	2.83E-06	1.56E-06	8.57E-07	4.70E-07	2.58E-07	1.42E-07	7.77E-08	4.26E-08	2.33E-08	1.28E-08
2	4.11E-06	1.99E-06	9.67E-07	4.69E-07	2.27E-07	1.10E-07	5.32E-08	2.57E-08	1.24E-08	5.91E-09
3	1.65E-05	7.68E-06	3.58E-06	1.67E-06	7.75E-07	3.61E-07	1.68E-07	7.80E-08	3.62E-08	1.68E-08
4	9.82E-04	3.82E-04	1.39E-04	4.86E-05	1.67E-05	5.69E-06	1.93E-06	6.55E-07	2.22E-07	7.49E-08
5	3.82E-05	1.97E-05	1.01E-05	5.14E-06	2.63E-06	1.34E-06	6.82E-07	3.48E-07	1.77E-07	9.02E-08
6	5.55E-06	3.83E-06	2.64E-06	1.81E-06	1.25E-06	8.56E-07	5.87E-07	4.03E-07	2.77E-07	1.90E-07
7	1.80E-07	7.73E-08	3.31E-08	1.41E-08	6.00E-09	2.54E-09	1.07E-09	4.52E-10	1.90E-10	7.91E-11
8	5.01E-05	3.15E-05	1.97E-05	1.23E-05	7.73E-06	4.84E-06	3.03E-06	1.90E-06	1.19E-06	7.44E-07
9	1.23E-04	8.78E-05	6.23E-05	4.42E-05	3.13E-05	2.22E-05	1.57E-05	1.11E-05	7.86E-06	5.56E-06
10	1.11E-04	5.45E-05	2.66E-05	1.29E-05	6.30E-06	3.07E-06	1.49E-06	7.26E-07	3.53E-07	1.72E-07
11	1.35E-05	7.70E-06	4.39E-06	2.50E-06	1.42E-06	8.08E-07	4.60E-07	2.61E-07	1.49E-07	8.45E-08
12	2.62E-05	1.66E-05	1.05E-05	6.58E-06	4.15E-06	2.61E-06	1.65E-06	1.04E-06	6.53E-07	4.11E-07
13	7.46E-05	5.29E-05	3.73E-05	2.63E-05	1.86E-05	1.31E-05	9.20E-06	6.48E-06	4.56E-06	3.21E-06
14	1.80E-04	1.03E-04	5.92E-05	3.38E-05	1.93E-05	1.10E-05	6.28E-06	3.58E-06	2.04E-06	1.17E-06
15	4.78E-04	3.16E-04	2.08E-04	1.36E-04	8.90E-05	5.80E-05	3.78E-05	2.46E-05	1.60E-05	1.04E-05
16	6.62E-05	3.21E-05	1.56E-05	7.53E-06	3.65E-06	1.76E-06	8.54E-07	4.13E-07	2.00E-07	9.65E-08
17	3.51E-05	1.65E-05	7.78E-06	3.66E-06	1.72E-06	8.10E-07	3.81E-07	1.79E-07	8.44E-08	3.97E-08
18	3.38E-05	2.14E-05	1.35E-05	8.58E-06	5.43E-06	3.44E-06	2.18E-06	1.38E-06	8.72E-07	5.52E-07
19	1.58E-05	1.03E-05	6.71E-06	4.37E-06	2.84E-06	1.85E-06	1.20E-06	7.79E-07	5.06E-07	3.29E-07
20	4.94E-06	2.14E-06	9.22E-07	3.97E-07	1.71E-07	7.36E-08	3.16E-08	1.36E-08	5.80E-09	2.50E-09
21	1.08E-05	4.67E-06	2.01E-06	8.64E-07	3.71E-07	1.59E-07	6.80E-08	2.91E-08	1.24E-08	5.26E-09
22	6.51E-04	3.78E-04	2.18E-04	1.26E-04	7.27E-05	4.19E-05	2.41E-05	1.39E-05	8.02E-06	4.62E-06
23	2.58E-04	1.66E-04	1.06E-04	6.83E-05	4.38E-05	2.81E-05	1.80E-05	1.16E-05	7.43E-06	4.77E-06
24	1.51E-04	7.99E-05	4.19E-05	2.19E-05	1.15E-05	5.99E-06	3.13E-06	1.63E-06	8.53E-07	4.46E-07
25	3.44E-06	2.20E-06	1.40E-06	8.96E-07	5.71E-07	3.65E-07	2.33E-07	1.48E-07	9.47E-08	6.04E-08
26	4.04E-04	2.29E-04	1.29E-04	7.30E-05	4.12E-05	2.33E-05	1.31E-05	7.41E-06	4.18E-06	2.36E-06
27	2.13E-06	1.10E-06	5.69E-07	2.94E-07	1.51E-07	7.78E-08	4.00E-08	2.06E-08	1.06E-08	5.42E-09
28	1.52E-07	5.77E-08	2.18E-08	8.23E-09	3.08E-09	1.14E-09	4.26E-10	1.61E-10	7.20E-11	5.66E-11
29	8.01E-06	2.60E-06	8.39E-07	2.70E-07	8.64E-08	2.75E-08	8.68E-09	2.72E-09	9.01E-10	4.11E-10
30	1.34E-05	8.05E-06	4.83E-06	2.89E-06	1.74E-06	1.04E-06	6.24E-07	3.74E-07	2.24E-07	1.35E-07
31	1.59E-05	8.88E-06	4.94E-06	2.75E-06	1.53E-06	8.53E-07	4.75E-07	2.64E-07	1.47E-07	8.17E-08
32	1.27E-04	5.99E-05	2.82E-05	1.33E-05	6.24E-06	2.93E-06	1.38E-06	6.48E-07	3.04E-07	1.43E-07
33	1.32E-04	5.60E-05	2.37E-05	1.00E-05	4.24E-06	1.79E-06	7.57E-07	3.20E-07	1.35E-07	5.68E-08
34	1.85E-04	9.24E-05	4.61E-05	2.30E-05	1.14E-05	5.70E-06	2.84E-06	1.42E-06	7.06E-07	3.52E-07
35	1.45E-04	9.31E-05	5.96E-05	3.81E-05	2.43E-05	1.55E-05	9.93E-06	6.35E-06	4.06E-06	2.59E-06
36	1.76E-04	1.26E-04	9.02E-05	6.44E-05	4.60E-05	3.28E-05	2.34E-05	1.67E-05	1.19E-05	8.47E-06
37	2.58E-05	1.23E-05	5.89E-06	2.82E-06	1.35E-06	6.44E-07	3.08E-07	1.47E-07	7.02E-08	3.34E-08
38	4.61E-07	1.59E-07	5.50E-08	1.89E-08	6.46E-09	2.18E-09	7.30E-10	2.49E-10	9.76E-11	7.80E-11
39	6.72E-04	4.20E-04	2.60E-04	1.60E-04	9.87E-05	6.07E-05	3.73E-05	2.29E-05	1.41E-05	8.66E-06
40	7.16E-05	4.35E-05	2.63E-05	1.59E-05	9.64E-06	5.82E-06	3.52E-06	2.13E-06	1.29E-06	7.76E-07
41	6.08E-05	3.23E-05	1.71E-05	9.08E-06	4.81E-06	2.55E-06	1.35E-06	7.17E-07	3.80E-07	2.01E-07
42	3.57E-05	2.29E-05	1.47E-05	9.38E-06	6.00E-06	3.83E-06	2.45E-06	1.56E-06	9.99E-07	6.38E-07
43	5.31E-05	2.88E-05	1.56E-05	8.47E-06	4.59E-06	2.48E-06	1.34E-06	7.28E-07	3.94E-07	2.14E-07
44	7.11E-07	2.46E-07	8.48E-08	2.92E-08	1.00E-08	3.42E-09	1.15E-09	3.89E-10	1.31E-10	6.36E-11
45	2.94E-04	1.98E-04	1.31E-04	8.57E-05	5.61E-05	3.66E-05	2.39E-05	1.56E-05	1.01E-05	6.62E-06
46	3.32E-06	1.81E-06	9.79E-07	5.31E-07	2.87E-07	1.56E-07	8.42E-08	4.55E-08	2.46E-08	1.33E-08
47	5.66E-06	2.70E-06	1.28E-06	6.06E-07	2.87E-07	1.36E-07	6.41E-08	3.03E-08	1.43E-08	6.71E-09
48	6.03E-05	3.26E-05	1.76E-05	9.48E-06	5.11E-06	2.75E-06	1.48E-06	7.96E-07	4.28E-07	2.30E-07
49	4.37E-05	2.53E-05	1.41E-05	7.74E-06	4.21E-06	2.28E-06	1.24E-06	6.70E-07	3.63E-07	1.96E-07
50	1.04E-06	4.00E-07	1.53E-07	5.84E-08	2.23E-08	8.45E-09	3.17E-09	1.18E-09	4.40E-10	1.83E-10

Table F.4.7. Probabilistic Modeling Results for C-720 Building Area (variable degradation scenario) - Plant Boundary POE (conc in mg/L) (continued)

Run	50 yrs	55 yrs	60 yrs	65 yrs	70 yrs	75 yrs	80 yrs	85 yrs	90 yrs	95 yrs
51	6.59E-06	3.52E-06	1.87E-06	9.92E-07	5.25E-07	2.78E-07	1.47E-07	7.79E-08	4.12E-08	2.18E-08
52	1.77E-06	6.61E-07	2.46E-07	9.15E-08	3.40E-08	1.25E-08	4.56E-09	1.64E-09	6.05E-10	2.32E-10
53	2.78E-04	1.53E-04	8.31E-05	4.51E-05	2.44E-05	1.32E-05	7.15E-06	3.87E-06	2.09E-06	1.13E-06
54	2.23E-05	1.37E-05	8.46E-06	5.21E-06	3.21E-06	1.97E-06	1.22E-06	7.48E-07	4.60E-07	2.83E-07
55	1.44E-06	7.19E-07	3.59E-07	1.79E-07	8.89E-08	4.42E-08	2.20E-08	1.09E-08	5.42E-09	2.69E-09
56	4.87E-06	2.03E-06	8.43E-07	3.49E-07	1.45E-07	5.98E-08	2.47E-08	1.01E-08	4.15E-09	1.71E-09
57	3.49E-04	2.26E-04	1.46E-04	9.37E-05	6.03E-05	3.88E-05	2.49E-05	1.60E-05	1.03E-05	6.60E-06
58	1.11E-04	7.05E-05	4.47E-05	2.84E-05	1.80E-05	1.14E-05	7.22E-06	4.57E-06	2.90E-06	1.84E-06
59	6.24E-04	3.84E-04	2.36E-04	1.45E-04	8.88E-05	5.45E-05	3.34E-05	2.05E-05	1.26E-05	7.72E-06
60	5.66E-04	3.67E-04	2.37E-04	1.53E-04	9.92E-05	6.40E-05	4.13E-05	2.67E-05	1.72E-05	1.11E-05
61	1.15E-04	5.07E-05	2.23E-05	9.83E-06	4.32E-06	1.90E-06	8.36E-07	3.67E-07	1.61E-07	7.08E-08
62	9.30E-05	5.55E-05	3.31E-05	1.97E-05	1.17E-05	6.99E-06	4.16E-06	2.48E-06	1.47E-06	8.77E-07
63	8.03E-06	2.94E-06	1.07E-06	3.88E-07	1.41E-07	5.09E-08	1.84E-08	6.63E-09	2.37E-09	8.36E-10
64	2.13E-04	1.33E-04	8.16E-05	4.98E-05	3.03E-05	1.84E-05	1.11E-05	6.74E-06	4.08E-06	2.47E-06
65	1.13E-03	6.68E-04	3.87E-04	2.22E-04	1.27E-04	7.25E-05	4.13E-05	2.35E-05	1.34E-05	7.64E-06
66	2.30E-06	1.34E-06	7.77E-07	4.51E-07	2.62E-07	1.52E-07	8.79E-08	5.09E-08	2.95E-08	1.70E-08
67	3.89E-03	2.84E-03	2.06E-03	1.49E-03	1.08E-03	7.81E-04	5.65E-04	4.09E-04	2.96E-04	2.14E-04
68	5.34E-06	2.78E-06	1.44E-06	7.48E-07	3.88E-07	2.01E-07	1.05E-07	5.42E-08	2.81E-08	1.45E-08
69	2.60E-04	1.81E-04	1.25E-04	8.66E-05	5.98E-05	4.12E-05	2.84E-05	1.96E-05	1.35E-05	9.30E-06
70	9.28E-05	4.64E-05	2.32E-05	1.16E-05	5.80E-06	2.90E-06	1.45E-06	7.23E-07	3.61E-07	1.80E-07
71	1.87E-04	1.15E-04	7.01E-05	4.25E-05	2.58E-05	1.56E-05	9.42E-06	5.70E-06	3.44E-06	2.08E-06
72	1.42E-04	8.95E-05	5.62E-05	3.53E-05	2.21E-05	1.39E-05	8.71E-06	5.46E-06	3.43E-06	2.15E-06
73	2.51E-06	1.86E-06	1.10E-06	5.94E-07	3.07E-07	1.56E-07	7.84E-08	3.93E-08	1.97E-08	9.83E-09
74	3.25E-07	1.15E-07	4.09E-08	1.45E-08	5.09E-09	1.77E-09	6.13E-10	2.15E-10	8.16E-11	7.24E-11
75	3.08E-04	1.71E-04	9.44E-05	5.21E-05	2.87E-05	1.59E-05	8.74E-06	4.82E-06	2.66E-06	1.47E-06
76	4.45E-05	2.56E-05	1.48E-05	8.49E-06	4.89E-06	2.81E-06	1.62E-06	9.31E-07	5.36E-07	3.08E-07
77	1.64E-06	7.26E-07	3.18E-07	1.38E-07	6.00E-08	2.60E-08	1.12E-08	4.81E-09	2.07E-09	9.05E-10
78	5.81E-05	5.93E-05	4.91E-05	3.53E-05	2.30E-05	1.41E-05	8.38E-06	4.86E-06	2.78E-06	1.58E-06
79	1.04E-02	6.13E-03	3.60E-03	2.10E-03	1.23E-03	7.18E-04	4.19E-04	2.45E-04	1.43E-04	8.35E-05
80	2.96E-05	1.67E-05	9.41E-06	5.30E-06	2.98E-06	1.68E-06	9.46E-07	5.33E-07	3.00E-07	1.69E-07
81	1.54E-06	5.87E-07	2.24E-07	8.52E-08	3.24E-08	1.23E-08	4.61E-09	1.72E-09	6.51E-10	2.56E-10
82	1.19E-04	4.22E-05	1.49E-05	5.26E-06	1.85E-06	6.53E-07	2.30E-07	8.10E-08	2.84E-08	9.83E-09
83	1.96E-05	8.47E-06	3.65E-06	1.57E-06	6.77E-07	2.92E-07	1.26E-07	5.40E-08	2.32E-08	9.94E-09
84	8.49E-04	5.21E-04	3.19E-04	1.96E-04	1.20E-04	7.34E-05	4.50E-05	2.76E-05	1.69E-05	1.03E-05
85	1.57E-04	9.89E-05	6.19E-05	3.87E-05	2.42E-05	1.51E-05	9.42E-06	5.88E-06	3.67E-06	2.29E-06
86	1.48E-06	5.72E-07	2.21E-07	8.55E-08	3.30E-08	1.27E-08	4.89E-09	1.86E-09	7.07E-10	2.70E-10
87	1.32E-05	5.37E-06	2.04E-06	7.53E-07	2.73E-07	9.77E-08	3.48E-08	1.23E-08	4.36E-09	1.54E-09
88	1.44E-04	8.65E-05	5.18E-05	3.10E-05	1.85E-05	1.11E-05	6.62E-06	3.96E-06	2.36E-06	1.41E-06
89	2.62E-07	8.94E-08	3.04E-08	1.03E-08	3.43E-09	1.13E-09	3.78E-10	1.61E-10	1.25E-10	1.09E-10
90	6.31E-06	3.11E-06	1.53E-06	7.51E-07	3.69E-07	1.81E-07	8.90E-08	4.37E-08	2.14E-08	1.05E-08
91	5.41E-06	3.23E-06	1.93E-06	1.15E-06	6.80E-07	4.04E-07	2.39E-07	1.42E-07	8.43E-08	5.00E-08
92	1.92E-04	1.25E-04	8.08E-05	5.23E-05	3.38E-05	2.18E-05	1.41E-05	9.12E-06	5.89E-06	3.81E-06
93	5.58E-04	3.13E-04	1.76E-04	9.85E-05	5.52E-05	3.09E-05	1.73E-05	9.69E-06	5.42E-06	3.04E-06
94	2.36E-05	1.43E-05	8.66E-06	5.23E-06	3.16E-06	1.91E-06	1.15E-06	6.97E-07	4.21E-07	2.54E-07
95	8.03E-06	4.42E-06	2.43E-06	1.33E-06	7.32E-07	4.02E-07	2.20E-07	1.21E-07	6.62E-08	3.63E-08
96	3.91E-04	2.62E-04	1.76E-04	1.18E-04	7.88E-05	5.27E-05	3.53E-05	2.36E-05	1.58E-05	1.06E-05
97	8.12E-05	4.97E-05	3.03E-05	1.85E-05	1.13E-05	6.91E-06	4.22E-06	2.58E-06	1.57E-06	9.61E-07
98	3.53E-05	1.94E-05	1.07E-05	5.85E-06	3.21E-06	1.76E-06	9.64E-07	5.29E-07	2.90E-07	1.59E-07
99	2.92E-05	2.02E-05	1.40E-05	9.70E-06	6.70E-06	4.63E-06	3.20E-06	2.21E-06	1.53E-06	1.06E-06
100	7.98E-07	3.13E-07	1.22E-07	4.78E-08	1.86E-08	7.24E-09	2.78E-09	1.07E-09	4.14E-10	1.58E-10

Table F.4.8. Probabilistic Modeling Results for C-720 Building Area (variable degradation scenario) - Property Boundary POE (conc in mg/L)

Run	0 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	30 yrs	35 yrs	40 yrs	45 yrs
1	0.00E+00	0.00E+00	0.00E+00	3.22E-07	2.95E-05	2.51E-05	1.71E-05	1.01E-05	5.72E-06	3.19E-06
2	0.00E+00	0.00E+00	1.28E-07	1.09E-04	1.17E-04	7.58E-05	4.08E-05	2.07E-05	1.02E-05	5.01E-06
3	0.00E+00	0.00E+00	1.70E-10	6.38E-05	2.58E-04	2.45E-04	1.43E-04	7.22E-05	3.48E-05	1.64E-05
4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.28E-09	3.76E-07	1.11E-05	8.21E-05
5	0.00E+00	0.00E+00	0.00E+00	2.08E-07	9.09E-05	1.68E-04	1.54E-04	1.08E-04	6.29E-05	3.43E-05
6	0.00E+00	0.00E+00	0.00E+00	9.62E-09	4.22E-06	5.31E-06	5.59E-06	4.69E-06	3.49E-06	2.49E-06
7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.31E-13	5.05E-07	9.22E-07	5.24E-07	2.51E-07
8	0.00E+00	0.00E+00	6.27E-11	5.40E-05	1.45E-04	1.58E-04	1.19E-04	7.97E-05	5.15E-05	3.28E-05
9	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.94E-06	6.07E-05	8.33E-05	8.32E-05	6.75E-05	5.05E-05
10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.26E-11	6.46E-07	3.12E-05	1.26E-04	1.47E-04
11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.34E-08	3.50E-06	8.82E-06
12	0.00E+00	0.00E+00	0.00E+00	2.89E-09	6.47E-06	2.19E-05	2.57E-05	2.06E-05	1.42E-05	9.25E-06
13	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.44E-05	7.58E-05	7.54E-05	6.12E-05	4.52E-05
14	0.00E+00	0.00E+00	0.00E+00	4.06E-08	4.27E-05	3.00E-04	5.01E-04	4.65E-04	3.22E-04	2.00E-04
15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.50E-08	3.22E-05	2.65E-04	4.60E-04	4.96E-04	4.19E-04
16	0.00E+00	0.00E+00	0.00E+00	4.05E-05	5.21E-04	7.49E-04	6.24E-04	3.69E-04	1.93E-04	9.65E-05
17	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.05E-08	1.45E-04	1.60E-04	7.93E-05	3.80E-05
18	0.00E+00	0.00E+00	2.94E-06	1.26E-04	1.49E-04	1.17E-04	8.02E-05	5.25E-05	3.38E-05	2.15E-05
19	0.00E+00	0.00E+00	0.00E+00	2.51E-07	3.20E-05	3.84E-05	3.32E-05	2.41E-05	1.65E-05	1.10E-05
20	0.00E+00	0.00E+00	0.00E+00	3.04E-12	9.67E-07	3.04E-05	5.50E-05	3.67E-05	1.84E-05	8.49E-06
21	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.26E-09	1.97E-06	1.36E-05	2.32E-05	2.12E-05	1.34E-05
22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.21E-07	7.62E-05	5.24E-04	9.31E-04	9.19E-04	6.67E-04
23	0.00E+00	0.00E+00	0.00E+00	2.47E-09	1.53E-03	1.16E-03	7.98E-04	5.28E-04	3.44E-04	2.22E-04
24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.82E-07	1.26E-05	8.02E-05	1.58E-04	1.67E-04
25	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.41E-06	1.04E-05	6.93E-06	4.51E-06	2.90E-06	1.86E-06
26	0.00E+00	0.00E+00	0.00E+00	3.61E-06	6.96E-04	1.43E-03	1.38E-03	9.47E-04	5.77E-04	3.37E-04
27	0.00E+00	0.00E+00	0.00E+00	1.23E-05	2.71E-05	1.93E-05	1.17E-05	6.54E-06	3.52E-06	1.86E-06
28	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.80E-07	8.96E-06	5.52E-06	2.21E-06	8.58E-07	3.29E-07
29	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.96E-10	5.68E-07	1.94E-05	8.72E-05	1.29E-04	9.81E-05
30	0.00E+00	0.00E+00	2.06E-04	2.13E-04	1.52E-04	9.76E-05	6.03E-05	3.66E-05	2.21E-05	1.33E-05
31	0.00E+00	0.00E+00	1.41E-04	3.06E-04	2.57E-04	1.64E-04	9.66E-05	5.52E-05	3.11E-05	1.74E-05
32	0.00E+00	0.00E+00	0.00E+00	9.38E-12	1.95E-06	1.25E-04	5.45E-04	7.61E-04	5.97E-04	3.48E-04
33	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.70E-09	4.04E-06	8.53E-05	2.77E-04	3.44E-04	2.48E-04
34	0.00E+00	0.00E+00	0.00E+00	7.70E-06	5.38E-04	1.10E-03	9.22E-04	5.44E-04	2.89E-04	1.48E-04
35	0.00E+00	0.00E+00	0.00E+00	2.23E-04	5.19E-04	5.66E-04	4.33E-04	2.97E-04	1.96E-04	1.27E-04
36	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.03E-04	2.06E-04	2.20E-04	1.95E-04	1.49E-04	1.10E-04
37	0.00E+00	0.00E+00	2.24E-04	1.46E-03	1.32E-03	7.42E-04	3.76E-04	1.84E-04	8.89E-05	4.27E-05
38	0.00E+00	0.00E+00	0.00E+00	1.67E-06	3.68E-05	3.68E-05	1.85E-05	7.26E-06	2.63E-06	9.29E-07
39	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.10E-08	8.04E-06	8.83E-05	2.70E-04	4.12E-04
40	0.00E+00	0.00E+00	0.00E+00	2.46E-05	3.13E-04	3.21E-04	2.52E-04	1.67E-04	1.06E-04	6.55E-05
41	0.00E+00	0.00E+00	0.00E+00	3.28E-09	1.57E-05	1.73E-04	2.86E-04	2.38E-04	1.49E-04	8.39E-05
42	0.00E+00	0.00E+00	0.00E+00	3.74E-12	7.88E-05	9.08E-05	8.22E-05	5.92E-05	3.97E-05	2.60E-05
43	0.00E+00	0.00E+00	6.39E-07	3.41E-04	6.02E-04	5.28E-04	3.38E-04	1.97E-04	1.11E-04	6.10E-05
44	0.00E+00	0.00E+00	2.55E-04	3.32E-04	1.92E-04	7.78E-05	2.86E-05	1.02E-05	3.56E-06	1.24E-06
45	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.44E-09	4.77E-07	5.99E-06	2.24E-05
46	0.00E+00	0.00E+00	1.05E-11	2.67E-05	2.77E-05	2.21E-05	1.41E-05	8.25E-06	4.65E-06	2.57E-06
47	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.01E-14	4.85E-08	2.12E-06	6.85E-06	7.49E-06	5.18E-06
48	0.00E+00	0.00E+00	0.00E+00	1.58E-06	9.44E-05	2.00E-04	2.06E-04	1.45E-04	8.75E-05	4.97E-05
49	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.19E-14	6.71E-10	2.79E-08	2.74E-07
50	0.00E+00	0.00E+00	0.00E+00	1.11E-05	5.73E-05	4.86E-05	2.42E-05	1.01E-05	4.00E-06	1.55E-06

Table F.4.8. Probabilistic Modeling Results for C-720 Building Area (variable degradation scenario) - Property Boundary POE (conc in mg/L) (continued)

Run	0 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	30 yrs	35 yrs	40 yrs	45 yrs
51	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.01E-07	4.97E-06	1.01E-05	7.89E-06
52	0.00E+00	0.00E+00	8.91E-07	2.37E-04	3.21E-04	1.89E-04	8.08E-05	3.17E-05	1.21E-05	4.54E-06
53	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.58E-08	3.10E-06	3.37E-05	1.00E-04	1.43E-04
54	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.94E-06	1.00E-04	6.92E-05	4.48E-05	2.82E-05	1.76E-05
55	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.37E-08	6.85E-06	6.23E-06	4.14E-06	2.26E-06	1.17E-06
56	0.00E+00	0.00E+00	0.00E+00	8.12E-07	4.27E-05	6.88E-05	6.00E-05	3.59E-05	1.72E-05	7.63E-06
57	0.00E+00	0.00E+00	0.00E+00	4.46E-05	5.68E-04	7.08E-04	6.59E-04	4.87E-04	3.33E-04	2.21E-04
58	0.00E+00	0.00E+00	8.13E-07	3.85E-04	4.86E-04	4.03E-04	2.82E-04	1.87E-04	1.21E-04	7.74E-05
59	0.00E+00	0.00E+00	0.00E+00	9.03E-06	1.11E-03	2.32E-03	2.24E-03	1.61E-03	1.05E-03	6.61E-04
60	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.60E-06	2.59E-04	7.95E-04	9.55E-04	7.97E-04	5.70E-04
61	0.00E+00	0.00E+00	0.00E+00	6.32E-06	1.22E-03	2.37E-03	1.92E-03	1.07E-03	5.15E-04	2.36E-04
62	0.00E+00	0.00E+00	4.61E-10	1.26E-04	4.66E-04	5.62E-04	4.42E-04	2.94E-04	1.84E-04	1.12E-04
63	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.68E-10	2.18E-07	5.03E-06	1.65E-05	2.05E-05	1.49E-05
64	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.01E-11	4.56E-08	1.81E-06	1.18E-05	2.88E-05
65	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.55E-12	3.06E-08	1.94E-06	2.14E-05	8.23E-05
66	0.00E+00	0.00E+00	0.00E+00	8.71E-10	2.54E-06	4.52E-06	4.20E-06	3.00E-06	1.88E-06	1.13E-06
67	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.48E-05	2.05E-03	3.95E-03	4.13E-03	3.47E-03
68	0.00E+00	0.00E+00	3.60E-05	1.11E-04	1.07E-04	6.74E-05	3.76E-05	2.02E-05	1.06E-05	5.56E-06
69	0.00E+00	0.00E+00	0.00E+00	3.31E-06	2.38E-04	3.45E-04	3.67E-04	3.05E-04	2.28E-04	1.64E-04
70	0.00E+00	0.00E+00	0.00E+00	2.70E-05	9.05E-04	1.41E-03	1.07E-03	6.11E-04	3.22E-04	1.64E-04
71	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.73E-09	8.42E-07	7.85E-06	2.38E-05	3.77E-05
72	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E-11	1.04E-05	2.20E-04	2.95E-04	2.14E-04	1.40E-04
73	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.06E-12
74	0.00E+00	0.00E+00	1.61E-06	1.15E-04	7.45E-05	3.26E-05	1.26E-05	4.63E-06	1.67E-06	5.99E-07
75	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.57E-06	3.31E-04	9.05E-04	9.90E-04	7.27E-04	4.47E-04
76	0.00E+00	0.00E+00	3.52E-04	5.51E-04	4.58E-04	2.95E-04	1.78E-04	1.05E-04	6.08E-05	3.51E-05
77	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.33E-08	1.30E-05	2.04E-05	1.24E-05	6.86E-06	3.40E-06
78	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.29E-12
79	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.14E-10	4.92E-06	3.87E-04	3.40E-03	9.10E-03	1.22E-02
80	0.00E+00	0.00E+00	1.63E-04	4.61E-04	4.38E-04	2.89E-04	1.74E-04	1.01E-04	5.73E-05	3.25E-05
81	0.00E+00	0.00E+00	7.95E-07	1.44E-04	1.51E-04	8.20E-05	3.51E-05	1.41E-05	5.48E-06	2.11E-06
82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.72E-09	5.03E-05	1.45E-03	2.66E-03	1.60E-03	6.60E-04
83	0.00E+00	0.00E+00	2.35E-06	7.86E-04	8.64E-04	5.40E-04	2.62E-04	1.19E-04	5.24E-05	2.28E-05
84	0.00E+00	0.00E+00	1.32E-04	3.70E-03	5.17E-03	4.13E-03	2.77E-03	1.76E-03	1.10E-03	6.79E-04
85	0.00E+00	0.00E+00	0.00E+00	9.41E-07	2.42E-04	4.07E-04	4.17E-04	3.23E-04	2.20E-04	1.43E-04
86	0.00E+00	0.00E+00	1.33E-05	2.12E-04	1.56E-04	7.65E-05	3.21E-05	1.29E-05	5.07E-06	1.98E-06
87	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.17E-11	1.36E-08	3.78E-07	2.20E-06
88	0.00E+00	0.00E+00	1.15E-10	3.77E-04	6.45E-04	6.55E-04	4.84E-04	3.15E-04	1.97E-04	1.20E-04
89	0.00E+00	0.00E+00	2.82E-06	1.29E-04	8.02E-05	3.26E-05	1.19E-05	4.16E-06	1.44E-06	4.93E-07
90	0.00E+00	0.00E+00	0.00E+00	1.54E-08	2.59E-05	5.58E-05	4.55E-05	2.72E-05	1.44E-05	7.31E-06
91	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.81E-09	3.90E-07	2.05E-06
92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.89E-08	2.42E-05	1.61E-04	2.46E-04	2.26E-04	1.68E-04
93	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.49E-06	2.35E-04	1.21E-03	1.84E-03	1.57E-03	1.03E-03
94	0.00E+00	0.00E+00	0.00E+00	4.03E-06	4.86E-05	6.41E-05	5.57E-05	3.86E-05	2.49E-05	1.55E-05
95	0.00E+00	0.00E+00	0.00E+00	2.63E-08	2.76E-05	3.29E-05	2.60E-05	1.64E-05	9.51E-06	5.37E-06
96	0.00E+00	0.00E+00	0.00E+00	3.89E-07	2.75E-04	7.47E-04	8.30E-04	6.65E-04	4.76E-04	3.29E-04
97	0.00E+00	0.00E+00	9.92E-05	5.39E-04	6.50E-04	4.93E-04	3.27E-04	2.08E-04	1.29E-04	7.95E-05
98	0.00E+00	0.00E+00	0.00E+00	1.39E-07	2.80E-05	8.39E-05	8.84E-05	6.26E-05	3.81E-05	2.19E-05
99	0.00E+00	0.00E+00	0.00E+00	4.73E-05	7.73E-05	8.43E-05	7.05E-05	5.22E-05	3.73E-05	2.62E-05
100	0.00E+00	0.00E+00	0.00E+00	3.62E-05	6.66E-05	3.60E-05	1.59E-05	6.57E-06	2.64E-06	1.04E-06

Table F.4.8. Probabilistic Modeling Results for C-720 Building Area (variable degradation scenario) - Property Boundary POE (conc in mg/L) (continued)

Run	50 yrs	55 yrs	60 yrs	65 yrs	70 yrs	75 yrs	80 yrs	85 yrs	90 yrs	95 yrs
1	1.77E-06	9.73E-07	5.35E-07	2.94E-07	1.61E-07	8.85E-08	4.85E-08	2.66E-08	1.46E-08	7.99E-09
2	2.44E-06	1.18E-06	5.74E-07	2.78E-07	1.35E-07	6.53E-08	3.16E-08	1.53E-08	7.39E-09	3.55E-09
3	7.71E-06	3.60E-06	1.68E-06	7.81E-07	3.64E-07	1.69E-07	7.88E-08	3.67E-08	1.70E-08	7.92E-09
4	2.47E-04	3.96E-04	4.05E-04	2.97E-04	1.70E-04	8.12E-05	3.42E-05	1.32E-05	4.80E-06	1.69E-06
5	1.81E-05	9.43E-06	4.86E-06	2.49E-06	1.28E-06	6.51E-07	3.32E-07	1.69E-07	8.63E-08	4.39E-08
6	1.75E-06	1.21E-06	8.36E-07	5.76E-07	3.96E-07	2.72E-07	1.87E-07	1.28E-07	8.79E-08	6.03E-08
7	1.11E-07	4.83E-08	2.08E-08	8.88E-09	3.79E-09	1.61E-09	6.84E-10	2.89E-10	1.22E-10	5.11E-11
8	2.07E-05	1.30E-05	8.15E-06	5.10E-06	3.20E-06	2.00E-06	1.25E-06	7.85E-07	4.91E-07	3.08E-07
9	3.68E-05	2.64E-05	1.89E-05	1.34E-05	9.51E-06	6.74E-06	4.77E-06	3.38E-06	2.39E-06	1.69E-06
10	9.81E-05	5.28E-05	2.66E-05	1.31E-05	6.43E-06	3.14E-06	1.53E-06	7.44E-07	3.62E-07	1.76E-07
11	7.12E-06	4.30E-06	2.49E-06	1.42E-06	8.11E-07	4.62E-07	2.63E-07	1.49E-07	8.50E-08	4.83E-08
12	5.93E-06	3.77E-06	2.38E-06	1.50E-06	9.47E-07	5.97E-07	3.76E-07	2.37E-07	1.49E-07	9.40E-08
13	3.26E-05	2.32E-05	1.64E-05	1.16E-05	8.18E-06	5.77E-06	4.06E-06	2.86E-06	2.01E-06	1.42E-06
14	1.19E-04	6.90E-05	3.97E-05	2.28E-05	1.30E-05	7.44E-06	4.25E-06	2.42E-06	1.38E-06	7.88E-07
15	3.08E-04	2.13E-04	1.43E-04	9.49E-05	6.25E-05	4.09E-05	2.67E-05	1.74E-05	1.14E-05	7.40E-06
16	4.74E-05	2.31E-05	1.12E-05	5.42E-06	2.63E-06	1.27E-06	6.15E-07	2.98E-07	1.44E-07	6.97E-08
17	1.80E-05	8.53E-06	4.02E-06	1.89E-06	8.91E-07	4.19E-07	1.97E-07	9.28E-08	4.37E-08	2.05E-08
18	1.37E-05	8.67E-06	5.49E-06	3.48E-06	2.20E-06	1.39E-06	8.83E-07	5.59E-07	3.54E-07	2.24E-07
19	7.27E-06	4.76E-06	3.11E-06	2.02E-06	1.32E-06	8.56E-07	5.56E-07	3.61E-07	2.35E-07	1.53E-07
20	3.79E-06	1.66E-06	7.22E-07	3.12E-07	1.35E-07	5.81E-08	2.50E-08	1.08E-08	4.63E-09	1.99E-09
21	6.90E-06	3.21E-06	1.43E-06	6.26E-07	2.71E-07	1.17E-07	5.01E-08	2.15E-08	9.20E-09	3.94E-09
22	4.22E-04	2.53E-04	1.49E-04	8.66E-05	5.01E-05	2.89E-05	1.67E-05	9.63E-06	5.55E-06	3.20E-06
23	1.43E-04	9.20E-05	5.91E-05	3.79E-05	2.43E-05	1.56E-05	1.00E-05	6.43E-06	4.12E-06	2.65E-06
24	1.24E-04	7.59E-05	4.25E-05	2.29E-05	1.21E-05	6.37E-06	3.33E-06	1.74E-06	9.11E-07	4.76E-07
25	1.19E-06	7.60E-07	4.85E-07	3.10E-07	1.98E-07	1.26E-07	8.05E-08	5.13E-08	3.28E-08	2.09E-08
26	1.94E-04	1.10E-04	6.25E-05	3.53E-05	2.00E-05	1.13E-05	6.37E-06	3.59E-06	2.03E-06	1.15E-06
27	9.74E-07	5.06E-07	2.62E-07	1.35E-07	6.96E-08	3.58E-08	1.84E-08	9.48E-09	4.87E-09	2.50E-09
28	1.26E-07	4.77E-08	1.81E-08	6.86E-09	2.59E-09	9.73E-10	3.62E-10	1.35E-10	5.04E-11	2.07E-11
29	5.02E-05	2.03E-05	7.28E-06	2.45E-06	8.05E-07	2.61E-07	8.41E-08	2.70E-08	8.62E-09	2.73E-09
30	7.98E-06	4.79E-06	2.87E-06	1.72E-06	1.03E-06	6.19E-07	3.71E-07	2.23E-07	1.34E-07	8.01E-08
31	9.69E-06	5.40E-06	3.01E-06	1.68E-06	9.33E-07	5.19E-07	2.89E-07	1.61E-07	8.96E-08	4.98E-08
32	1.79E-04	8.73E-05	4.17E-05	1.98E-05	9.33E-06	4.39E-06	2.07E-06	9.71E-07	4.56E-07	2.14E-07
33	1.34E-04	6.26E-05	2.76E-05	1.19E-05	5.07E-06	2.15E-06	9.10E-07	3.85E-07	1.62E-07	6.86E-08
34	7.46E-05	3.74E-05	1.87E-05	9.31E-06	4.64E-06	2.31E-06	1.15E-06	5.74E-07	2.86E-07	1.43E-07
35	8.16E-05	5.23E-05	3.35E-05	2.14E-05	1.37E-05	8.75E-06	5.59E-06	3.57E-06	2.28E-06	1.46E-06
36	8.00E-05	5.76E-05	4.13E-05	2.95E-05	2.11E-05	1.50E-05	1.07E-05	7.65E-06	5.46E-06	3.89E-06
37	2.05E-05	9.79E-06	4.68E-06	2.24E-06	1.07E-06	5.12E-07	2.45E-07	1.17E-07	5.59E-08	2.67E-08
38	3.24E-07	1.12E-07	3.88E-08	1.34E-08	4.62E-09	1.58E-09	5.37E-10	1.80E-10	6.10E-11	2.16E-11
39	4.14E-04	3.25E-04	2.24E-04	1.45E-04	9.13E-05	5.68E-05	3.51E-05	2.16E-05	1.33E-05	8.18E-06
40	4.01E-05	2.44E-05	1.48E-05	8.96E-06	5.42E-06	3.28E-06	1.98E-06	1.20E-06	7.23E-07	4.37E-07
41	4.56E-05	2.45E-05	1.30E-05	6.92E-06	3.67E-06	1.94E-06	1.03E-06	5.46E-07	2.90E-07	1.53E-07
42	1.68E-05	1.08E-05	6.94E-06	4.44E-06	2.84E-06	1.82E-06	1.16E-06	7.41E-07	4.74E-07	3.02E-07
43	3.33E-05	1.81E-05	9.85E-06	5.34E-06	2.89E-06	1.57E-06	8.49E-07	4.60E-07	2.49E-07	1.35E-07
44	4.27E-07	1.48E-07	5.10E-08	1.76E-08	6.06E-09	2.08E-09	7.01E-10	2.35E-10	7.97E-11	2.94E-11
45	4.15E-05	4.98E-05	4.54E-05	3.50E-05	2.47E-05	1.67E-05	1.11E-05	7.28E-06	4.76E-06	3.11E-06
46	1.41E-06	7.68E-07	4.17E-07	2.26E-07	1.22E-07	6.63E-08	3.59E-08	1.94E-08	1.05E-08	5.67E-09
47	2.89E-06	1.46E-06	7.11E-07	3.41E-07	1.62E-07	7.69E-08	3.64E-08	1.72E-08	8.14E-09	3.85E-09
48	2.75E-05	1.50E-05	8.12E-06	4.38E-06	2.36E-06	1.27E-06	6.85E-07	3.69E-07	1.98E-07	1.07E-07
49	1.05E-06	2.12E-06	2.74E-06	2.59E-06	1.97E-06	1.30E-06	7.82E-07	4.47E-07	2.49E-07	1.36E-07
50	5.98E-07	2.29E-07	8.78E-08	3.36E-08	1.28E-08	4.90E-09	1.86E-09	7.01E-10	2.61E-10	9.69E-11

Table F.4.8. Probabilistic Modeling Results for C-720 Building Area (variable degradation scenario) - Property Boundary POE (conc in mg/L) (continued)

Run	50 yrs	55 yrs	60 yrs	65 yrs	70 yrs	75 yrs	80 yrs	85 yrs	90 yrs	95 yrs
51	4.72E-06	2.61E-06	1.41E-06	7.52E-07	4.00E-07	2.12E-07	1.12E-07	5.95E-08	3.15E-08	1.67E-08
52	1.70E-06	6.33E-07	2.36E-07	8.78E-08	3.27E-08	1.21E-08	4.46E-09	1.62E-09	5.84E-10	2.16E-10
53	1.32E-04	9.45E-05	5.86E-05	3.38E-05	1.88E-05	1.03E-05	5.62E-06	3.05E-06	1.65E-06	8.93E-07
54	1.09E-05	6.71E-06	4.14E-06	2.55E-06	1.57E-06	9.66E-07	5.94E-07	3.66E-07	2.25E-07	1.39E-07
55	5.92E-07	2.97E-07	1.49E-07	7.41E-08	3.69E-08	1.84E-08	9.14E-09	4.55E-09	2.26E-09	1.12E-09
56	3.27E-06	1.38E-06	5.74E-07	2.39E-07	9.90E-08	4.10E-08	1.69E-08	7.00E-09	2.88E-09	1.18E-09
57	1.45E-04	9.40E-05	6.07E-05	3.91E-05	2.52E-05	1.62E-05	1.04E-05	6.69E-06	4.30E-06	2.76E-06
58	4.93E-05	3.13E-05	1.99E-05	1.26E-05	7.99E-06	5.06E-06	3.21E-06	2.03E-06	1.29E-06	8.17E-07
59	4.11E-04	2.54E-04	1.56E-04	9.60E-05	5.89E-05	3.62E-05	2.22E-05	1.36E-05	8.36E-06	5.13E-06
60	3.84E-04	2.53E-04	1.65E-04	1.07E-04	6.93E-05	4.48E-05	2.89E-05	1.87E-05	1.21E-05	7.79E-06
61	1.06E-04	4.71E-05	2.08E-05	9.18E-06	4.04E-06	1.78E-06	7.81E-07	3.43E-07	1.51E-07	6.63E-08
62	6.79E-05	4.07E-05	2.43E-05	1.45E-05	8.64E-06	5.15E-06	3.06E-06	1.82E-06	1.08E-06	6.46E-07
63	7.85E-06	3.41E-06	1.34E-06	5.02E-07	1.85E-07	6.74E-08	2.45E-08	8.88E-09	3.22E-09	1.16E-09
64	3.97E-05	3.86E-05	3.00E-05	2.06E-05	1.32E-05	8.23E-06	5.06E-06	3.08E-06	1.87E-06	1.14E-06
65	1.61E-04	1.99E-04	1.80E-04	1.32E-04	8.59E-05	5.22E-05	3.07E-05	1.77E-05	1.02E-05	5.80E-06
66	6.68E-07	3.91E-07	2.27E-07	1.32E-07	7.66E-08	4.44E-08	2.58E-08	1.49E-08	8.65E-09	5.01E-09
67	2.65E-03	1.96E-03	1.44E-03	1.05E-03	7.58E-04	5.49E-04	3.97E-04	2.88E-04	2.08E-04	1.50E-04
68	2.89E-06	1.50E-06	7.81E-07	4.06E-07	2.11E-07	1.09E-07	5.67E-08	2.94E-08	1.52E-08	7.89E-09
69	1.16E-04	8.07E-05	5.60E-05	3.88E-05	2.68E-05	1.85E-05	1.28E-05	8.80E-06	6.06E-06	4.18E-06
70	8.30E-05	4.17E-05	2.09E-05	1.04E-05	5.22E-06	2.61E-06	1.30E-06	6.51E-07	3.25E-07	1.62E-07
71	3.91E-05	3.09E-05	2.11E-05	1.35E-05	8.36E-06	5.11E-06	3.11E-06	1.88E-06	1.14E-06	6.89E-07
72	8.96E-05	5.67E-05	3.57E-05	2.24E-05	1.41E-05	8.83E-06	5.54E-06	3.48E-06	2.18E-06	1.37E-06
73	3.79E-10	1.05E-08	6.60E-08	1.61E-07	2.15E-07	1.92E-07	1.34E-07	7.97E-08	4.35E-08	2.27E-08
74	2.13E-07	7.58E-08	2.69E-08	9.54E-09	3.37E-09	1.18E-09	4.11E-10	1.43E-10	4.95E-11	2.23E-11
75	2.58E-04	1.45E-04	8.08E-05	4.48E-05	2.47E-05	1.37E-05	7.54E-06	4.16E-06	2.29E-06	1.26E-06
76	2.03E-05	1.17E-05	6.72E-06	3.87E-06	2.23E-06	1.28E-06	7.37E-07	4.24E-07	2.44E-07	1.40E-07
77	1.59E-06	7.17E-07	3.19E-07	1.40E-07	6.11E-08	2.66E-08	1.15E-08	4.96E-09	2.13E-09	9.18E-10
78	1.88E-10	4.11E-09	3.62E-08	1.66E-07	4.68E-07	9.13E-07	1.34E-06	1.57E-06	1.53E-06	1.30E-06
79	1.08E-02	7.66E-03	4.86E-03	2.94E-03	1.74E-03	1.02E-03	6.00E-04	3.51E-04	2.05E-04	1.20E-04
80	1.84E-05	1.03E-05	5.83E-06	3.28E-06	1.85E-06	1.04E-06	5.86E-07	3.30E-07	1.86E-07	1.05E-07
81	8.09E-07	3.09E-07	1.18E-07	4.50E-08	1.71E-08	6.51E-09	2.46E-09	9.23E-10	3.46E-10	1.31E-10
82	2.45E-04	8.84E-05	3.14E-05	1.11E-05	3.93E-06	1.39E-06	4.89E-07	1.73E-07	6.08E-08	2.14E-08
83	9.89E-06	4.27E-06	1.84E-06	7.93E-07	3.42E-07	1.47E-07	6.34E-08	2.73E-08	1.17E-08	5.04E-09
84	4.18E-04	2.56E-04	1.57E-04	9.64E-05	5.90E-05	3.62E-05	2.22E-05	1.36E-05	8.32E-06	5.09E-06
85	9.16E-05	5.78E-05	3.63E-05	2.28E-05	1.42E-05	8.89E-06	5.55E-06	3.47E-06	2.16E-06	1.35E-06
86	7.68E-07	2.97E-07	1.15E-07	4.44E-08	1.72E-08	6.62E-09	2.55E-09	9.75E-10	3.70E-10	1.41E-10
87	4.91E-06	5.98E-06	4.88E-06	3.03E-06	1.55E-06	6.90E-07	2.80E-07	1.07E-07	3.97E-08	1.44E-08
88	7.28E-05	4.38E-05	2.63E-05	1.57E-05	9.40E-06	5.62E-06	3.36E-06	2.01E-06	1.20E-06	7.17E-07
89	1.69E-07	5.77E-08	1.97E-08	6.70E-09	2.27E-09	7.55E-10	2.48E-10	8.42E-11	3.75E-11	2.89E-11
90	3.65E-06	1.81E-06	8.92E-07	4.39E-07	2.16E-07	1.06E-07	5.20E-08	2.56E-08	1.25E-08	6.15E-09
91	2.32E-06	1.58E-06	9.64E-07	5.78E-07	3.45E-07	2.05E-07	1.22E-07	7.24E-08	4.30E-08	2.55E-08
92	1.15E-04	7.62E-05	4.99E-05	3.24E-05	2.10E-05	1.36E-05	8.80E-06	5.69E-06	3.68E-06	2.38E-06
93	6.16E-04	3.53E-04	2.00E-04	1.13E-04	6.31E-05	3.54E-05	1.98E-05	1.11E-05	6.22E-06	3.48E-06
94	9.53E-06	5.81E-06	3.52E-06	2.13E-06	1.29E-06	7.79E-07	4.71E-07	2.84E-07	1.72E-07	1.04E-07
95	2.99E-06	1.65E-06	9.11E-07	5.01E-07	2.75E-07	1.51E-07	8.27E-08	4.54E-08	2.49E-08	1.36E-08
96	2.23E-04	1.50E-04	1.01E-04	6.77E-05	4.54E-05	3.04E-05	2.03E-05	1.36E-05	9.11E-06	6.09E-06
97	4.88E-05	2.99E-05	1.83E-05	1.11E-05	6.81E-06	4.16E-06	2.54E-06	1.55E-06	9.47E-07	5.78E-07
98	1.22E-05	6.79E-06	3.74E-06	2.06E-06	1.13E-06	6.19E-07	3.39E-07	1.86E-07	1.02E-07	5.59E-08
99	1.83E-05	1.27E-05	8.81E-06	6.09E-06	4.21E-06	2.91E-06	2.01E-06	1.39E-06	9.62E-07	6.65E-07
100	4.11E-07	1.61E-07	6.31E-08	2.47E-08	9.65E-09	3.76E-09	1.46E-09	5.63E-10	2.16E-10	8.37E-11

Table F.4.9. Probabilistic Modeling Results for C-720 Building Area (variable degradation scenario) - Ohio River POE (conc in mg/L)

Run	0 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	30 yrs	35 yrs	40 yrs	45 yrs
1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.68E-08	2.26E-07	2.06E-07
2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.17E-13	5.15E-10
3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.66E-16
7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
8	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.06E-14
9	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
13	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
14	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
16	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
17	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.73E-12	4.56E-09	6.53E-08
19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
21	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
23	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.36E-07	4.35E-06
24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
27	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.30E-10	7.06E-08	7.82E-08
28	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
29	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
30	0.00E+00	0.00E+00	0.00E+00	2.47E-06	1.47E-05	1.36E-05	9.38E-06	5.96E-06	3.66E-06	2.22E-06
31	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.26E-11	1.76E-07	9.97E-07	1.07E-06
32	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
33	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
34	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
35	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.58E-11	2.30E-08
36	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.07E-11	7.03E-08
37	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.57E-08	3.93E-06	1.45E-05
38	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
39	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.64E-12	2.19E-08
41	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
42	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.16E-11	8.03E-08
43	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.67E-13	1.65E-09
44	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.01E-08	2.17E-06	3.18E-06	1.94E-06	8.06E-07
45	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
46	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.80E-11	6.85E-09
47	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
48	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
49	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table F.4.9. Probabilistic Modeling Results for C-720 Building Area (variable degradation scenario) - Ohio River POE (conc in mg/L) (continued)

Run	0 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	30 yrs	35 yrs	40 yrs	45 yrs
51	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
52	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.29E-10
53	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
54	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.22E-10
55	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
56	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.00E-13	4.82E-09
58	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.54E-11	7.64E-08	8.43E-07
59	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
60	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
61	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
62	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
63	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
64	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
65	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
66	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
67	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
68	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.26E-10	5.38E-07	1.20E-06	1.11E-06	7.01E-07
69	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.27E-14
70	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
71	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
72	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
73	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
74	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.93E-10	2.78E-08
75	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
76	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.78E-09	5.45E-06	9.75E-06	8.53E-06	5.58E-06	3.38E-06
77	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
78	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
79	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
80	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.98E-07	6.97E-06	1.05E-05	8.60E-06
81	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.64E-13	3.61E-10
82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
83	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.46E-12	2.85E-08	4.66E-07
84	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.67E-09	3.89E-06	2.54E-05
85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
86	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.63E-12	2.71E-07	1.01E-06	7.57E-07	3.80E-07
87	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.77E-13	2.89E-08	1.59E-06
89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.04E-11
90	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
91	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
93	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
94	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
95	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
96	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.32E-09	2.00E-06	9.59E-06	1.24E-05
98	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
99	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.85E-09	1.55E-06	2.40E-06	2.52E-06
100	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table F.4.9. Probabilistic Modeling Results for C-720 Building Area (variable degradation scenario) - Ohio River POE (conc in mg/L) (continued)

Run	50 yrs	55 yrs	60 yrs	65 yrs	70 yrs	75 yrs	80 yrs	85 yrs	90 yrs	95 yrs
1	1.48E-07	8.88E-08	5.08E-08	2.84E-08	1.58E-08	8.69E-09	4.78E-09	2.62E-09	1.44E-09	7.90E-10
2	1.46E-08	3.51E-08	3.10E-08	1.89E-08	1.01E-08	5.08E-09	2.51E-09	1.23E-09	5.96E-10	2.89E-10
3	0.00E+00	1.80E-12	1.86E-10	2.17E-09	6.06E-09	7.10E-09	5.07E-09	2.80E-09	1.40E-09	6.70E-10
4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	0.00E+00	0.00E+00	0.00E+00	6.08E-13	5.47E-11	7.96E-10	3.12E-09	5.15E-09	5.16E-09	3.89E-09
6	2.74E-12	1.48E-10	5.48E-10	7.21E-10	7.25E-10	6.04E-10	4.50E-10	3.22E-10	2.26E-10	1.57E-10
7	0.00E+00	0.00E+00	0.00E+00	2.34E-15	9.23E-13	1.78E-11	4.63E-11	3.95E-11	2.18E-11	1.03E-11
8	4.27E-11	1.42E-09	5.54E-09	7.89E-09	7.09E-09	5.10E-09	3.38E-09	2.18E-09	1.38E-09	8.69E-10
9	0.00E+00	0.00E+00	0.00E+00	6.67E-14	5.73E-12	6.61E-11	1.99E-10	2.83E-10	2.85E-10	2.39E-10
10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.37E-15	1.44E-13	1.38E-12	4.49E-12	7.25E-12	7.57E-12
13	0.00E+00	1.80E-14	1.32E-10	1.15E-08	7.31E-08	1.14E-07	1.10E-07	8.81E-08	6.51E-08	4.69E-08
14	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.55E-13	2.29E-11	5.81E-10	5.63E-09
15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.39E-13
16	0.00E+00	0.00E+00	0.00E+00	8.48E-12	8.70E-10	1.64E-08	8.89E-08	2.00E-07	2.52E-07	2.14E-07
17	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.75E-12	2.41E-10	3.32E-09	8.82E-09	8.18E-09	4.60E-09
18	1.08E-07	9.85E-08	7.11E-08	4.75E-08	3.08E-08	1.97E-08	1.25E-08	7.95E-09	5.04E-09	3.19E-09
19	3.20E-13	3.35E-10	1.16E-08	4.70E-08	6.37E-08	5.70E-08	4.27E-08	2.96E-08	1.99E-08	1.31E-08
20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.91E-16
21	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
23	4.57E-06	3.20E-06	2.13E-06	1.39E-06	9.01E-07	5.81E-07	3.73E-07	2.40E-07	1.54E-07	9.87E-08
24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	5.51E-15	9.16E-12	2.91E-10	8.12E-10	7.17E-10	4.81E-10	3.11E-10	2.00E-10	1.28E-10	8.19E-11
26	0.00E+00	0.00E+00	8.01E-15	1.43E-11	8.17E-10	8.58E-09	2.76E-08	4.14E-08	3.93E-08	2.85E-08
27	5.40E-08	3.21E-08	1.77E-08	9.52E-09	5.02E-09	2.62E-09	1.36E-09	7.04E-10	3.63E-10	1.87E-10
28	0.00E+00	0.00E+00	0.00E+00	5.11E-17	3.61E-13	2.12E-11	2.13E-10	5.61E-10	5.66E-10	3.16E-10
29	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
30	1.34E-06	8.05E-07	4.83E-07	2.90E-07	1.74E-07	1.04E-07	6.25E-08	3.75E-08	2.25E-08	1.35E-08
31	7.53E-07	4.57E-07	2.64E-07	1.50E-07	8.40E-08	4.69E-08	2.62E-08	1.46E-08	8.12E-09	4.52E-09
32	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
33	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
34	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.05E-13	5.78E-12	7.32E-11	3.09E-10	5.83E-10	6.26E-10
35	3.86E-07	8.17E-07	8.83E-07	6.97E-07	4.82E-07	3.19E-07	2.07E-07	1.33E-07	8.56E-08	5.48E-08
36	7.47E-07	9.93E-07	9.88E-07	8.16E-07	6.16E-07	4.52E-07	3.27E-07	2.35E-07	1.69E-07	1.21E-07
37	1.42E-05	8.53E-06	4.40E-06	2.17E-06	1.05E-06	5.04E-07	2.42E-07	1.16E-07	5.53E-08	2.65E-08
38	0.00E+00	0.00E+00	0.00E+00	6.08E-15	3.98E-13	4.63E-12	1.50E-11	1.97E-11	1.41E-11	7.01E-12
39	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	3.44E-07	5.47E-07	5.01E-07	3.64E-07	2.37E-07	1.49E-07	9.16E-08	5.60E-08	3.40E-08	2.06E-08
41	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.11E-14	2.87E-12	7.38E-11
42	4.13E-07	4.56E-07	3.85E-07	2.72E-07	1.82E-07	1.19E-07	7.66E-08	4.92E-08	3.16E-08	2.02E-08
43	9.44E-08	4.40E-07	6.41E-07	5.43E-07	3.52E-07	2.06E-07	1.16E-07	6.40E-08	3.50E-08	1.90E-08
44	2.99E-07	1.07E-07	3.73E-08	1.30E-08	4.49E-09	1.55E-09	5.35E-10	1.85E-10	6.36E-11	2.18E-11
45	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
46	1.87E-08	1.74E-08	1.25E-08	7.67E-09	4.42E-09	2.47E-09	1.36E-09	7.45E-10	4.05E-10	2.20E-10
47	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
48	0.00E+00	0.00E+00	0.00E+00	1.24E-14	2.81E-12	9.44E-11	8.12E-10	2.61E-09	4.28E-09	4.47E-09
49	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	0.00E+00	6.58E-15	2.49E-12	7.78E-11	4.25E-10	7.29E-10	6.09E-10	3.35E-10	1.48E-10	6.01E-11

Table F.4.9. Probabilistic Modeling Results for C-720 Building Area (variable degradation scenario) - Ohio River POE (conc in mg/L) (continued)

Run	50 yrs	55 yrs	60 yrs	65 yrs	70 yrs	75 yrs	80 yrs	85 yrs	90 yrs	95 yrs
51	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
52	3.95E-08	2.84E-07	4.42E-07	3.15E-07	1.51E-07	6.15E-08	2.38E-08	8.99E-09	3.37E-09	1.26E-09
53	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
54	1.89E-07	4.87E-07	3.60E-07	2.34E-07	1.48E-07	9.21E-08	5.70E-08	3.52E-08	2.17E-08	1.34E-08
55	0.00E+00	8.51E-15	6.17E-12	1.45E-10	3.86E-10	3.61E-10	2.34E-10	1.30E-10	6.74E-11	3.42E-11
56	0.00E+00	0.00E+00	1.23E-14	3.14E-12	8.73E-11	5.21E-10	1.12E-09	1.28E-09	9.84E-10	5.76E-10
57	2.66E-07	8.33E-07	1.04E-06	9.49E-07	7.12E-07	4.89E-07	3.25E-07	2.13E-07	1.38E-07	8.94E-08
58	1.27E-06	1.14E-06	8.18E-07	5.48E-07	3.57E-07	2.29E-07	1.46E-07	9.28E-08	5.89E-08	3.74E-08
59	0.00E+00	0.00E+00	0.00E+00	6.98E-11	1.08E-08	2.76E-07	1.86E-06	4.81E-06	6.59E-06	6.09E-06
60	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.88E-12
61	0.00E+00	0.00E+00	0.00E+00	9.26E-11	1.11E-08	2.22E-07	1.17E-06	2.39E-06	2.58E-06	1.86E-06
62	2.11E-10	5.53E-08	1.01E-06	3.54E-06	5.18E-06	4.81E-06	3.48E-06	2.26E-06	1.40E-06	8.54E-07
63	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
64	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
65	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
66	0.00E+00	0.00E+00	1.90E-15	2.46E-13	3.41E-12	1.05E-11	1.38E-11	1.21E-11	8.61E-12	5.46E-12
67	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.83E-12	1.70E-09	6.69E-08	7.59E-07
68	3.91E-07	2.10E-07	1.11E-07	5.78E-08	3.01E-08	1.56E-08	8.12E-09	4.21E-09	2.19E-09	1.14E-09
69	2.00E-10	1.27E-08	6.00E-08	9.31E-08	9.93E-08	8.51E-08	6.46E-08	4.67E-08	3.30E-08	2.31E-08
70	0.00E+00	0.00E+00	1.31E-12	6.60E-10	3.17E-08	3.09E-07	9.62E-07	1.38E-06	1.19E-06	7.66E-07
71	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
72	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.85E-12	2.91E-10
73	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
74	1.06E-07	8.23E-08	3.90E-08	1.55E-08	5.75E-09	2.09E-09	7.49E-10	2.67E-10	9.50E-11	3.37E-11
75	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.42E-12	5.74E-11
76	1.99E-06	1.16E-06	6.71E-07	3.87E-07	2.23E-07	1.28E-07	7.39E-08	4.25E-08	2.45E-08	1.41E-08
77	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.11E-13	5.99E-11	1.63E-09	1.00E-08	2.06E-08	2.04E-08
78	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
79	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
80	5.48E-06	3.25E-06	1.87E-06	1.07E-06	6.03E-07	3.41E-07	1.92E-07	1.08E-07	6.09E-08	3.43E-08
81	7.45E-09	1.60E-08	1.27E-08	6.44E-09	2.73E-09	1.09E-09	4.23E-10	1.63E-10	6.24E-11	2.38E-11
82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
83	7.35E-07	5.49E-07	2.91E-07	1.35E-07	6.04E-08	2.65E-08	1.15E-08	4.97E-09	2.14E-09	9.24E-10
84	3.77E-05	3.23E-05	2.22E-05	1.42E-05	8.91E-06	5.51E-06	3.39E-06	2.08E-06	1.28E-06	7.82E-07
85	0.00E+00	2.69E-13	2.46E-10	1.18E-08	8.24E-08	1.78E-07	2.11E-07	1.85E-07	1.36E-07	9.13E-08
86	1.61E-07	6.47E-08	2.55E-08	9.94E-09	3.86E-09	1.49E-09	5.78E-10	2.23E-10	8.63E-11	3.33E-11
87	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
88	4.34E-06	5.03E-06	4.14E-06	2.81E-06	1.78E-06	1.10E-06	6.66E-07	4.02E-07	2.41E-07	1.45E-07
89	1.74E-09	1.37E-08	1.76E-08	9.58E-09	3.85E-09	1.40E-09	4.89E-10	1.69E-10	5.78E-11	1.98E-11
90	0.00E+00	0.00E+00	0.00E+00	1.12E-13	1.10E-11	1.65E-10	6.38E-10	9.88E-10	8.83E-10	5.81E-10
91	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.55E-15
93	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
94	0.00E+00	4.75E-14	1.03E-11	1.97E-10	7.53E-10	1.16E-09	1.14E-09	8.62E-10	5.77E-10	3.66E-10
95	7.46E-15	9.01E-12	3.23E-10	1.21E-09	1.46E-09	1.15E-09	7.37E-10	4.32E-10	2.45E-10	1.37E-10
96	0.00E+00	0.00E+00	0.00E+00	2.70E-11	4.00E-09	9.45E-08	5.79E-07	1.39E-06	1.85E-06	1.74E-06
97	1.00E-05	6.76E-06	4.31E-06	2.69E-06	1.66E-06	1.02E-06	6.24E-07	3.81E-07	2.33E-07	1.42E-07
98	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.14E-17	1.12E-14	2.84E-13	2.39E-12	8.51E-12
99	2.06E-06	1.51E-06	1.08E-06	7.58E-07	5.28E-07	3.67E-07	2.54E-07	1.76E-07	1.22E-07	8.41E-08
100	2.30E-13	5.50E-11	7.21E-10	1.44E-09	1.06E-09	5.23E-10	2.25E-10	9.20E-11	3.67E-11	1.45E-11

Table F.4.10. Probabilistic Modeling Results for SWMU 1 (fixed degradation scenario) - Plant Boundary POE (conc in mg/L)

RUN	0 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	30 yrs	35 yrs	40 yrs	45 yrs
1	0.00E+00	4.31E-02	3.33E-02	2.47E-02	1.77E-02	1.26E-02	8.86E-03	6.23E-03	4.37E-03	3.07E-03
2	0.00E+00	5.70E-02	6.72E-02	5.72E-02	4.54E-02	3.50E-02	2.67E-02	2.03E-02	1.54E-02	1.17E-02
3	0.00E+00	1.35E-02	2.21E-02	2.08E-02	1.76E-02	1.41E-02	1.10E-02	8.53E-03	6.57E-03	5.06E-03
4	0.00E+00	9.42E-03	3.06E-01	3.86E-01	3.24E-01	2.45E-01	1.79E-01	1.29E-01	9.26E-02	6.63E-02
5	0.00E+00	0.00E+00	2.20E-02	1.99E-02	1.68E-02	1.40E-02	1.17E-02	9.69E-03	8.05E-03	6.68E-03
6	0.00E+00	0.00E+00	1.96E-02	2.66E-02	2.86E-02	2.53E-02	2.14E-02	1.78E-02	1.46E-02	1.19E-02
7	0.00E+00	0.00E+00	7.77E-02	1.14E-01	1.06E-01	8.93E-02	7.37E-02	6.02E-02	4.90E-02	3.98E-02
8	0.00E+00	4.99E-02	2.55E-01	3.82E-01	3.17E-01	2.37E-01	1.71E-01	1.22E-01	8.60E-02	6.06E-02
9	0.00E+00	1.86E-01	1.62E-01	1.18E-01	8.35E-02	5.82E-02	4.03E-02	2.78E-02	1.92E-02	1.33E-02
10	0.00E+00	1.22E-04	9.57E-02	9.57E-02	7.97E-02	6.40E-02	5.07E-02	4.00E-02	3.14E-02	2.47E-02
11	0.00E+00	0.00E+00	7.28E-02	1.81E-01	1.54E-01	1.29E-01	1.09E-01	9.09E-02	7.61E-02	6.37E-02
12	0.00E+00	4.29E-02	1.33E-01	1.40E-01	1.10E-01	8.29E-02	6.13E-02	4.50E-02	3.29E-02	2.41E-02
13	0.00E+00	1.79E-02	1.96E-02	1.58E-02	1.18E-02	8.64E-03	6.24E-03	4.49E-03	3.22E-03	2.31E-03
14	0.00E+00	8.19E-02	1.22E-01	9.27E-02	6.88E-02	5.07E-02	3.72E-02	2.74E-02	2.01E-02	1.47E-02
15	0.00E+00	2.28E-02	1.19E-01	1.53E-01	1.31E-01	1.04E-01	7.98E-02	6.06E-02	4.57E-02	3.44E-02
16	0.00E+00	0.00E+00	1.22E-01	1.02E-01	8.38E-02	6.82E-02	5.53E-02	4.48E-02	3.63E-02	2.94E-02
17	0.00E+00	1.49E-02	4.86E-02	5.72E-02	4.56E-02	3.43E-02	2.53E-02	1.85E-02	1.35E-02	9.79E-03
18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.33E-06	3.19E-04	3.37E-03	1.66E-02	5.16E-02	1.19E-01
19	0.00E+00	1.50E-01	2.08E-01	1.65E-01	1.24E-01	9.22E-02	6.84E-02	5.06E-02	3.75E-02	2.77E-02
20	0.00E+00	0.00E+00	8.11E-03	2.21E-02	2.32E-02	2.10E-02	1.83E-02	1.57E-02	1.33E-02	1.12E-02
21	0.00E+00	0.00E+00	7.12E-02	1.86E-01	2.60E-01	2.37E-01	2.00E-01	1.65E-01	1.35E-01	1.11E-01
22	0.00E+00	1.01E-05	4.01E-02	4.07E-02	3.46E-02	2.83E-02	2.27E-02	1.81E-02	1.44E-02	1.14E-02
23	0.00E+00	0.00E+00	0.00E+00	6.66E-03	9.98E-03	1.21E-02	1.09E-02	9.44E-03	8.10E-03	6.92E-03
24	0.00E+00	4.94E-02	1.20E-01	9.13E-02	6.17E-02	4.05E-02	2.64E-02	1.71E-02	1.11E-02	7.22E-03
25	0.00E+00	5.38E-02	6.82E-02	5.35E-02	4.16E-02	3.22E-02	2.50E-02	1.93E-02	1.49E-02	1.16E-02
26	0.00E+00	0.00E+00	2.07E-01	1.84E-01	1.54E-01	1.26E-01	1.03E-01	8.34E-02	6.75E-02	5.46E-02
27	0.00E+00	3.18E-03	3.15E-03	2.63E-03	2.06E-03	1.57E-03	1.19E-03	8.91E-04	6.68E-04	5.00E-04
28	0.00E+00	7.64E-03	1.14E-01	8.95E-02	7.04E-02	5.56E-02	4.39E-02	3.47E-02	2.74E-02	2.17E-02
29	0.00E+00	2.56E-02	1.93E-01	2.54E-01	2.31E-01	1.83E-01	1.38E-01	1.02E-01	7.48E-02	5.44E-02
30	0.00E+00	2.49E-03	2.46E-03	2.06E-03	1.58E-03	1.17E-03	8.50E-04	6.14E-04	4.42E-04	3.17E-04
31	0.00E+00	5.22E-02	3.80E-02	2.82E-02	2.12E-02	1.60E-02	1.21E-02	9.17E-03	6.95E-03	5.27E-03
32	0.00E+00	7.07E-02	2.72E-01	2.47E-01	2.01E-01	1.56E-01	1.18E-01	8.86E-02	6.63E-02	4.96E-02
33	0.00E+00	1.57E-02	1.98E-01	1.60E-01	1.20E-01	9.05E-02	6.83E-02	5.16E-02	3.89E-02	2.94E-02
34	0.00E+00	0.00E+00	9.40E-02	8.52E-02	6.95E-02	5.73E-02	4.76E-02	3.96E-02	3.29E-02	2.74E-02
35	0.00E+00	1.59E-02	3.66E-02	5.71E-02	5.60E-02	4.64E-02	3.69E-02	2.88E-02	2.24E-02	1.73E-02
36	0.00E+00	0.00E+00	1.07E-02	1.16E-02	1.13E-02	1.01E-02	8.77E-03	7.42E-03	6.21E-03	5.15E-03
37	0.00E+00	0.00E+00	2.22E-02	3.33E-02	3.20E-02	2.73E-02	2.29E-02	1.91E-02	1.59E-02	1.31E-02
38	0.00E+00	1.52E-01	1.30E-01	9.41E-02	6.55E-02	4.49E-02	3.06E-02	2.07E-02	1.41E-02	9.53E-03
39	0.00E+00	1.11E-02	3.33E-01	3.03E-01	2.43E-01	1.89E-01	1.45E-01	1.11E-01	8.43E-02	6.41E-02
40	0.00E+00	2.43E-03	6.20E-03	6.96E-03	5.34E-03	3.81E-03	2.66E-03	1.83E-03	1.26E-03	8.63E-04
41	0.00E+00	4.07E-01	5.53E-01	3.93E-01	2.72E-01	1.88E-01	1.29E-01	8.91E-02	6.14E-02	4.23E-02
42	0.00E+00	6.52E-02	1.55E-01	1.50E-01	1.13E-01	8.15E-02	5.75E-02	4.03E-02	2.82E-02	1.97E-02
43	0.00E+00	1.35E-01	8.68E-02	5.90E-02	4.12E-02	2.91E-02	2.07E-02	1.47E-02	1.05E-02	7.47E-03
44	0.00E+00	6.21E-03	5.68E-03	4.59E-03	3.65E-03	2.88E-03	2.28E-03	1.79E-03	1.41E-03	1.11E-03
45	0.00E+00	0.00E+00	0.00E+00	4.89E-02	5.71E-02	4.87E-02	4.09E-02	3.45E-02	2.91E-02	2.46E-02
46	0.00E+00	6.96E-02	1.32E-01	1.68E-01	1.45E-01	1.14E-01	8.64E-02	6.47E-02	4.80E-02	3.55E-02
47	0.00E+00	4.60E-02	2.04E-01	2.13E-01	1.70E-01	1.27E-01	9.27E-02	6.70E-02	4.82E-02	3.47E-02
48	0.00E+00	3.44E-02	1.00E-01	1.12E-01	9.15E-02	7.04E-02	5.30E-02	3.95E-02	2.94E-02	2.18E-02
49	0.00E+00	0.00E+00	1.04E-02	4.73E-02	5.58E-02	5.08E-02	4.33E-02	3.61E-02	2.98E-02	2.44E-02
50	0.00E+00	2.33E-01	3.07E-01	2.34E-01	1.70E-01	1.21E-01	8.63E-02	6.13E-02	4.35E-02	3.08E-02

Table F.4.10. Probabilistic Modeling Results for SWMU 1 (fixed degradation scenario) - Plant Boundary POE (conc in mg/L)

(continued)

RUN	0 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	30 yrs	35 yrs	40 yrs	45 yrs
51	0.00E+00	0.00E+00	6.78E-02	8.28E-02	6.75E-02	5.57E-02	4.62E-02	3.85E-02	3.21E-02	2.67E-02
52	0.00E+00	9.98E-02	1.53E-01	1.18E-01	8.07E-02	5.33E-02	3.48E-02	2.26E-02	1.47E-02	9.52E-03
53	0.00E+00	4.00E-03	6.85E-02	1.43E-01	1.41E-01	1.10E-01	8.03E-02	5.74E-02	4.06E-02	2.87E-02
54	0.00E+00	0.00E+00	1.58E-02	3.96E-02	6.00E-02	6.00E-02	5.13E-02	4.25E-02	3.47E-02	2.81E-02
55	0.00E+00	1.67E-01	1.95E-01	1.65E-01	1.30E-01	9.97E-02	7.55E-02	5.69E-02	4.28E-02	3.22E-02
56	0.00E+00	0.00E+00	3.72E-03	3.65E-03	3.09E-03	2.53E-03	2.05E-03	1.65E-03	1.32E-03	1.06E-03
57	0.00E+00	1.63E-02	5.92E-02	8.05E-02	6.70E-02	5.11E-02	3.77E-02	2.74E-02	1.98E-02	1.43E-02
58	0.00E+00	2.09E-02	1.55E-02	1.14E-02	8.46E-03	6.29E-03	4.68E-03	3.48E-03	2.59E-03	1.93E-03
59	0.00E+00	2.13E-02	2.99E-02	2.46E-02	1.85E-02	1.35E-02	9.73E-03	7.00E-03	5.03E-03	3.61E-03
60	0.00E+00	0.00E+00	0.00E+00	6.76E-02	7.15E-02	6.17E-02	5.28E-02	4.50E-02	3.84E-02	3.27E-02
61	0.00E+00	1.38E+00	1.42E+00	1.03E+00	7.23E-01	5.02E-01	3.48E-01	2.40E-01	1.66E-01	1.14E-01
62	0.00E+00	3.95E-02	3.23E-02	2.35E-02	1.72E-02	1.26E-02	9.20E-03	6.73E-03	4.93E-03	3.61E-03
63	0.00E+00	5.00E-03	9.49E-02	1.92E-01	2.17E-01	1.81E-01	1.40E-01	1.06E-01	7.94E-02	5.91E-02
64	0.00E+00	8.83E-06	7.11E-02	6.59E-02	5.04E-02	3.89E-02	3.02E-02	2.36E-02	1.85E-02	1.45E-02
65	0.00E+00	0.00E+00	0.00E+00	3.59E-02	7.42E-02	9.12E-02	8.56E-02	7.48E-02	6.41E-02	5.45E-02
66	0.00E+00	1.53E-01	1.56E-01	1.16E-01	8.69E-02	6.54E-02	4.94E-02	3.73E-02	2.82E-02	2.13E-02
67	0.00E+00	1.63E-03	1.08E-01	2.33E-01	2.79E-01	2.39E-01	1.94E-01	1.55E-01	1.23E-01	9.70E-02
68	0.00E+00	5.33E-03	5.07E-03	4.24E-03	3.34E-03	2.56E-03	1.95E-03	1.47E-03	1.11E-03	8.40E-04
69	0.00E+00	7.16E-02	7.04E-02	5.49E-02	4.17E-02	3.14E-02	2.35E-02	1.76E-02	1.31E-02	9.79E-03
70	0.00E+00	4.97E-03	1.19E-02	1.39E-02	1.15E-02	9.05E-03	6.94E-03	5.27E-03	3.98E-03	3.01E-03
71	0.00E+00	1.44E-03	1.75E-02	1.77E-02	1.44E-02	1.10E-02	8.27E-03	6.15E-03	4.56E-03	3.37E-03
72	0.00E+00	4.58E-02	5.60E-02	3.91E-02	2.66E-02	1.81E-02	1.22E-02	8.28E-03	5.61E-03	3.80E-03
73	0.00E+00	4.13E-03	8.13E-02	1.05E-01	8.74E-02	6.50E-02	4.67E-02	3.32E-02	2.34E-02	1.65E-02
74	0.00E+00	2.14E-03	7.22E-03	1.07E-02	9.56E-03	7.81E-03	6.21E-03	4.88E-03	3.82E-03	2.98E-03
75	0.00E+00	6.83E-02	7.13E-02	4.98E-02	3.51E-02	2.48E-02	1.75E-02	1.24E-02	8.78E-03	6.22E-03
76	0.00E+00	0.00E+00	3.32E-03	2.67E-03	2.15E-03	1.73E-03	1.40E-03	1.12E-03	9.07E-04	7.31E-04
77	0.00E+00	0.00E+00	3.89E-05	1.31E-02	1.29E-02	1.14E-02	9.78E-03	8.34E-03	7.08E-03	6.00E-03
78	0.00E+00	0.00E+00	3.56E-02	1.66E-01	2.68E-01	2.84E-01	2.51E-01	2.06E-01	1.65E-01	1.30E-01
79	0.00E+00	8.25E-04	2.03E-01	1.77E-01	1.36E-01	1.06E-01	8.22E-02	6.40E-02	4.98E-02	3.88E-02
80	0.00E+00	1.48E-02	5.67E-02	9.23E-02	7.99E-02	6.20E-02	4.65E-02	3.44E-02	2.53E-02	1.86E-02
81	0.00E+00	2.57E-02	2.04E-02	1.52E-02	1.11E-02	8.10E-03	5.87E-03	4.24E-03	3.07E-03	2.22E-03
82	0.00E+00	6.88E-04	4.24E-02	7.88E-02	9.03E-02	7.77E-02	6.30E-02	5.01E-02	3.93E-02	3.07E-02
83	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.10E-03	7.13E-03	6.54E-03	5.72E-03	4.95E-03	4.27E-03
84	0.00E+00	5.82E-02	6.66E-02	5.20E-02	3.83E-02	2.76E-02	1.97E-02	1.40E-02	9.96E-03	7.07E-03
85	0.00E+00	2.12E-02	5.66E-02	5.27E-02	4.38E-02	3.50E-02	2.75E-02	2.15E-02	1.67E-02	1.30E-02
86	0.00E+00	1.11E-02	2.81E-02	3.68E-02	3.40E-02	2.85E-02	2.32E-02	1.86E-02	1.49E-02	1.18E-02
87	0.00E+00	0.00E+00	1.93E-01	2.32E-01	1.91E-01	1.51E-01	1.19E-01	9.42E-02	7.42E-02	5.84E-02
88	0.00E+00	0.00E+00	0.00E+00	3.26E-03	2.81E-03	2.40E-03	2.04E-03	1.74E-03	1.48E-03	1.25E-03
89	0.00E+00	5.60E-02	4.72E-02	3.45E-02	2.49E-02	1.79E-02	1.28E-02	9.19E-03	6.59E-03	4.72E-03
90	0.00E+00	1.13E-02	2.87E-02	3.35E-02	2.75E-02	2.13E-02	1.60E-02	1.20E-02	8.90E-03	6.60E-03
91	0.00E+00	2.14E-02	7.70E-02	8.22E-02	6.26E-02	4.46E-02	3.11E-02	2.15E-02	1.48E-02	1.02E-02
92	0.00E+00	1.37E-01	7.56E-01	1.25E+00	1.03E+00	7.42E-01	5.12E-01	3.48E-01	2.35E-01	1.59E-01
93	0.00E+00	2.95E-03	1.61E-02	1.42E-02	1.12E-02	8.59E-03	6.52E-03	4.93E-03	3.72E-03	2.80E-03
94	0.00E+00	2.62E-01	2.18E-01	1.57E-01	1.15E-01	8.44E-02	6.21E-02	4.58E-02	3.38E-02	2.49E-02
95	0.00E+00	2.89E-03	4.25E-03	3.63E-03	2.92E-03	2.29E-03	1.78E-03	1.38E-03	1.07E-03	8.29E-04
96	0.00E+00	2.04E-03	1.49E-02	2.41E-02	2.27E-02	1.87E-02	1.49E-02	1.17E-02	9.17E-03	7.16E-03
97	0.00E+00	1.43E-01	1.31E-01	1.03E-01	7.96E-02	6.15E-02	4.74E-02	3.66E-02	2.82E-02	2.17E-02
98	0.00E+00	1.03E-03	6.82E-02	1.52E-01	2.02E-01	1.82E-01	1.50E-01	1.20E-01	9.55E-02	7.52E-02
99	0.00E+00	6.14E-02	1.04E-01	8.50E-02	5.84E-02	3.83E-02	2.47E-02	1.58E-02	1.01E-02	6.49E-03
100	0.00E+00	7.14E-03	2.69E-02	2.21E-02	1.78E-02	1.42E-02	1.12E-02	8.89E-03	7.03E-03	5.56E-03

Table F.4.10. Probabilistic Modeling Results for SWMU 1 (fixed degradation scenario) - Plant Boundary POE (conc in mg/L)

(continued)

RUN	50 yrs	55 yrs	60 yrs	65 yrs	70 yrs	75 yrs	80 yrs	85 yrs	90 yrs	95 yrs
1	2.15E-03	1.51E-03	1.06E-03	7.44E-04	5.22E-04	3.66E-04	2.57E-04	1.80E-04	1.27E-04	8.88E-05
2	8.82E-03	6.67E-03	5.05E-03	3.82E-03	2.89E-03	2.18E-03	1.65E-03	1.25E-03	9.46E-04	7.15E-04
3	3.88E-03	2.98E-03	2.29E-03	1.76E-03	1.35E-03	1.04E-03	7.98E-04	6.13E-04	4.71E-04	3.61E-04
4	4.74E-02	3.39E-02	2.42E-02	1.73E-02	1.24E-02	8.84E-03	6.32E-03	4.51E-03	3.23E-03	2.30E-03
5	5.55E-03	4.60E-03	3.82E-03	3.17E-03	2.63E-03	2.18E-03	1.81E-03	1.50E-03	1.25E-03	1.03E-03
6	9.76E-03	7.96E-03	6.49E-03	5.29E-03	4.32E-03	3.52E-03	2.87E-03	2.34E-03	1.90E-03	1.55E-03
7	3.23E-02	2.62E-02	2.13E-02	1.73E-02	1.40E-02	1.14E-02	9.22E-03	7.48E-03	6.07E-03	4.92E-03
8	4.27E-02	3.00E-02	2.11E-02	1.49E-02	1.04E-02	7.35E-03	5.17E-03	3.63E-03	2.56E-03	1.80E-03
9	9.16E-03	6.32E-03	4.36E-03	3.01E-03	2.08E-03	1.43E-03	9.90E-04	6.83E-04	4.71E-04	3.25E-04
10	1.94E-02	1.52E-02	1.19E-02	9.38E-03	7.36E-03	5.77E-03	4.53E-03	3.56E-03	2.79E-03	2.19E-03
11	5.33E-02	4.46E-02	3.74E-02	3.13E-02	2.62E-02	2.19E-02	1.83E-02	1.53E-02	1.29E-02	1.08E-02
12	1.76E-02	1.28E-02	9.38E-03	6.85E-03	5.00E-03	3.65E-03	2.67E-03	1.95E-03	1.42E-03	1.04E-03
13	1.66E-03	1.19E-03	8.50E-04	6.09E-04	4.37E-04	3.13E-04	2.24E-04	1.61E-04	1.15E-04	8.25E-05
14	1.08E-02	7.93E-03	5.82E-03	4.27E-03	3.14E-03	2.30E-03	1.69E-03	1.24E-03	9.09E-04	6.67E-04
15	2.59E-02	1.95E-02	1.46E-02	1.10E-02	8.25E-03	6.20E-03	4.66E-03	3.50E-03	2.63E-03	1.97E-03
16	2.38E-02	1.92E-02	1.56E-02	1.26E-02	1.02E-02	8.27E-03	6.69E-03	5.42E-03	4.38E-03	3.55E-03
17	7.12E-03	5.17E-03	3.76E-03	2.73E-03	1.98E-03	1.44E-03	1.05E-03	7.60E-04	5.52E-04	4.01E-04
18	2.24E-01	3.62E-01	5.25E-01	6.99E-01	8.72E-01	1.03E+00	1.17E+00	1.27E+00	1.35E+00	1.40E+00
19	2.05E-02	1.52E-02	1.12E-02	8.30E-03	6.14E-03	4.54E-03	3.36E-03	2.48E-03	1.84E-03	1.36E-03
20	9.38E-03	7.85E-03	6.57E-03	5.50E-03	4.60E-03	3.84E-03	3.21E-03	2.68E-03	2.24E-03	1.88E-03
21	9.06E-02	7.39E-02	6.04E-02	4.93E-02	4.02E-02	3.28E-02	2.68E-02	2.19E-02	1.79E-02	1.46E-02
22	9.05E-03	7.17E-03	5.68E-03	4.50E-03	3.57E-03	2.83E-03	2.24E-03	1.77E-03	1.41E-03	1.11E-03
23	5.90E-03	5.02E-03	4.27E-03	3.63E-03	3.09E-03	2.63E-03	2.24E-03	1.90E-03	1.62E-03	1.38E-03
24	4.68E-03	3.04E-03	1.97E-03	1.28E-03	8.28E-04	5.37E-04	3.48E-04	2.26E-04	1.46E-04	9.50E-05
25	8.95E-03	6.92E-03	5.35E-03	4.14E-03	3.20E-03	2.48E-03	1.91E-03	1.48E-03	1.15E-03	8.86E-04
26	4.42E-02	3.58E-02	2.89E-02	2.34E-02	1.89E-02	1.53E-02	1.24E-02	1.00E-02	8.09E-03	6.54E-03
27	3.74E-04	2.80E-04	2.09E-04	1.57E-04	1.17E-04	8.77E-05	6.56E-05	4.91E-05	3.67E-05	2.75E-05
28	1.72E-02	1.36E-02	1.08E-02	8.51E-03	6.73E-03	5.32E-03	4.21E-03	3.33E-03	2.63E-03	2.08E-03
29	3.95E-02	2.86E-02	2.07E-02	1.50E-02	1.09E-02	7.86E-03	5.69E-03	4.12E-03	2.98E-03	2.16E-03
30	2.28E-04	1.64E-04	1.17E-04	8.42E-05	6.04E-05	4.34E-05	3.11E-05	2.23E-05	1.60E-05	1.15E-05
31	3.99E-03	3.02E-03	2.29E-03	1.73E-03	1.31E-03	9.95E-04	7.54E-04	5.71E-04	4.33E-04	3.28E-04
32	3.70E-02	2.77E-02	2.06E-02	1.54E-02	1.15E-02	8.59E-03	6.41E-03	4.79E-03	3.57E-03	2.67E-03
33	2.22E-02	1.68E-02	1.27E-02	9.57E-03	7.23E-03	5.46E-03	4.13E-03	3.12E-03	2.35E-03	1.78E-03
34	2.28E-02	1.90E-02	1.59E-02	1.32E-02	1.10E-02	9.19E-03	7.66E-03	6.38E-03	5.32E-03	4.43E-03
35	1.33E-02	1.03E-02	7.94E-03	6.12E-03	4.72E-03	3.64E-03	2.80E-03	2.16E-03	1.67E-03	1.28E-03
36	4.26E-03	3.51E-03	2.89E-03	2.37E-03	1.95E-03	1.60E-03	1.31E-03	1.08E-03	8.87E-04	7.28E-04
37	1.09E-02	9.01E-03	7.47E-03	6.19E-03	5.12E-03	4.24E-03	3.51E-03	2.91E-03	2.41E-03	1.99E-03
38	6.46E-03	4.38E-03	2.97E-03	2.01E-03	1.36E-03	9.23E-04	6.25E-04	4.24E-04	2.87E-04	1.95E-04
39	4.87E-02	3.70E-02	2.81E-02	2.13E-02	1.62E-02	1.23E-02	9.34E-03	7.09E-03	5.39E-03	4.09E-03
40	5.92E-04	4.05E-04	2.78E-04	1.90E-04	1.31E-04	8.95E-05	6.13E-05	4.20E-05	2.88E-05	1.97E-05
41	2.91E-02	2.01E-02	1.38E-02	9.51E-03	6.55E-03	4.51E-03	3.11E-03	2.14E-03	1.47E-03	1.01E-03
42	1.37E-02	9.56E-03	6.67E-03	4.65E-03	3.24E-03	2.26E-03	1.58E-03	1.10E-03	7.66E-04	5.34E-04
43	5.32E-03	3.79E-03	2.70E-03	1.93E-03	1.37E-03	9.78E-04	6.96E-04	4.96E-04	3.53E-04	2.52E-04
44	8.76E-04	6.90E-04	5.44E-04	4.28E-04	3.37E-04	2.65E-04	2.09E-04	1.65E-04	1.30E-04	1.02E-04
45	2.07E-02	1.75E-02	1.48E-02	1.25E-02	1.06E-02	8.94E-03	7.55E-03	6.38E-03	5.39E-03	4.55E-03
46	2.63E-02	1.94E-02	1.43E-02	1.06E-02	7.78E-03	5.74E-03	4.23E-03	3.12E-03	2.30E-03	1.70E-03
47	2.49E-02	1.79E-02	1.29E-02	9.23E-03	6.63E-03	4.76E-03	3.42E-03	2.46E-03	1.76E-03	1.27E-03
48	1.62E-02	1.20E-02	8.90E-03	6.60E-03	4.89E-03	3.62E-03	2.69E-03	1.99E-03	1.48E-03	1.09E-03
49	2.00E-02	1.63E-02	1.34E-02	1.09E-02	8.90E-03	7.26E-03	5.93E-03	4.84E-03	3.95E-03	3.23E-03
50	2.19E-02	1.55E-02	1.10E-02	7.79E-03	5.52E-03	3.92E-03	2.78E-03	1.97E-03	1.40E-03	9.90E-04

Table F.4.10. Probabilistic Modeling Results for SWMU 1 (fixed degradation scenario) - Plant Boundary POE (conc in mg/L)

(continued)

RUN	50 yrs	55 yrs	60 yrs	65 yrs	70 yrs	75 yrs	80 yrs	85 yrs	90 yrs	95 yrs
51	2.23E-02	1.86E-02	1.55E-02	1.29E-02	1.08E-02	9.00E-03	7.51E-03	6.27E-03	5.23E-03	4.36E-03
52	6.17E-03	4.00E-03	2.60E-03	1.68E-03	1.09E-03	7.08E-04	4.59E-04	2.98E-04	1.93E-04	1.25E-04
53	2.02E-02	1.43E-02	1.00E-02	7.08E-03	4.99E-03	3.51E-03	2.47E-03	1.74E-03	1.23E-03	8.64E-04
54	2.27E-02	1.83E-02	1.48E-02	1.19E-02	9.62E-03	7.76E-03	6.25E-03	5.04E-03	4.06E-03	3.28E-03
55	2.42E-02	1.82E-02	1.37E-02	1.03E-02	7.73E-03	5.81E-03	4.37E-03	3.28E-03	2.47E-03	1.86E-03
56	8.49E-04	6.80E-04	5.45E-04	4.36E-04	3.49E-04	2.80E-04	2.24E-04	1.79E-04	1.44E-04	1.15E-04
57	1.03E-02	7.37E-03	5.30E-03	3.81E-03	2.73E-03	1.96E-03	1.41E-03	1.01E-03	7.28E-04	5.22E-04
58	1.44E-03	1.07E-03	7.96E-04	5.93E-04	4.41E-04	3.29E-04	2.45E-04	1.82E-04	1.36E-04	1.01E-04
59	2.59E-03	1.86E-03	1.33E-03	9.57E-04	6.87E-04	4.93E-04	3.54E-04	2.54E-04	1.82E-04	1.31E-04
60	2.78E-02	2.37E-02	2.01E-02	1.71E-02	1.46E-02	1.24E-02	1.06E-02	8.99E-03	7.66E-03	6.52E-03
61	7.89E-02	5.45E-02	3.76E-02	2.59E-02	1.79E-02	1.24E-02	8.53E-03	5.88E-03	4.06E-03	2.80E-03
62	2.64E-03	1.94E-03	1.42E-03	1.04E-03	7.60E-04	5.56E-04	4.07E-04	2.98E-04	2.18E-04	1.60E-04
63	4.39E-02	3.26E-02	2.41E-02	1.79E-02	1.33E-02	9.83E-03	7.29E-03	5.40E-03	4.01E-03	2.97E-03
64	1.14E-02	8.91E-03	6.98E-03	5.48E-03	4.30E-03	3.37E-03	2.64E-03	2.07E-03	1.63E-03	1.28E-03
65	4.62E-02	3.92E-02	3.31E-02	2.81E-02	2.38E-02	2.01E-02	1.70E-02	1.44E-02	1.22E-02	1.03E-02
66	1.61E-02	1.22E-02	9.23E-03	6.98E-03	5.28E-03	3.99E-03	3.02E-03	2.28E-03	1.73E-03	1.31E-03
67	7.65E-02	6.03E-02	4.76E-02	3.75E-02	2.96E-02	2.33E-02	1.84E-02	1.45E-02	1.14E-02	9.01E-03
68	6.34E-04	4.78E-04	3.61E-04	2.72E-04	2.05E-04	1.55E-04	1.17E-04	8.82E-05	6.65E-05	5.02E-05
69	7.31E-03	5.46E-03	4.07E-03	3.04E-03	2.27E-03	1.70E-03	1.27E-03	9.45E-04	7.05E-04	5.27E-04
70	2.27E-03	1.71E-03	1.29E-03	9.75E-04	7.36E-04	5.55E-04	4.19E-04	3.16E-04	2.38E-04	1.80E-04
71	2.49E-03	1.84E-03	1.36E-03	1.01E-03	7.43E-04	5.49E-04	4.06E-04	3.00E-04	2.22E-04	1.64E-04
72	2.57E-03	1.74E-03	1.18E-03	7.97E-04	5.40E-04	3.65E-04	2.47E-04	1.67E-04	1.13E-04	7.67E-05
73	1.16E-02	8.17E-03	5.75E-03	4.04E-03	2.84E-03	2.00E-03	1.41E-03	9.89E-04	6.96E-04	4.89E-04
74	2.32E-03	1.81E-03	1.41E-03	1.10E-03	8.57E-04	6.67E-04	5.20E-04	4.05E-04	3.15E-04	2.46E-04
75	4.41E-03	3.12E-03	2.21E-03	1.56E-03	1.11E-03	7.84E-04	5.56E-04	3.93E-04	2.79E-04	1.97E-04
76	5.90E-04	4.75E-04	3.83E-04	3.09E-04	2.50E-04	2.01E-04	1.62E-04	1.31E-04	1.05E-04	8.50E-05
77	5.08E-03	4.30E-03	3.64E-03	3.08E-03	2.60E-03	2.20E-03	1.86E-03	1.57E-03	1.33E-03	1.12E-03
78	1.02E-01	8.02E-02	6.28E-02	4.91E-02	3.84E-02	3.00E-02	2.34E-02	1.83E-02	1.43E-02	1.12E-02
79	3.03E-02	2.36E-02	1.84E-02	1.43E-02	1.12E-02	8.70E-03	6.78E-03	5.28E-03	4.11E-03	3.21E-03
80	1.37E-02	1.00E-02	7.36E-03	5.40E-03	3.96E-03	2.91E-03	2.13E-03	1.57E-03	1.15E-03	8.43E-04
81	1.60E-03	1.16E-03	8.38E-04	6.06E-04	4.38E-04	3.16E-04	2.29E-04	1.65E-04	1.20E-04	8.64E-05
82	2.39E-02	1.86E-02	1.45E-02	1.12E-02	8.73E-03	6.78E-03	5.27E-03	4.09E-03	3.18E-03	2.47E-03
83	3.68E-03	3.16E-03	2.71E-03	2.33E-03	2.00E-03	1.72E-03	1.48E-03	1.27E-03	1.09E-03	9.35E-04
84	5.02E-03	3.57E-03	2.53E-03	1.80E-03	1.28E-03	9.08E-04	6.45E-04	4.58E-04	3.25E-04	2.31E-04
85	1.01E-02	7.85E-03	6.10E-03	4.73E-03	3.67E-03	2.85E-03	2.21E-03	1.72E-03	1.33E-03	1.04E-03
86	9.37E-03	7.42E-03	5.87E-03	4.64E-03	3.66E-03	2.89E-03	2.29E-03	1.81E-03	1.43E-03	1.13E-03
87	4.60E-02	3.63E-02	2.86E-02	2.25E-02	1.77E-02	1.39E-02	1.10E-02	8.64E-03	6.81E-03	5.36E-03
88	1.06E-03	9.04E-04	7.67E-04	6.51E-04	5.53E-04	4.69E-04	3.99E-04	3.38E-04	2.87E-04	2.44E-04
89	3.38E-03	2.43E-03	1.74E-03	1.25E-03	8.93E-04	6.40E-04	4.59E-04	3.29E-04	2.36E-04	1.69E-04
90	4.90E-03	3.63E-03	2.69E-03	2.00E-03	1.48E-03	1.10E-03	8.13E-04	6.03E-04	4.47E-04	3.31E-04
91	7.00E-03	4.81E-03	3.31E-03	2.28E-03	1.57E-03	1.08E-03	7.40E-04	5.09E-04	3.50E-04	2.41E-04
92	1.07E-01	7.20E-02	4.85E-02	3.27E-02	2.20E-02	1.48E-02	9.99E-03	6.73E-03	4.54E-03	3.06E-03
93	2.11E-03	1.59E-03	1.20E-03	9.03E-04	6.80E-04	5.12E-04	3.86E-04	2.91E-04	2.19E-04	1.65E-04
94	1.84E-02	1.36E-02	1.00E-02	7.38E-03	5.45E-03	4.02E-03	2.97E-03	2.19E-03	1.62E-03	1.19E-03
95	6.41E-04	4.96E-04	3.83E-04	2.96E-04	2.29E-04	1.77E-04	1.37E-04	1.06E-04	8.20E-05	6.34E-05
96	5.58E-03	4.35E-03	3.39E-03	2.64E-03	2.06E-03	1.60E-03	1.25E-03	9.73E-04	7.58E-04	5.90E-04
97	1.67E-02	1.29E-02	9.91E-03	7.63E-03	5.88E-03	4.53E-03	3.49E-03	2.69E-03	2.07E-03	1.59E-03
98	5.90E-02	4.63E-02	3.63E-02	2.84E-02	2.22E-02	1.74E-02	1.36E-02	1.07E-02	8.36E-03	6.54E-03
99	4.15E-03	2.65E-03	1.70E-03	1.09E-03	6.94E-04	4.44E-04	2.84E-04	1.81E-04	1.16E-04	7.42E-05
100	4.39E-03	3.47E-03	2.74E-03	2.16E-03	1.71E-03	1.35E-03	1.07E-03	8.43E-04	6.66E-04	5.26E-04

Table F.4.11. Probabilistic Modeling Results for SWMU 1 (fixed degradation scenario) - Property Boundary POE (conc in mg/L)

RUN	0 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	30 yrs	35 yrs	40 yrs	45 yrs
1	0.00E+00	4.18E-03	1.16E-02	8.79E-03	6.40E-03	4.56E-03	3.22E-03	2.27E-03	1.59E-03	1.12E-03
2	0.00E+00	0.00E+00	1.34E-02	1.64E-02	1.39E-02	1.10E-02	8.50E-03	6.48E-03	4.93E-03	3.73E-03
3	0.00E+00	0.00E+00	1.03E-03	4.25E-03	4.17E-03	3.59E-03	2.90E-03	2.28E-03	1.77E-03	1.37E-03
4	0.00E+00	0.00E+00	0.00E+00	8.61E-09	6.97E-05	4.75E-03	3.72E-02	9.56E-02	1.33E-01	1.33E-01
5	0.00E+00	0.00E+00	0.00E+00	1.45E-03	4.07E-03	3.52E-03	2.94E-03	2.46E-03	2.04E-03	1.70E-03
6	0.00E+00	0.00E+00	3.32E-04	3.83E-03	5.14E-03	5.42E-03	4.78E-03	4.04E-03	3.35E-03	2.75E-03
7	0.00E+00	0.00E+00	2.29E-04	1.60E-02	2.53E-02	2.49E-02	2.11E-02	1.74E-02	1.43E-02	1.16E-02
8	0.00E+00	5.67E-09	1.21E-02	6.16E-02	9.49E-02	8.09E-02	6.08E-02	4.39E-02	3.12E-02	2.21E-02
9	0.00E+00	0.00E+00	2.18E-02	4.53E-02	3.44E-02	2.45E-02	1.71E-02	1.19E-02	8.22E-03	5.68E-03
10	0.00E+00	0.00E+00	0.00E+00	2.48E-05	3.71E-03	1.56E-02	1.99E-02	1.77E-02	1.45E-02	1.15E-02
11	0.00E+00	0.00E+00	0.00E+00	1.01E-06	7.07E-03	4.31E-02	4.92E-02	4.24E-02	3.56E-02	2.98E-02
12	0.00E+00	0.00E+00	8.09E-04	1.67E-02	2.77E-02	2.45E-02	1.89E-02	1.41E-02	1.04E-02	7.60E-03
13	0.00E+00	8.20E-10	3.04E-03	3.83E-03	3.11E-03	2.34E-03	1.71E-03	1.24E-03	8.90E-04	6.38E-04
14	0.00E+00	0.00E+00	1.16E-04	1.61E-02	2.24E-02	1.74E-02	1.29E-02	9.52E-03	7.00E-03	5.14E-03
15	0.00E+00	0.00E+00	1.35E-06	4.18E-03	2.04E-02	2.95E-02	2.77E-02	2.24E-02	1.74E-02	1.32E-02
16	0.00E+00	0.00E+00	3.42E-06	1.56E-02	2.16E-02	1.80E-02	1.47E-02	1.20E-02	9.69E-03	7.85E-03
17	0.00E+00	0.00E+00	1.32E-03	7.84E-03	1.13E-02	9.51E-03	7.24E-03	5.36E-03	3.93E-03	2.86E-03
18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
19	0.00E+00	0.00E+00	2.26E-02	3.97E-02	3.21E-02	2.42E-02	1.80E-02	1.34E-02	9.92E-03	7.34E-03
20	0.00E+00	0.00E+00	0.00E+00	3.15E-07	8.11E-04	3.56E-03	4.39E-03	4.19E-03	3.71E-03	3.19E-03
21	0.00E+00	0.00E+00	0.00E+00	1.35E-05	3.79E-03	2.13E-02	4.16E-02	4.95E-02	4.52E-02	3.81E-02
22	0.00E+00	0.00E+00	1.30E-10	2.35E-04	4.68E-03	7.70E-03	7.21E-03	6.03E-03	4.89E-03	3.91E-03
23	0.00E+00	0.00E+00	0.00E+00	8.53E-04	2.08E-03	2.90E-03	3.09E-03	2.72E-03	2.35E-03	2.01E-03
24	0.00E+00	0.00E+00	3.28E-09	2.04E-04	6.67E-03	1.79E-02	1.86E-02	1.39E-02	9.40E-03	6.18E-03
25	0.00E+00	0.00E+00	8.75E-03	1.33E-02	1.05E-02	8.13E-03	6.31E-03	4.88E-03	3.78E-03	2.92E-03
26	0.00E+00	0.00E+00	1.01E-05	8.14E-03	1.02E-02	8.86E-03	7.38E-03	6.04E-03	4.91E-03	3.98E-03
27	0.00E+00	4.27E-07	5.43E-04	4.90E-04	3.95E-04	3.05E-04	2.31E-04	1.74E-04	1.31E-04	9.80E-05
28	0.00E+00	0.00E+00	3.10E-04	2.11E-02	1.93E-02	1.52E-02	1.20E-02	9.46E-03	7.48E-03	5.91E-03
29	0.00E+00	0.00E+00	0.00E+00	8.06E-05	7.07E-03	3.37E-02	5.69E-02	6.14E-02	5.32E-02	4.17E-02
30	0.00E+00	5.49E-04	5.70E-04	4.90E-04	3.81E-04	2.83E-04	2.07E-04	1.49E-04	1.08E-04	7.73E-05
31	0.00E+00	9.12E-08	1.12E-02	8.17E-03	6.10E-03	4.60E-03	3.47E-03	2.63E-03	1.99E-03	1.51E-03
32	0.00E+00	0.00E+00	3.66E-07	5.59E-03	4.13E-02	5.23E-02	4.59E-02	3.66E-02	2.81E-02	2.12E-02
33	0.00E+00	0.00E+00	0.00E+00	3.14E-04	2.15E-02	6.51E-02	6.85E-02	5.43E-02	4.10E-02	3.10E-02
34	0.00E+00	0.00E+00	0.00E+00	2.19E-03	1.82E-02	1.60E-02	1.31E-02	1.08E-02	9.00E-03	7.49E-03
35	0.00E+00	0.00E+00	6.89E-03	1.47E-02	2.13E-02	1.98E-02	1.63E-02	1.29E-02	1.01E-02	7.81E-03
36	0.00E+00	0.00E+00	6.24E-04	2.00E-03	2.11E-03	1.99E-03	1.76E-03	1.51E-03	1.27E-03	1.06E-03
37	0.00E+00	0.00E+00	4.28E-04	6.95E-03	9.25E-03	8.30E-03	7.05E-03	5.90E-03	4.91E-03	4.08E-03
38	0.00E+00	0.00E+00	8.38E-03	3.64E-02	2.87E-02	2.04E-02	1.41E-02	9.60E-03	6.53E-03	4.43E-03
39	0.00E+00	0.00E+00	0.00E+00	3.21E-05	6.74E-03	3.79E-02	5.56E-02	5.11E-02	4.12E-02	3.20E-02
40	0.00E+00	1.15E-06	7.42E-04	1.60E-03	1.57E-03	1.18E-03	8.38E-04	5.82E-04	4.01E-04	2.75E-04
41	0.00E+00	0.00E+00	3.55E-04	5.77E-02	1.03E-01	7.90E-02	5.51E-02	3.80E-02	2.62E-02	1.81E-02
42	0.00E+00	1.33E-04	1.69E-02	2.84E-02	2.38E-02	1.76E-02	1.26E-02	8.86E-03	6.20E-03	4.33E-03
43	0.00E+00	3.60E-07	3.07E-02	2.09E-02	1.43E-02	9.97E-03	7.05E-03	5.01E-03	3.56E-03	2.54E-03
44	0.00E+00	0.00E+00	1.03E-03	8.49E-04	6.79E-04	5.38E-04	4.25E-04	3.35E-04	2.64E-04	2.08E-04
45	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.91E-09	5.30E-05	2.12E-03	9.05E-03	1.41E-02	1.44E-02
46	0.00E+00	1.78E-07	1.46E-02	2.57E-02	2.92E-02	2.44E-02	1.90E-02	1.44E-02	1.07E-02	7.96E-03
47	0.00E+00	0.00E+00	3.42E-08	1.07E-03	1.83E-02	3.90E-02	4.09E-02	3.34E-02	2.52E-02	1.84E-02
48	0.00E+00	0.00E+00	5.01E-04	1.28E-02	2.15E-02	2.00E-02	1.59E-02	1.21E-02	9.06E-03	6.75E-03
49	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.85E-09	6.08E-06	2.79E-04	2.05E-03	5.66E-03	8.96E-03
50	0.00E+00	0.00E+00	2.01E-02	6.05E-02	4.99E-02	3.66E-02	2.63E-02	1.87E-02	1.33E-02	9.42E-03

Table F.4.11. Probabilistic Modeling Results for SWMU 1 (fixed degradation scenario) - Property Boundary POE (conc in mg/L)

(continued)

RUN	0 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	30 yrs	35 yrs	40 yrs	45 yrs
51	1.56E-02	1.33E-02	1.10E-02	9.11E-03	7.58E-03	6.31E-03	5.26E-03	4.39E-03	3.66E-03	3.05E-03
52	2.40E-02	1.59E-02	1.04E-02	6.74E-03	4.38E-03	2.84E-03	1.84E-03	1.19E-03	7.74E-04	5.02E-04
53	4.69E-03	1.52E-02	2.40E-02	2.46E-02	2.02E-02	1.51E-02	1.09E-02	7.76E-03	5.49E-03	3.87E-03
54	1.12E-02	1.03E-02	8.68E-03	7.15E-03	5.83E-03	4.72E-03	3.81E-03	3.08E-03	2.48E-03	2.00E-03
55	2.53E-02	1.94E-02	1.47E-02	1.11E-02	8.32E-03	6.26E-03	4.70E-03	3.54E-03	2.66E-03	2.00E-03
56	7.12E-04	5.90E-04	4.79E-04	3.86E-04	3.10E-04	2.48E-04	1.99E-04	1.59E-04	1.28E-04	1.02E-04
57	1.16E-02	8.76E-03	6.44E-03	4.68E-03	3.38E-03	2.43E-03	1.75E-03	1.26E-03	9.03E-04	6.49E-04
58	1.39E-03	1.03E-03	7.66E-04	5.70E-04	4.24E-04	3.16E-04	2.35E-04	1.75E-04	1.30E-04	9.72E-05
59	4.20E-03	3.10E-03	2.25E-03	1.62E-03	1.17E-03	8.37E-04	6.01E-04	4.31E-04	3.09E-04	2.22E-04
60	8.28E-03	1.45E-02	1.31E-02	1.13E-02	9.64E-03	8.21E-03	7.00E-03	5.95E-03	5.07E-03	4.31E-03
61	1.68E-01	1.17E-01	8.14E-02	5.63E-02	3.89E-02	2.68E-02	1.85E-02	1.28E-02	8.82E-03	6.08E-03
62	3.76E-03	2.75E-03	2.01E-03	1.47E-03	1.08E-03	7.90E-04	5.78E-04	4.23E-04	3.10E-04	2.27E-04
63	1.46E-02	3.34E-02	4.47E-02	4.29E-02	3.51E-02	2.71E-02	2.04E-02	1.53E-02	1.14E-02	8.44E-03
64	4.16E-03	1.05E-02	1.18E-02	9.94E-03	7.79E-03	6.06E-03	4.73E-03	3.70E-03	2.90E-03	2.27E-03
65	6.51E-06	5.56E-04	4.08E-03	1.00E-02	1.46E-02	1.60E-02	1.51E-02	1.33E-02	1.14E-02	9.73E-03
66	1.84E-02	1.38E-02	1.04E-02	7.89E-03	5.97E-03	4.51E-03	3.41E-03	2.58E-03	1.95E-03	1.48E-03
67	7.63E-02	8.07E-02	6.84E-02	5.53E-02	4.41E-02	3.49E-02	2.76E-02	2.17E-02	1.72E-02	1.35E-02
68	5.02E-04	3.83E-04	2.90E-04	2.19E-04	1.65E-04	1.25E-04	9.42E-05	7.11E-05	5.36E-05	4.04E-05
69	1.08E-02	8.12E-03	6.09E-03	4.55E-03	3.40E-03	2.54E-03	1.89E-03	1.41E-03	1.06E-03	7.88E-04
70	2.86E-03	2.29E-03	1.77E-03	1.35E-03	1.02E-03	7.73E-04	5.84E-04	4.41E-04	3.32E-04	2.51E-04
71	1.90E-03	3.15E-03	3.12E-03	2.57E-03	1.98E-03	1.49E-03	1.11E-03	8.19E-04	6.06E-04	4.48E-04
72	7.54E-03	5.15E-03	3.49E-03	2.37E-03	1.60E-03	1.08E-03	7.34E-04	4.97E-04	3.36E-04	2.28E-04
73	1.25E-03	6.78E-03	1.39E-02	1.69E-02	1.54E-02	1.21E-02	8.95E-03	6.43E-03	4.56E-03	3.22E-03
74	1.72E-03	1.40E-03	1.11E-03	8.70E-04	6.80E-04	5.31E-04	4.14E-04	3.22E-04	2.51E-04	1.96E-04
75	1.27E-02	8.92E-03	6.30E-03	4.45E-03	3.15E-03	2.23E-03	1.58E-03	1.12E-03	7.93E-04	5.61E-04
76	3.09E-04	2.49E-04	2.00E-04	1.62E-04	1.30E-04	1.05E-04	8.47E-05	6.83E-05	5.51E-05	4.44E-05
77	2.65E-03	2.40E-03	2.09E-03	1.79E-03	1.52E-03	1.29E-03	1.09E-03	9.24E-04	7.81E-04	6.61E-04
78	4.23E-08	9.59E-06	2.62E-04	2.13E-03	8.16E-03	1.91E-02	3.16E-02	4.10E-02	4.47E-02	4.31E-02
79	2.65E-02	4.31E-02	4.00E-02	3.19E-02	2.48E-02	1.93E-02	1.50E-02	1.17E-02	9.11E-03	7.10E-03
80	1.29E-02	9.79E-03	7.29E-03	5.38E-03	3.96E-03	2.91E-03	2.13E-03	1.57E-03	1.15E-03	8.43E-04
81	2.05E-03	1.49E-03	1.08E-03	7.80E-04	5.64E-04	4.08E-04	2.95E-04	2.13E-04	1.54E-04	1.11E-04
82	1.21E-02	1.67E-02	1.62E-02	1.36E-02	1.09E-02	8.62E-03	6.76E-03	5.27E-03	4.10E-03	3.19E-03
83	1.22E-03	1.35E-03	1.20E-03	1.05E-03	9.06E-04	7.81E-04	6.72E-04	5.77E-04	4.96E-04	4.26E-04
84	6.08E-03	4.36E-03	3.11E-03	2.22E-03	1.57E-03	1.12E-03	7.94E-04	5.64E-04	4.01E-04	2.85E-04
85	1.19E-02	9.61E-03	7.59E-03	5.93E-03	4.62E-03	3.60E-03	2.79E-03	2.17E-03	1.69E-03	1.31E-03
86	5.18E-03	4.27E-03	3.45E-03	2.76E-03	2.19E-03	1.74E-03	1.38E-03	1.09E-03	8.63E-04	6.82E-04
87	3.59E-03	1.93E-02	3.47E-02	3.73E-02	3.25E-02	2.63E-02	2.08E-02	1.64E-02	1.30E-02	1.02E-02
88	5.07E-04	4.32E-04	3.68E-04	3.13E-04	2.66E-04	2.26E-04	1.92E-04	1.63E-04	1.38E-04	1.17E-04
89	4.78E-03	3.44E-03	2.46E-03	1.77E-03	1.27E-03	9.08E-04	6.50E-04	4.66E-04	3.34E-04	2.40E-04
90	6.78E-03	5.37E-03	4.09E-03	3.07E-03	2.28E-03	1.70E-03	1.26E-03	9.34E-04	6.92E-04	5.13E-04
91	1.50E-02	1.41E-02	1.06E-02	7.56E-03	5.26E-03	3.63E-03	2.50E-03	1.72E-03	1.18E-03	8.15E-04
92	2.53E-01	2.57E-01	1.96E-01	1.37E-01	9.40E-02	6.37E-02	4.30E-02	2.90E-02	1.95E-02	1.32E-02
93	3.02E-03	2.58E-03	2.02E-03	1.54E-03	1.17E-03	8.83E-04	6.66E-04	5.02E-04	3.78E-04	2.85E-04
94	2.86E-02	2.10E-02	1.55E-02	1.14E-02	8.40E-03	6.20E-03	4.57E-03	3.37E-03	2.49E-03	1.84E-03
95	5.75E-04	4.52E-04	3.52E-04	2.73E-04	2.11E-04	1.64E-04	1.27E-04	9.78E-05	7.57E-05	5.85E-05
96	4.73E-03	4.06E-03	3.28E-03	2.59E-03	2.03E-03	1.59E-03	1.24E-03	9.65E-04	7.52E-04	5.86E-04
97	1.32E-02	1.02E-02	7.85E-03	6.05E-03	4.66E-03	3.59E-03	2.76E-03	2.13E-03	1.64E-03	1.26E-03
98	3.20E-02	3.94E-02	3.55E-02	2.93E-02	2.35E-02	1.86E-02	1.47E-02	1.15E-02	9.03E-03	7.07E-03
99	1.02E-02	6.63E-03	4.26E-03	2.73E-03	1.75E-03	1.12E-03	7.14E-04	4.57E-04	2.92E-04	1.87E-04
100	3.58E-03	2.86E-03	2.27E-03	1.79E-03	1.42E-03	1.12E-03	8.85E-04	6.99E-04	5.52E-04	4.36E-04

Table F.4.11. Probabilistic Modeling Results for SWMU 1 (fixed degradation scenario) - Property Boundary POE (conc in mg/L)

(continued)

RUN	50 yrs	55 yrs	60 yrs	65 yrs	70 yrs	75 yrs	80 yrs	85 yrs	90 yrs	95 yrs
1	7.84E-04	5.50E-04	3.86E-04	2.71E-04	1.90E-04	1.33E-04	9.36E-05	6.57E-05	4.61E-05	3.23E-05
2	2.83E-03	2.14E-03	1.62E-03	1.22E-03	9.26E-04	7.00E-04	5.30E-04	4.01E-04	3.03E-04	2.29E-04
3	1.05E-03	8.08E-04	6.20E-04	4.77E-04	3.66E-04	2.81E-04	2.16E-04	1.66E-04	1.27E-04	9.79E-05
4	1.11E-01	8.51E-02	6.26E-02	4.53E-02	3.26E-02	2.33E-02	1.67E-02	1.19E-02	8.52E-03	6.09E-03
5	1.41E-03	1.17E-03	9.70E-04	8.05E-04	6.68E-04	5.54E-04	4.60E-04	3.81E-04	3.16E-04	2.63E-04
6	2.25E-03	1.84E-03	1.50E-03	1.22E-03	9.97E-04	8.13E-04	6.63E-04	5.40E-04	4.40E-04	3.58E-04
7	9.45E-03	7.67E-03	6.22E-03	5.05E-03	4.09E-03	3.32E-03	2.69E-03	2.19E-03	1.77E-03	1.44E-03
8	1.56E-02	1.10E-02	7.71E-03	5.42E-03	3.82E-03	2.68E-03	1.89E-03	1.33E-03	9.33E-04	6.56E-04
9	3.92E-03	2.71E-03	1.87E-03	1.29E-03	8.89E-04	6.14E-04	4.24E-04	2.92E-04	2.02E-04	1.39E-04
10	9.10E-03	7.17E-03	5.63E-03	4.42E-03	3.47E-03	2.73E-03	2.14E-03	1.68E-03	1.32E-03	1.03E-03
11	2.50E-02	2.09E-02	1.75E-02	1.47E-02	1.23E-02	1.03E-02	8.60E-03	7.19E-03	6.02E-03	5.04E-03
12	5.56E-03	4.06E-03	2.97E-03	2.17E-03	1.58E-03	1.16E-03	8.45E-04	6.17E-04	4.51E-04	3.29E-04
13	4.58E-04	3.28E-04	2.35E-04	1.69E-04	1.21E-04	8.66E-05	6.20E-05	4.45E-05	3.19E-05	2.28E-05
14	3.77E-03	2.77E-03	2.03E-03	1.49E-03	1.09E-03	8.03E-04	5.89E-04	4.32E-04	3.17E-04	2.33E-04
15	1.00E-02	7.53E-03	5.67E-03	4.26E-03	3.20E-03	2.41E-03	1.81E-03	1.36E-03	1.02E-03	7.66E-04
16	6.35E-03	5.14E-03	4.16E-03	3.37E-03	2.73E-03	2.21E-03	1.79E-03	1.45E-03	1.17E-03	9.49E-04
17	2.08E-03	1.51E-03	1.10E-03	7.99E-04	5.80E-04	4.22E-04	3.06E-04	2.23E-04	1.62E-04	1.17E-04
18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
19	5.43E-03	4.02E-03	2.97E-03	2.20E-03	1.63E-03	1.20E-03	8.89E-04	6.58E-04	4.86E-04	3.60E-04
20	2.71E-03	2.29E-03	1.92E-03	1.61E-03	1.35E-03	1.13E-03	9.44E-04	7.89E-04	6.60E-04	5.52E-04
21	3.15E-02	2.59E-02	2.12E-02	1.73E-02	1.41E-02	1.15E-02	9.40E-03	7.67E-03	6.26E-03	5.11E-03
22	3.11E-03	2.47E-03	1.96E-03	1.55E-03	1.23E-03	9.76E-04	7.73E-04	6.12E-04	4.85E-04	3.85E-04
23	1.72E-03	1.46E-03	1.25E-03	1.06E-03	9.01E-04	7.67E-04	6.52E-04	5.55E-04	4.72E-04	4.01E-04
24	4.02E-03	2.61E-03	1.70E-03	1.10E-03	7.13E-04	4.62E-04	3.00E-04	1.95E-04	1.26E-04	8.18E-05
25	2.26E-03	1.75E-03	1.35E-03	1.05E-03	8.10E-04	6.26E-04	4.84E-04	3.75E-04	2.90E-04	2.24E-04
26	3.22E-03	2.61E-03	2.11E-03	1.71E-03	1.38E-03	1.12E-03	9.02E-04	7.30E-04	5.90E-04	4.77E-04
27	7.33E-05	5.49E-05	4.10E-05	3.07E-05	2.30E-05	1.72E-05	1.29E-05	9.62E-06	7.19E-06	5.38E-06
28	4.68E-03	3.70E-03	2.93E-03	2.32E-03	1.83E-03	1.45E-03	1.15E-03	9.07E-04	7.17E-04	5.67E-04
29	3.14E-02	2.31E-02	1.69E-02	1.23E-02	8.92E-03	6.46E-03	4.68E-03	3.39E-03	2.45E-03	1.78E-03
30	5.55E-05	3.98E-05	2.86E-05	2.05E-05	1.47E-05	1.06E-05	7.58E-06	5.44E-06	3.90E-06	2.80E-06
31	1.14E-03	8.66E-04	6.56E-04	4.97E-04	3.76E-04	2.85E-04	2.16E-04	1.64E-04	1.24E-04	9.39E-05
32	1.59E-02	1.19E-02	8.90E-03	6.65E-03	4.96E-03	3.71E-03	2.77E-03	2.07E-03	1.54E-03	1.15E-03
33	2.34E-02	1.76E-02	1.33E-02	1.01E-02	7.60E-03	5.74E-03	4.34E-03	3.28E-03	2.47E-03	1.87E-03
34	6.23E-03	5.19E-03	4.33E-03	3.60E-03	3.00E-03	2.50E-03	2.09E-03	1.74E-03	1.45E-03	1.21E-03
35	6.04E-03	4.66E-03	3.59E-03	2.77E-03	2.14E-03	1.65E-03	1.27E-03	9.78E-04	7.54E-04	5.81E-04
36	8.78E-04	7.25E-04	5.97E-04	4.91E-04	4.04E-04	3.32E-04	2.72E-04	2.24E-04	1.84E-04	1.51E-04
37	3.38E-03	2.80E-03	2.32E-03	1.92E-03	1.59E-03	1.32E-03	1.09E-03	9.03E-04	7.48E-04	6.19E-04
38	3.00E-03	2.03E-03	1.38E-03	9.34E-04	6.33E-04	4.29E-04	2.91E-04	1.97E-04	1.33E-04	9.04E-05
39	2.45E-02	1.87E-02	1.43E-02	1.08E-02	8.23E-03	6.25E-03	4.75E-03	3.61E-03	2.74E-03	2.08E-03
40	1.89E-04	1.29E-04	8.87E-05	6.08E-05	4.17E-05	2.86E-05	1.96E-05	1.34E-05	9.19E-06	6.30E-06
41	1.24E-02	8.57E-03	5.90E-03	4.06E-03	2.80E-03	1.93E-03	1.33E-03	9.13E-04	6.29E-04	4.33E-04
42	3.02E-03	2.11E-03	1.47E-03	1.02E-03	7.14E-04	4.98E-04	3.47E-04	2.42E-04	1.69E-04	1.18E-04
43	1.81E-03	1.29E-03	9.17E-04	6.53E-04	4.66E-04	3.32E-04	2.36E-04	1.68E-04	1.20E-04	8.55E-05
44	1.64E-04	1.29E-04	1.01E-04	7.99E-05	6.29E-05	4.96E-05	3.90E-05	3.07E-05	2.42E-05	1.91E-05
45	1.26E-02	1.07E-02	9.05E-03	7.63E-03	6.45E-03	5.45E-03	4.60E-03	3.89E-03	3.29E-03	2.78E-03
46	5.89E-03	4.35E-03	3.21E-03	2.37E-03	1.75E-03	1.29E-03	9.51E-04	7.02E-04	5.18E-04	3.82E-04
47	1.33E-02	9.59E-03	6.90E-03	4.95E-03	3.56E-03	2.56E-03	1.84E-03	1.32E-03	9.47E-04	6.80E-04
48	5.01E-03	3.72E-03	2.76E-03	2.05E-03	1.52E-03	1.12E-03	8.33E-04	6.18E-04	4.58E-04	3.40E-04
49	1.03E-02	1.00E-02	8.85E-03	7.50E-03	6.23E-03	5.13E-03	4.20E-03	3.44E-03	2.81E-03	2.29E-03
50	6.68E-03	4.74E-03	3.36E-03	2.38E-03	1.69E-03	1.20E-03	8.49E-04	6.02E-04	4.27E-04	3.03E-04

Table F.4.11. Probabilistic Modeling Results for SWMU 1 (fixed degradation scenario) - Property Boundary POE (conc in mg/L)

(continued)

RUN	50 yrs	55 yrs	60 yrs	65 yrs	70 yrs	75 yrs	80 yrs	85 yrs	90 yrs	95 yrs
51	2.55E-03	2.12E-03	1.77E-03	1.48E-03	1.23E-03	2.55E-03	2.12E-03	1.77E-03	1.48E-03	1.23E-03
52	3.26E-04	2.11E-04	1.37E-04	8.88E-05	5.76E-05	3.26E-04	2.11E-04	1.37E-04	8.88E-05	5.76E-05
53	2.73E-03	1.92E-03	1.36E-03	9.55E-04	6.72E-04	2.73E-03	1.92E-03	1.36E-03	9.55E-04	6.72E-04
54	1.61E-03	1.30E-03	1.05E-03	8.45E-04	6.81E-04	1.61E-03	1.30E-03	1.05E-03	8.45E-04	6.81E-04
55	1.50E-03	1.13E-03	8.49E-04	6.38E-04	4.80E-04	1.50E-03	1.13E-03	8.49E-04	6.38E-04	4.80E-04
56	8.19E-05	6.56E-05	5.25E-05	4.21E-05	3.37E-05	8.19E-05	6.56E-05	5.25E-05	4.21E-05	3.37E-05
57	4.66E-04	3.35E-04	2.41E-04	1.73E-04	1.24E-04	4.66E-04	3.35E-04	2.41E-04	1.73E-04	1.24E-04
58	7.23E-05	5.38E-05	4.01E-05	2.99E-05	2.22E-05	7.23E-05	5.38E-05	4.01E-05	2.99E-05	2.22E-05
59	1.59E-04	1.14E-04	8.20E-05	5.89E-05	4.22E-05	1.59E-04	1.14E-04	8.20E-05	5.89E-05	4.22E-05
60	3.67E-03	3.12E-03	2.66E-03	2.26E-03	1.93E-03	3.67E-03	3.12E-03	2.66E-03	2.26E-03	1.93E-03
61	4.20E-03	2.90E-03	2.00E-03	1.38E-03	9.52E-04	4.20E-03	2.90E-03	2.00E-03	1.38E-03	9.52E-04
62	1.66E-04	1.22E-04	8.90E-05	6.52E-05	4.78E-05	1.66E-04	1.22E-04	8.90E-05	6.52E-05	4.78E-05
63	6.26E-03	4.64E-03	3.44E-03	2.55E-03	1.89E-03	6.26E-03	4.64E-03	3.44E-03	2.55E-03	1.89E-03
64	1.78E-03	1.40E-03	1.10E-03	8.60E-04	6.74E-04	1.78E-03	1.40E-03	1.10E-03	8.60E-04	6.74E-04
65	8.26E-03	6.99E-03	5.92E-03	5.01E-03	4.24E-03	8.26E-03	6.99E-03	5.92E-03	5.01E-03	4.24E-03
66	1.12E-03	8.44E-04	6.38E-04	4.83E-04	3.65E-04	1.12E-03	8.44E-04	6.38E-04	4.83E-04	3.65E-04
67	1.07E-02	8.40E-03	6.63E-03	5.22E-03	4.12E-03	1.07E-02	8.40E-03	6.63E-03	5.22E-03	4.12E-03
68	3.05E-05	2.30E-05	1.74E-05	1.31E-05	9.88E-06	3.05E-05	2.30E-05	1.74E-05	1.31E-05	9.88E-06
69	5.88E-04	4.39E-04	3.28E-04	2.45E-04	1.83E-04	5.88E-04	4.39E-04	3.28E-04	2.45E-04	1.83E-04
70	1.89E-04	1.43E-04	1.08E-04	8.12E-05	6.13E-05	1.89E-04	1.43E-04	1.08E-04	8.12E-05	6.13E-05
71	3.31E-04	2.45E-04	1.81E-04	1.34E-04	9.88E-05	3.31E-04	2.45E-04	1.81E-04	1.34E-04	9.88E-05
72	1.54E-04	1.04E-04	7.06E-05	4.78E-05	3.24E-05	1.54E-04	1.04E-04	7.06E-05	4.78E-05	3.24E-05
73	2.27E-03	1.60E-03	1.12E-03	7.90E-04	5.55E-04	2.27E-03	1.60E-03	1.12E-03	7.90E-04	5.55E-04
74	1.52E-04	1.19E-04	9.25E-05	7.21E-05	5.61E-05	1.52E-04	1.19E-04	9.25E-05	7.21E-05	5.61E-05
75	3.97E-04	2.81E-04	1.99E-04	1.41E-04	1.00E-04	3.97E-04	2.81E-04	1.99E-04	1.41E-04	1.00E-04
76	3.58E-05	2.89E-05	2.33E-05	1.88E-05	1.51E-05	3.58E-05	2.89E-05	2.33E-05	1.88E-05	1.51E-05
77	5.59E-04	4.73E-04	4.00E-04	3.38E-04	2.86E-04	5.59E-04	4.73E-04	4.00E-04	3.38E-04	2.86E-04
78	3.83E-02	3.23E-02	2.63E-02	2.10E-02	1.66E-02	3.83E-02	3.23E-02	2.63E-02	2.10E-02	1.66E-02
79	5.53E-03	4.31E-03	3.36E-03	2.62E-03	2.04E-03	5.53E-03	4.31E-03	3.36E-03	2.62E-03	2.04E-03
80	6.19E-04	4.54E-04	3.33E-04	2.44E-04	1.79E-04	6.19E-04	4.54E-04	3.33E-04	2.44E-04	1.79E-04
81	8.04E-05	5.82E-05	4.20E-05	3.04E-05	2.20E-05	8.04E-05	5.82E-05	4.20E-05	3.04E-05	2.20E-05
82	2.48E-03	1.93E-03	1.50E-03	1.16E-03	9.03E-04	2.48E-03	1.93E-03	1.50E-03	1.16E-03	9.03E-04
83	3.66E-04	3.14E-04	2.70E-04	2.32E-04	1.99E-04	3.66E-04	3.14E-04	2.70E-04	2.32E-04	1.99E-04
84	2.02E-04	1.44E-04	1.02E-04	7.24E-05	5.14E-05	2.02E-04	1.44E-04	1.02E-04	7.24E-05	5.14E-05
85	1.02E-03	7.88E-04	6.12E-04	4.75E-04	3.69E-04	1.02E-03	7.88E-04	6.12E-04	4.75E-04	3.69E-04
86	5.39E-04	4.25E-04	3.36E-04	2.65E-04	2.10E-04	5.39E-04	4.25E-04	3.36E-04	2.65E-04	2.10E-04
87	8.04E-03	6.33E-03	4.99E-03	3.93E-03	3.09E-03	8.04E-03	6.33E-03	4.99E-03	3.93E-03	3.09E-03
88	9.95E-05	8.44E-05	7.17E-05	6.09E-05	5.17E-05	9.95E-05	8.44E-05	7.17E-05	6.09E-05	5.17E-05
89	1.72E-04	1.23E-04	8.81E-05	6.32E-05	4.53E-05	1.72E-04	1.23E-04	8.81E-05	6.32E-05	4.53E-05
90	3.81E-04	2.82E-04	2.09E-04	1.55E-04	1.15E-04	3.81E-04	2.82E-04	2.09E-04	1.55E-04	1.15E-04
91	5.60E-04	3.85E-04	2.65E-04	1.82E-04	1.25E-04	5.60E-04	3.85E-04	2.65E-04	1.82E-04	1.25E-04
92	8.87E-03	5.97E-03	4.02E-03	2.71E-03	1.83E-03	8.87E-03	5.97E-03	4.02E-03	2.71E-03	1.83E-03
93	2.15E-04	1.62E-04	1.22E-04	9.17E-05	6.91E-05	2.15E-04	1.62E-04	1.22E-04	9.17E-05	6.91E-05
94	1.36E-03	1.00E-03	7.38E-04	5.44E-04	4.02E-04	1.36E-03	1.00E-03	7.38E-04	5.44E-04	4.02E-04
95	4.52E-05	3.50E-05	2.71E-05	2.09E-05	1.62E-05	4.52E-05	3.50E-05	2.71E-05	2.09E-05	1.62E-05
96	4.56E-04	3.56E-04	2.77E-04	2.16E-04	1.68E-04	4.56E-04	3.56E-04	2.77E-04	2.16E-04	1.68E-04
97	9.73E-04	7.49E-04	5.77E-04	4.44E-04	3.42E-04	9.73E-04	7.49E-04	5.77E-04	4.44E-04	3.42E-04
98	5.54E-03	4.34E-03	3.40E-03	2.66E-03	2.08E-03	5.54E-03	4.34E-03	3.40E-03	2.66E-03	2.08E-03
99	1.20E-04	7.64E-05	4.89E-05	3.13E-05	2.00E-05	1.20E-04	7.64E-05	4.89E-05	3.13E-05	2.00E-05
100	3.45E-04	2.72E-04	2.15E-04	1.70E-04	1.34E-04	3.45E-04	2.72E-04	2.15E-04	1.70E-04	1.34E-04

Table F.4.12. Probabilistic Modeling Results for SWMU 1 (fixed degradation scenario) - OHIO River POE (conc in mg/L)

RUN	0 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	30 yrs	35 yrs	40 yrs	45 yrs
1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.53E-04	4.26E-03	3.31E-03	2.43E-03	1.74E-03
2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.65E-06	8.81E-04
3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.67E-06
7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
8	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.93E-05
9	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
13	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
14	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
16	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
17	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
21	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
23	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.38E-04	6.45E-04
24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.16E-05
26	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
27	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.85E-05	1.33E-04	1.20E-04	9.58E-05
28	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
29	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
30	0.00E+00	0.00E+00	0.00E+00	1.81E-04	1.78E-04	1.49E-04	1.14E-04	8.43E-05	6.13E-05	4.43E-05
31	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.36E-05	2.96E-03	3.27E-03	2.43E-03
32	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
33	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
34	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
35	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.55E-04	2.17E-03
36	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.21E-05	4.01E-04	6.21E-04
37	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.31E-04	2.21E-03
38	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
39	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.03E-04	3.79E-04
41	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
42	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.14E-05	1.50E-03	5.78E-03	7.53E-03
43	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.44E-05	2.08E-03
44	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.30E-05	2.47E-04	2.17E-04	1.74E-04	1.38E-04
45	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
46	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.90E-05	1.31E-03	4.40E-03
47	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
48	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
49	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table F.4.12. Probabilistic Modeling Results for SWMU 1 (fixed degradation scenario) - OHIO River POE (conc in mg/L)

(continued)

RUN	0 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	30 yrs	35 yrs	40 yrs	45 yrs
51	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
52	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.60E-04
53	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
54	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.80E-06	3.02E-04	1.17E-03
55	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.32E-05
56	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.95E-05	9.71E-04
58	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.94E-05	6.42E-04	7.29E-04
59	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
60	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
61	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
62	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
63	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
64	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
65	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
66	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
67	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
68	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.44E-05	2.69E-04	2.37E-04	1.91E-04	1.48E-04
69	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.33E-04
70	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
71	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
72	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
73	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
74	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.13E-04
75	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
76	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.41E-04	1.19E-04	9.57E-05	7.70E-05	6.20E-05
77	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
78	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
79	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
80	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.19E-04	2.57E-03	4.88E-03	4.86E-03
81	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.79E-06	4.02E-04
82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
83	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
84	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.57E-04	2.02E-03	2.37E-03
85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
86	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.40E-05	7.42E-04	1.16E-03	1.25E-03	1.08E-03
87	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.19E-05
89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.72E-05
90	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
91	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
93	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
94	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
95	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
96	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.49E-04	7.40E-03	7.34E-03	5.77E-03
98	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
99	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.21E-06	3.45E-03	7.24E-03	7.06E-03	5.03E-03	3.33E-03
100	0.00E+00	0.00E+00	1.49E-03	5.36E-03	4.45E-03	3.58E-03	2.86E-03	2.27E-03	1.79E-03	1.42E-03

Table F.4.12. Probabilistic Modeling Results for SWMU 1 (fixed degradation scenario) - OHIO River POE (conc in mg/L)

(continued)

RUN	50 yrs	55 yrs	60 yrs	65 yrs	70 yrs	75 yrs	80 yrs	85 yrs	90 yrs	95 yrs
1	1.23E-03	8.67E-04	6.09E-04	4.28E-04	3.00E-04	2.11E-04	1.48E-04	1.04E-04	7.28E-05	5.11E-05
2	4.45E-03	5.47E-03	4.67E-03	3.70E-03	2.86E-03	2.18E-03	1.66E-03	1.25E-03	9.50E-04	7.19E-04
3	0.00E+00	1.02E-05	1.96E-04	7.06E-04	9.92E-04	9.53E-04	8.06E-04	6.47E-04	5.07E-04	3.93E-04
4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.39E-05	2.08E-04	5.68E-04	7.50E-04	7.04E-04	5.98E-04
6	2.79E-04	8.30E-04	1.14E-03	1.20E-03	1.08E-03	9.17E-04	7.62E-04	6.27E-04	5.13E-04	4.19E-04
7	0.00E+00	2.08E-04	2.28E-03	6.12E-03	8.26E-03	8.01E-03	6.85E-03	5.67E-03	4.64E-03	3.78E-03
8	1.17E-03	9.29E-03	2.39E-02	3.06E-02	2.67E-02	2.02E-02	1.46E-02	1.04E-02	7.36E-03	5.19E-03
9	0.00E+00	1.25E-05	6.64E-04	5.39E-03	1.21E-02	1.28E-02	9.92E-03	7.08E-03	4.94E-03	3.43E-03
10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.34E-05	6.37E-04	2.37E-03	4.36E-03	5.03E-03	4.44E-03
13	1.57E-04	7.51E-04	1.00E-03	8.51E-04	6.47E-04	4.75E-04	3.44E-04	2.47E-04	1.78E-04	1.27E-04
14	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.47E-06	9.76E-05	6.59E-04	2.05E-03
15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.04E-05
16	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.67E-05	5.85E-04	2.22E-03	3.72E-03	3.88E-03	3.34E-03
17	0.00E+00	0.00E+00	1.15E-04	7.54E-04	1.80E-03	2.30E-03	2.07E-03	1.61E-03	1.20E-03	8.82E-04
18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
19	4.04E-04	3.68E-03	7.02E-03	6.65E-03	5.16E-03	3.86E-03	2.87E-03	2.12E-03	1.57E-03	1.16E-03
20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
21	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
23	9.53E-04	1.10E-03	1.00E-03	8.71E-04	7.48E-04	6.39E-04	5.44E-04	4.63E-04	3.94E-04	3.35E-04
24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	6.64E-04	2.85E-03	3.30E-03	2.67E-03	2.08E-03	1.61E-03	1.25E-03	9.67E-04	7.48E-04	5.79E-04
26	0.00E+00	0.00E+00	0.00E+00	4.10E-05	5.38E-04	1.90E-03	2.89E-03	2.88E-03	2.48E-03	2.05E-03
27	7.39E-05	5.60E-05	4.21E-05	3.16E-05	2.37E-05	1.77E-05	1.33E-05	9.92E-06	7.42E-06	5.55E-06
28	0.00E+00	0.00E+00	0.00E+00	5.12E-05	7.14E-04	2.63E-03	4.00E-03	3.80E-03	3.08E-03	2.44E-03
29	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
30	3.19E-05	2.29E-05	1.64E-05	1.18E-05	8.46E-06	6.07E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
31	1.83E-03	1.38E-03	1.04E-03	7.89E-04	5.98E-04	4.53E-04	3.43E-04	2.60E-04	1.97E-04	1.49E-04
32	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
33	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
34	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.15E-05	5.35E-04	2.22E-03	4.10E-03	4.57E-03
35	5.10E-03	7.16E-03	7.03E-03	5.86E-03	4.67E-03	3.65E-03	2.83E-03	2.19E-03	1.69E-03	1.30E-03
36	6.36E-04	5.89E-04	5.18E-04	4.42E-04	3.72E-04	3.09E-04	2.56E-04	2.11E-04	1.74E-04	1.43E-04
37	3.12E-03	2.99E-03	2.56E-03	2.15E-03	1.79E-03	1.49E-03	1.23E-03	1.02E-03	8.45E-04	7.00E-04
38	0.00E+00	0.00E+00	0.00E+00	6.67E-05	1.13E-03	5.15E-03	9.31E-03	9.51E-03	7.39E-03	5.23E-03
39	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	5.65E-04	5.00E-04	3.71E-04	2.61E-04	1.81E-04	1.25E-04	8.56E-05	5.87E-05	4.02E-05	2.76E-05
41	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.50E-06	1.39E-04	1.22E-03
42	6.19E-03	4.55E-03	3.24E-03	2.27E-03	1.59E-03	1.11E-03	7.75E-04	5.41E-04	3.77E-04	2.63E-04
43	7.99E-03	7.26E-03	5.00E-03	3.49E-03	2.46E-03	1.75E-03	1.24E-03	8.86E-04	6.31E-04	4.49E-04
44	1.09E-04	8.58E-05	6.76E-05	5.32E-05	4.19E-05	3.30E-05	2.60E-05	2.05E-05	1.61E-05	1.27E-05
45	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
46	6.43E-03	6.34E-03	5.18E-03	4.00E-03	3.01E-03	2.24E-03	1.66E-03	1.23E-03	9.08E-04	6.70E-04
47	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
48	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.16E-05	4.57E-04	1.81E-03	3.52E-03	4.28E-03	3.95E-03
49	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	0.00E+00	9.84E-06	4.69E-04	3.63E-03	8.17E-03	8.96E-03	7.18E-03	5.26E-03	3.76E-03	2.68E-03

Table F.4.12. Probabilistic Modeling Results for SWMU 1 (fixed degradation scenario) - OHIO River POE (conc in mg/L)

(continued)

RUN	50 yrs	55 yrs	60 yrs	65 yrs	70 yrs	75 yrs	80 yrs	85 yrs	90 yrs	95 yrs
51	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.15E-05
52	7.62E-03	1.42E-02	1.32E-02	9.52E-03	6.39E-03	4.19E-03	2.73E-03	1.77E-03	1.15E-03	7.46E-04
53	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
54	2.29E-03	2.97E-03	2.80E-03	2.37E-03	1.95E-03	1.59E-03	1.29E-03	1.04E-03	8.42E-04	6.79E-04
55	9.15E-04	4.89E-03	6.80E-03	6.01E-03	4.77E-03	3.67E-03	2.78E-03	2.10E-03	1.58E-03	1.19E-03
56	0.00E+00	0.00E+00	0.00E+00	8.22E-06	6.95E-05	1.83E-04	2.39E-04	2.26E-04	1.90E-04	1.55E-04
57	2.52E-03	3.16E-03	2.72E-03	2.08E-03	1.54E-03	1.12E-03	8.10E-04	5.84E-04	4.20E-04	3.02E-04
58	5.43E-04	4.02E-04	2.99E-04	2.22E-04	1.65E-04	1.23E-04	9.17E-05	6.83E-05	5.08E-05	3.79E-05
59	0.00E+00	0.00E+00	0.00E+00	1.10E-05	1.62E-04	6.84E-04	1.22E-03	1.30E-03	1.08E-03	8.14E-04
60	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
61	0.00E+00	0.00E+00	1.80E-05	1.08E-03	1.23E-02	4.14E-02	6.02E-02	5.46E-02	4.07E-02	2.86E-02
62	8.60E-05	1.04E-03	2.11E-03	1.89E-03	1.40E-03	1.02E-03	7.48E-04	5.48E-04	4.01E-04	2.93E-04
63	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
64	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
65	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
66	0.00E+00	6.68E-06	3.34E-04	2.41E-03	4.73E-03	4.61E-03	3.58E-03	2.69E-03	2.03E-03	1.53E-03
67	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.30E-05	4.04E-04	2.68E-03	8.86E-03	1.77E-02
68	1.13E-04	8.55E-05	6.47E-05	4.88E-05	3.68E-05	2.78E-05	2.10E-05	1.58E-05	1.19E-05	9.00E-06
69	3.29E-03	6.13E-03	5.40E-03	4.16E-03	3.14E-03	2.36E-03	1.76E-03	1.32E-03	9.83E-04	7.34E-04
70	0.00E+00	0.00E+00	0.00E+00	2.55E-05	2.11E-04	6.07E-04	9.13E-04	9.41E-04	8.02E-04	6.33E-04
71	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
72	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.58E-05	2.73E-04	9.52E-04
73	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
74	3.38E-04	4.79E-04	4.54E-04	3.75E-04	2.99E-04	2.36E-04	1.84E-04	1.44E-04	1.12E-04	8.75E-05
75	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.22E-05	2.17E-04
76	5.00E-05	4.03E-05	3.25E-05	2.62E-05	2.11E-05	1.70E-05	1.37E-05	1.11E-05	8.94E-06	7.21E-06
77	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.66E-05	3.18E-04	6.12E-04	7.05E-04	6.56E-04
78	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
79	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
80	3.86E-03	2.92E-03	2.17E-03	1.60E-03	1.17E-03	8.63E-04	6.33E-04	4.65E-04	3.41E-04	2.50E-04
81	1.09E-03	9.79E-04	7.31E-04	5.34E-04	3.88E-04	2.81E-04	2.03E-04	1.47E-04	1.06E-04	7.68E-05
82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
83	5.38E-05	2.51E-04	3.10E-04	2.94E-04	2.59E-04	2.24E-04	1.94E-04	1.67E-04	1.43E-04	1.23E-04
84	1.88E-03	1.38E-03	9.96E-04	7.12E-04	5.07E-04	3.60E-04	2.56E-04	1.82E-04	1.29E-04	9.16E-05
85	0.00E+00	3.39E-05	7.53E-04	3.06E-03	4.62E-03	4.49E-03	3.77E-03	3.02E-03	2.38E-03	1.86E-03
86	8.89E-04	7.19E-04	5.75E-04	4.58E-04	3.63E-04	2.88E-04	2.28E-04	1.80E-04	1.42E-04	1.12E-04
87	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
88	1.21E-04	1.15E-04	9.88E-05	8.42E-05	7.16E-05	6.08E-05	5.16E-05	4.38E-05	3.72E-05	3.16E-05
89	5.70E-04	1.81E-03	1.84E-03	1.38E-03	9.96E-04	7.16E-04	5.14E-04	3.68E-04	2.64E-04	1.89E-04
90	0.00E+00	0.00E+00	0.00E+00	2.19E-05	2.66E-04	1.03E-03	1.91E-03	2.23E-03	2.00E-03	1.59E-03
91	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.75E-05
93	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
94	0.00E+00	3.15E-04	4.80E-03	1.38E-02	1.53E-02	1.19E-02	8.70E-03	6.38E-03	4.70E-03	3.46E-03
95	1.26E-05	1.10E-04	1.93E-04	1.82E-04	1.49E-04	1.18E-04	9.20E-05	7.14E-05	5.53E-05	4.28E-05
96	0.00E+00	0.00E+00	0.00E+00	5.64E-06	8.49E-05	3.96E-04	8.69E-04	1.18E-03	1.19E-03	1.02E-03
97	4.47E-03	3.45E-03	2.66E-03	2.05E-03	1.58E-03	1.22E-03	9.37E-04	7.22E-04	5.56E-04	4.28E-04
98	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.61E-05	6.30E-04	2.37E-03
99	2.16E-03	1.39E-03	8.88E-04	5.68E-04	3.64E-04	2.33E-04	1.49E-04	9.51E-05	6.08E-05	3.89E-05
100	1.12E-03	8.85E-04	6.99E-04	5.52E-04	4.36E-04	3.45E-04	2.72E-04	2.15E-04	1.70E-04	1.34E-04

Table F.4.13. Probabilistic Modeling Results for C-720 Building Area (fixed degradation scenario) - Plant Boundary POE (conc in mg/L)

RUN	0 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	30 yrs	35 yrs	40 yrs	45 yrs
1	0.00E+00	0.00E+00	0.00E+00	2.87E-04	4.31E-04	5.20E-04	4.95E-04	4.39E-04	3.80E-04	3.25E-04
2	0.00E+00	0.00E+00	1.07E-03	2.14E-03	2.25E-03	1.87E-03	1.45E-03	1.10E-03	8.17E-04	6.05E-04
3	0.00E+00	0.00E+00	1.65E-03	8.83E-03	1.20E-02	1.04E-02	7.98E-03	5.88E-03	4.27E-03	3.07E-03
4	0.00E+00	0.00E+00	0.00E+00	6.99E-08	3.76E-04	1.57E-02	9.69E-02	2.36E-01	3.40E-01	3.58E-01
5	0.00E+00	0.00E+00	1.86E-06	4.13E-03	7.61E-03	9.71E-03	9.56E-03	8.26E-03	6.79E-03	5.45E-03
6	0.00E+00	0.00E+00	0.00E+00	6.19E-05	9.91E-05	1.29E-04	1.35E-04	1.22E-04	1.05E-04	8.88E-05
7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.11E-05	3.18E-04	3.65E-04	3.52E-04	3.16E-04
8	0.00E+00	0.00E+00	4.34E-04	2.19E-03	3.07E-03	2.85E-03	2.33E-03	1.82E-03	1.40E-03	1.07E-03
9	0.00E+00	0.00E+00	0.00E+00	4.04E-05	2.12E-03	3.11E-03	3.57E-03	3.33E-03	2.93E-03	2.51E-03
10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.72E-04	1.12E-02	2.70E-02	2.64E-02	2.09E-02	1.58E-02
11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.81E-08	4.61E-04	1.69E-03	1.68E-03	1.43E-03
12	0.00E+00	0.00E+00	3.26E-08	6.76E-04	1.76E-03	2.30E-03	2.15E-03	1.82E-03	1.48E-03	1.19E-03
13	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.14E-04	1.00E-03	1.23E-03	1.23E-03	1.11E-03	9.73E-04
14	0.00E+00	0.00E+00	2.02E-05	2.53E-03	7.05E-03	9.03E-03	7.95E-03	6.14E-03	4.51E-03	3.23E-03
15	0.00E+00	0.00E+00	0.00E+00	8.99E-05	3.24E-03	6.74E-03	8.76E-03	8.91E-03	7.92E-03	6.68E-03
16	0.00E+00	0.00E+00	1.38E-03	9.05E-03	1.50E-02	1.47E-02	1.14E-02	8.20E-03	5.71E-03	3.92E-03
17	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.43E-10	2.04E-02	2.50E-02	2.11E-02	1.75E-02	1.44E-02
18	0.00E+00	0.00E+00	9.24E-04	1.52E-03	1.53E-03	1.26E-03	9.76E-04	7.38E-04	5.51E-04	4.10E-04
19	0.00E+00	0.00E+00	3.69E-10	3.02E-04	4.47E-04	4.88E-04	4.43E-04	3.78E-04	3.15E-04	2.59E-04
20	0.00E+00	0.00E+00	3.51E-07	1.65E-03	5.47E-03	5.52E-03	4.53E-03	3.50E-03	2.62E-03	1.94E-03
21	0.00E+00	0.00E+00	9.85E-09	3.39E-04	3.51E-03	7.69E-03	9.87E-03	9.20E-03	7.43E-03	5.65E-03
22	0.00E+00	0.00E+00	2.33E-09	1.34E-03	1.63E-02	3.35E-02	3.94E-02	3.53E-02	2.87E-02	2.26E-02
23	0.00E+00	0.00E+00	0.00E+00	4.53E-03	9.44E-03	7.84E-03	6.16E-03	4.73E-03	3.60E-03	2.72E-03
24	0.00E+00	0.00E+00	0.00E+00	2.53E-05	2.24E-03	9.16E-03	1.47E-02	1.56E-02	1.35E-02	1.09E-02
25	0.00E+00	0.00E+00	0.00E+00	6.46E-05	2.88E-04	2.55E-04	2.18E-04	1.85E-04	1.56E-04	1.31E-04
26	0.00E+00	0.00E+00	4.98E-05	2.20E-02	4.59E-02	5.45E-02	4.88E-02	4.02E-02	3.21E-02	2.53E-02
27	0.00E+00	0.00E+00	0.00E+00	5.19E-04	6.32E-04	6.71E-04	6.18E-04	5.42E-04	4.64E-04	3.91E-04
28	0.00E+00	0.00E+00	0.00E+00	3.51E-05	8.24E-04	7.71E-04	6.67E-04	5.66E-04	4.77E-04	3.99E-04
29	0.00E+00	0.00E+00	1.58E-09	1.06E-04	2.66E-03	7.84E-03	1.02E-02	9.11E-03	6.91E-03	4.91E-03
30	0.00E+00	2.38E-09	7.37E-04	8.64E-04	7.43E-04	5.87E-04	4.49E-04	3.39E-04	2.54E-04	1.90E-04
31	0.00E+00	2.11E-08	1.54E-03	2.05E-03	1.75E-03	1.32E-03	9.54E-04	6.76E-04	4.75E-04	3.32E-04
32	0.00E+00	0.00E+00	1.71E-06	2.49E-03	1.40E-02	2.29E-02	2.24E-02	1.76E-02	1.29E-02	9.20E-03
33	0.00E+00	0.00E+00	1.11E-08	1.24E-03	3.00E-02	8.65E-02	1.13E-01	1.01E-01	7.83E-02	5.74E-02
34	0.00E+00	0.00E+00	1.51E-03	4.77E-02	8.79E-02	8.58E-02	6.79E-02	5.07E-02	3.69E-02	2.66E-02
35	0.00E+00	0.00E+00	3.20E-04	3.67E-03	5.59E-03	5.68E-03	4.90E-03	4.04E-03	3.26E-03	2.61E-03
36	0.00E+00	0.00E+00	0.00E+00	2.99E-08	1.56E-03	2.14E-03	2.47E-03	2.32E-03	2.07E-03	1.80E-03
37	0.00E+00	1.63E-09	6.28E-03	1.15E-02	1.04E-02	7.87E-03	5.70E-03	4.06E-03	2.86E-03	2.01E-03
38	0.00E+00	0.00E+00	1.99E-04	3.92E-03	6.05E-03	5.61E-03	4.44E-03	3.33E-03	2.46E-03	1.79E-03
39	0.00E+00	0.00E+00	0.00E+00	1.27E-05	1.32E-03	6.45E-03	1.17E-02	1.33E-02	1.19E-02	9.59E-03
40	0.00E+00	0.00E+00	0.00E+00	2.85E-03	4.35E-03	5.04E-03	4.67E-03	4.05E-03	3.42E-03	2.86E-03
41	0.00E+00	0.00E+00	5.26E-06	2.22E-03	6.30E-03	7.39E-03	6.24E-03	4.76E-03	3.49E-03	2.53E-03
42	0.00E+00	0.00E+00	0.00E+00	2.38E-04	1.06E-03	1.37E-03	1.41E-03	1.27E-03	1.10E-03	9.48E-04
43	0.00E+00	0.00E+00	1.96E-03	5.59E-03	6.99E-03	6.00E-03	4.62E-03	3.41E-03	2.47E-03	1.77E-03
44	0.00E+00	2.62E-08	4.08E-03	7.24E-03	6.98E-03	5.52E-03	4.11E-03	2.99E-03	2.15E-03	1.54E-03
45	0.00E+00	0.00E+00	0.00E+00	1.71E-09	3.18E-05	1.09E-03	4.77E-03	9.07E-03	1.13E-02	1.11E-02
46	0.00E+00	0.00E+00	1.54E-04	4.92E-04	6.10E-04	5.95E-04	5.15E-04	4.25E-04	3.42E-04	2.73E-04
47	0.00E+00	0.00E+00	0.00E+00	1.95E-06	7.10E-04	2.79E-03	4.04E-03	4.17E-03	3.70E-03	3.11E-03
48	0.00E+00	0.00E+00	1.06E-04	3.50E-03	7.14E-03	8.40E-03	7.30E-03	5.74E-03	4.32E-03	3.19E-03
49	0.00E+00	0.00E+00	0.00E+00	5.17E-10	4.16E-06	2.15E-04	1.46E-03	3.71E-03	5.47E-03	5.86E-03
50	0.00E+00	0.00E+00	4.22E-04	3.09E-03	4.41E-03	3.92E-03	3.06E-03	2.28E-03	1.68E-03	1.22E-03

Table F.4.13. Probabilistic Modeling Results for C-720 Building Area (fixed degradation scenario) - Plant Boundary POE (conc in mg/L)

(continued)

RUN	0 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	30 yrs	35 yrs	40 yrs	45 yrs
51	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.70E-10	1.99E-04	9.20E-04	1.11E-03	1.05E-03	9.37E-04
52	0.00E+00	0.00E+00	1.99E-03	5.92E-03	6.92E-03	5.61E-03	4.15E-03	2.97E-03	2.10E-03	1.47E-03
53	0.00E+00	0.00E+00	2.39E-12	3.52E-05	2.55E-03	1.17E-02	1.99E-02	2.12E-02	1.79E-02	1.35E-02
54	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.15E-03	1.06E-03	8.91E-04	7.21E-04	5.75E-04	4.55E-04
55	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.43E-04	6.81E-04	7.85E-04	7.35E-04	6.51E-04	5.66E-04
56	0.00E+00	0.00E+00	2.65E-05	2.12E-03	5.06E-03	7.32E-03	7.41E-03	6.32E-03	5.08E-03	3.98E-03
57	0.00E+00	0.00E+00	2.46E-10	5.34E-03	9.42E-03	1.20E-02	1.18E-02	1.04E-02	8.79E-03	7.33E-03
58	0.00E+00	0.00E+00	2.01E-03	3.96E-03	4.53E-03	3.95E-03	3.20E-03	2.52E-03	1.95E-03	1.51E-03
59	0.00E+00	0.00E+00	1.71E-04	1.27E-02	2.18E-02	2.22E-02	1.85E-02	1.46E-02	1.13E-02	8.61E-03
60	0.00E+00	0.00E+00	5.49E-08	2.02E-03	9.58E-03	1.32E-02	1.27E-02	1.05E-02	8.29E-03	6.42E-03
61	0.00E+00	0.00E+00	1.15E-04	2.94E-02	6.26E-02	7.45E-02	6.65E-02	5.44E-02	4.31E-02	3.36E-02
62	0.00E+00	0.00E+00	5.34E-04	2.54E-03	3.74E-03	3.57E-03	2.91E-03	2.24E-03	1.68E-03	1.25E-03
63	0.00E+00	0.00E+00	5.70E-09	3.12E-04	6.17E-03	1.66E-02	2.28E-02	2.17E-02	1.71E-02	1.24E-02
64	0.00E+00	0.00E+00	0.00E+00	3.62E-08	9.74E-05	1.42E-03	3.79E-03	5.09E-03	4.69E-03	3.48E-03
65	0.00E+00	0.00E+00	0.00E+00	7.49E-07	4.78E-04	7.30E-03	2.64E-02	4.63E-02	5.31E-02	4.78E-02
66	0.00E+00	0.00E+00	5.22E-12	1.36E-04	2.74E-04	3.50E-04	3.41E-04	2.98E-04	2.50E-04	2.07E-04
67	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.48E-03	2.65E-02	3.68E-02	3.95E-02	3.62E-02	3.18E-02
68	0.00E+00	0.00E+00	6.11E-04	1.20E-03	1.40E-03	1.23E-03	1.00E-03	7.95E-04	6.22E-04	4.84E-04
69	0.00E+00	0.00E+00	1.36E-11	2.22E-03	4.09E-03	5.34E-03	5.43E-03	4.83E-03	4.11E-03	3.42E-03
70	0.00E+00	0.00E+00	5.73E-04	1.28E-02	2.17E-02	2.10E-02	1.70E-02	1.31E-02	9.86E-03	7.36E-03
71	0.00E+00	0.00E+00	0.00E+00	1.01E-05	7.88E-04	4.41E-03	9.62E-03	1.24E-02	1.16E-02	9.35E-03
72	0.00E+00	0.00E+00	0.00E+00	4.45E-09	1.56E-03	4.37E-03	3.79E-03	2.96E-03	2.24E-03	1.68E-03
73	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.05E-11	5.48E-07	3.08E-05	1.57E-04
74	0.00E+00	0.00E+00	1.82E-03	2.80E-03	2.67E-03	2.15E-03	1.64E-03	1.22E-03	8.97E-04	6.57E-04
75	0.00E+00	0.00E+00	7.95E-09	2.47E-03	1.74E-02	2.89E-02	3.05E-02	2.64E-02	2.14E-02	1.70E-02
76	0.00E+00	0.00E+00	2.57E-03	4.07E-03	3.82E-03	3.09E-03	2.38E-03	1.80E-03	1.35E-03	1.01E-03
77	0.00E+00	0.00E+00	0.00E+00	2.73E-07	7.66E-04	1.07E-03	1.20E-03	1.23E-03	1.13E-03	1.00E-03
78	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.03E-08	3.13E-06	7.59E-05	5.03E-04	1.60E-03
79	0.00E+00	0.00E+00	1.38E-09	8.08E-04	4.15E-02	1.74E-01	2.75E-01	2.72E-01	2.19E-01	1.63E-01
80	0.00E+00	0.00E+00	1.73E-03	2.94E-03	2.92E-03	2.40E-03	1.86E-03	1.41E-03	1.06E-03	7.92E-04
81	0.00E+00	0.00E+00	2.78E-03	6.70E-03	7.35E-03	5.98E-03	4.50E-03	3.29E-03	2.37E-03	1.70E-03
82	0.00E+00	0.00E+00	0.00E+00	1.88E-04	1.16E-01	2.75E-01	2.37E-01	1.73E-01	1.21E-01	8.37E-02
83	0.00E+00	0.00E+00	9.05E-03	2.37E-02	3.01E-02	2.68E-02	2.17E-02	1.70E-02	1.31E-02	9.99E-03
84	0.00E+00	0.00E+00	1.43E-02	3.31E-02	3.70E-02	3.09E-02	2.39E-02	1.81E-02	1.34E-02	9.95E-03
85	0.00E+00	0.00E+00	1.90E-07	2.84E-03	5.30E-03	6.72E-03	6.46E-03	5.58E-03	4.63E-03	3.77E-03
86	0.00E+00	0.00E+00	2.80E-03	5.76E-03	7.14E-03	6.49E-03	5.43E-03	4.41E-03	3.53E-03	2.81E-03
87	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.71E-06	2.13E-04	1.54E-03	3.77E-03	5.76E-03	6.73E-03
88	0.00E+00	0.00E+00	8.73E-04	4.82E-03	7.29E-03	7.75E-03	6.81E-03	5.66E-03	4.58E-03	3.66E-03
89	0.00E+00	2.20E-09	2.52E-03	3.16E-03	2.46E-03	1.71E-03	1.14E-03	7.45E-04	4.85E-04	3.15E-04
90	0.00E+00	0.00E+00	3.71E-08	1.28E-03	2.69E-03	3.20E-03	2.92E-03	2.46E-03	2.01E-03	1.62E-03
91	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.96E-10	5.52E-05	3.99E-04	4.70E-04	4.23E-04
92	0.00E+00	0.00E+00	0.00E+00	1.26E-04	2.95E-03	5.50E-03	6.09E-03	5.48E-03	4.59E-03	3.74E-03
93	0.00E+00	0.00E+00	6.18E-07	2.96E-03	1.81E-02	2.83E-02	2.66E-02	2.09E-02	1.55E-02	1.13E-02
94	0.00E+00	0.00E+00	5.21E-05	1.09E-03	1.72E-03	1.83E-03	1.58E-03	1.28E-03	1.00E-03	7.73E-04
95	0.00E+00	0.00E+00	0.00E+00	8.38E-04	1.49E-03	1.80E-03	1.70E-03	1.48E-03	1.25E-03	1.04E-03
96	0.00E+00	0.00E+00	2.00E-06	3.45E-03	6.77E-03	7.63E-03	6.73E-03	5.55E-03	4.45E-03	3.53E-03
97	0.00E+00	0.00E+00	2.13E-04	4.48E-04	5.72E-04	5.06E-04	4.01E-04	3.05E-04	2.27E-04	1.68E-04
98	0.00E+00	0.00E+00	9.59E-05	3.65E-03	6.53E-03	6.51E-03	5.15E-03	3.77E-03	2.67E-03	1.86E-03
99	0.00E+00	0.00E+00	0.00E+00	2.65E-04	4.07E-04	4.82E-04	4.50E-04	3.94E-04	3.36E-04	2.84E-04
100	0.00E+00	0.00E+00	9.31E-04	3.69E-03	3.81E-03	3.23E-03	2.57E-03	1.99E-03	1.52E-03	1.15E-03

Table F.4.13. Probabilistic Modeling Results for C-720 Building Area (fixed degradation scenario) - Plant Boundary POE (conc in mg/L)

(continued)

RUN	50 yrs	55 yrs	60 yrs	65 yrs	70 yrs	75 yrs	80 yrs	85 yrs	90 yrs	95 yrs
1	2.76E-04	2.33E-04	1.97E-04	1.67E-04	1.41E-04	1.19E-04	1.00E-04	8.43E-05	7.11E-05	6.00E-05
2	4.46E-04	3.29E-04	2.43E-04	1.79E-04	1.32E-04	9.71E-05	7.15E-05	5.26E-05	3.88E-05	2.86E-05
3	2.20E-03	1.58E-03	1.13E-03	8.07E-04	5.77E-04	4.13E-04	2.95E-04	2.11E-04	1.51E-04	1.08E-04
4	3.16E-01	2.54E-01	1.95E-01	1.47E-01	1.10E-01	8.18E-02	6.07E-02	4.50E-02	3.33E-02	2.47E-02
5	4.31E-03	3.39E-03	2.65E-03	2.07E-03	1.62E-03	1.26E-03	9.80E-04	7.63E-04	5.93E-04	4.62E-04
6	7.42E-05	6.16E-05	5.10E-05	4.22E-05	3.48E-05	2.87E-05	2.37E-05	1.95E-05	1.61E-05	1.33E-05
7	2.78E-04	2.43E-04	2.11E-04	1.82E-04	1.58E-04	1.36E-04	1.17E-04	1.01E-04	8.74E-05	7.54E-05
8	8.10E-04	6.13E-04	4.64E-04	3.50E-04	2.65E-04	2.00E-04	1.51E-04	1.14E-04	8.65E-05	6.54E-05
9	2.12E-03	1.79E-03	1.50E-03	1.25E-03	1.05E-03	8.76E-04	7.32E-04	6.11E-04	5.10E-04	4.26E-04
10	1.17E-02	8.63E-03	6.34E-03	4.65E-03	3.41E-03	2.50E-03	1.83E-03	1.34E-03	9.85E-04	7.22E-04
11	1.19E-03	9.81E-04	8.09E-04	6.66E-04	5.48E-04	4.51E-04	3.71E-04	3.05E-04	2.51E-04	2.06E-04
12	9.47E-04	7.51E-04	5.95E-04	4.71E-04	3.73E-04	2.95E-04	2.34E-04	1.85E-04	1.46E-04	1.16E-04
13	8.44E-04	7.28E-04	6.26E-04	5.37E-04	4.61E-04	3.95E-04	3.39E-04	2.90E-04	2.49E-04	2.13E-04
14	2.30E-03	1.62E-03	1.14E-03	8.03E-04	5.65E-04	3.97E-04	2.79E-04	1.96E-04	1.37E-04	9.65E-05
15	5.51E-03	4.48E-03	3.62E-03	2.92E-03	2.34E-03	1.88E-03	1.50E-03	1.20E-03	9.60E-04	7.68E-04
16	2.68E-03	1.83E-03	1.25E-03	8.48E-04	5.77E-04	3.93E-04	2.67E-04	1.82E-04	1.24E-04	8.43E-05
17	1.18E-02	9.60E-03	7.83E-03	6.39E-03	5.21E-03	4.25E-03	3.46E-03	2.82E-03	2.30E-03	1.88E-03
18	3.04E-04	2.26E-04	1.67E-04	1.24E-04	9.18E-05	6.80E-05	5.04E-05	3.73E-05	2.76E-05	2.05E-05
19	2.12E-04	1.72E-04	1.40E-04	1.14E-04	9.22E-05	7.47E-05	6.06E-05	4.91E-05	3.98E-05	3.22E-05
20	1.42E-03	1.04E-03	7.60E-04	5.54E-04	4.03E-04	2.94E-04	2.14E-04	1.55E-04	1.13E-04	8.23E-05
21	4.19E-03	3.07E-03	2.24E-03	1.62E-03	1.17E-03	8.50E-04	6.15E-04	4.44E-04	3.21E-04	2.32E-04
22	1.75E-02	1.34E-02	1.03E-02	7.85E-03	5.99E-03	4.57E-03	3.49E-03	2.66E-03	2.03E-03	1.55E-03
23	2.05E-03	1.55E-03	1.16E-03	8.76E-04	6.59E-04	4.96E-04	3.73E-04	2.81E-04	2.11E-04	1.59E-04
24	8.50E-03	6.55E-03	5.02E-03	3.83E-03	2.92E-03	2.23E-03	1.70E-03	1.29E-03	9.86E-04	7.52E-04
25	1.10E-04	9.26E-05	7.78E-05	6.53E-05	5.48E-05	4.60E-05	3.86E-05	3.24E-05	2.72E-05	2.28E-05
26	1.98E-02	1.54E-02	1.20E-02	9.32E-03	7.24E-03	5.62E-03	4.36E-03	3.38E-03	2.63E-03	2.04E-03
27	3.27E-04	2.72E-04	2.26E-04	1.87E-04	1.54E-04	1.27E-04	1.05E-04	8.66E-05	7.14E-05	5.89E-05
28	3.34E-04	2.78E-04	2.32E-04	1.94E-04	1.61E-04	1.35E-04	1.12E-04	9.35E-05	7.79E-05	6.49E-05
29	3.40E-03	2.33E-03	1.59E-03	1.08E-03	7.34E-04	4.99E-04	3.39E-04	2.30E-04	1.56E-04	1.06E-04
30	1.42E-04	1.06E-04	7.88E-05	5.88E-05	4.38E-05	3.27E-05	2.44E-05	1.82E-05	1.36E-05	1.01E-05
31	2.32E-04	1.62E-04	1.13E-04	7.89E-05	5.50E-05	3.83E-05	2.67E-05	1.87E-05	1.30E-05	9.08E-06
32	6.46E-03	4.51E-03	3.14E-03	2.18E-03	1.52E-03	1.05E-03	7.33E-04	5.09E-04	3.54E-04	2.46E-04
33	4.11E-02	2.92E-02	2.06E-02	1.45E-02	1.02E-02	7.22E-03	5.08E-03	3.58E-03	2.52E-03	1.77E-03
34	1.91E-02	1.37E-02	9.80E-03	7.01E-03	5.01E-03	3.59E-03	2.56E-03	1.83E-03	1.31E-03	9.38E-04
35	2.08E-03	1.66E-03	1.32E-03	1.05E-03	8.30E-04	6.59E-04	5.23E-04	4.15E-04	3.29E-04	2.61E-04
36	1.55E-03	1.32E-03	1.13E-03	9.62E-04	8.18E-04	6.95E-04	5.91E-04	5.02E-04	4.27E-04	3.62E-04
37	1.41E-03	9.93E-04	6.97E-04	4.89E-04	3.43E-04	2.41E-04	1.69E-04	1.19E-04	8.32E-05	5.83E-05
38	1.30E-03	9.45E-04	6.85E-04	4.97E-04	3.60E-04	2.61E-04	1.89E-04	1.37E-04	9.92E-05	7.19E-05
39	7.42E-03	5.64E-03	4.25E-03	3.19E-03	2.39E-03	1.79E-03	1.34E-03	9.99E-04	7.47E-04	5.59E-04
40	2.36E-03	1.95E-03	1.61E-03	1.32E-03	1.09E-03	8.92E-04	7.33E-04	6.02E-04	4.94E-04	4.06E-04
41	1.82E-03	1.31E-03	9.36E-04	6.70E-04	4.80E-04	3.44E-04	2.46E-04	1.76E-04	1.26E-04	9.04E-05
42	8.07E-04	6.84E-04	5.79E-04	4.90E-04	4.14E-04	3.49E-04	2.95E-04	2.49E-04	2.10E-04	1.77E-04
43	1.26E-03	8.99E-04	6.39E-04	4.54E-04	3.22E-04	2.28E-04	1.62E-04	1.15E-04	8.16E-05	5.79E-05
44	1.10E-03	7.82E-04	5.57E-04	3.97E-04	2.83E-04	2.01E-04	1.43E-04	1.02E-04	7.27E-05	5.18E-05
45	9.73E-03	8.08E-03	6.56E-03	5.27E-03	4.22E-03	3.37E-03	2.69E-03	2.14E-03	1.71E-03	1.36E-03
46	2.16E-04	1.70E-04	1.34E-04	1.05E-04	8.28E-05	6.51E-05	5.11E-05	4.01E-05	3.15E-05	2.47E-05
47	2.56E-03	2.09E-03	1.69E-03	1.37E-03	1.11E-03	8.96E-04	7.24E-04	5.85E-04	4.73E-04	3.82E-04
48	2.34E-03	1.70E-03	1.23E-03	8.95E-04	6.48E-04	4.69E-04	3.40E-04	2.46E-04	1.78E-04	1.29E-04
49	5.22E-03	4.21E-03	3.22E-03	2.40E-03	1.77E-03	1.29E-03	9.44E-04	6.89E-04	5.03E-04	3.66E-04
50	8.87E-04	6.44E-04	4.67E-04	3.38E-04	2.45E-04	1.78E-04	1.29E-04	9.34E-05	6.77E-05	4.90E-05

Table F.4.13. Probabilistic Modeling Results for C-720 Building Area (fixed degradation scenario) - Plant Boundary POE (conc in mg/L)

(continued)

RUN	50 yrs	55 yrs	60 yrs	65 yrs	70 yrs	75 yrs	80 yrs	85 yrs	90 yrs	95 yrs
51	8.18E-04	7.07E-04	6.09E-04	5.24E-04	4.50E-04	3.86E-04	3.31E-04	2.84E-04	2.43E-04	2.09E-04
52	1.03E-03	7.22E-04	5.05E-04	3.53E-04	2.47E-04	1.72E-04	1.21E-04	8.42E-05	5.89E-05	4.11E-05
53	9.76E-03	6.89E-03	4.81E-03	3.35E-03	2.32E-03	1.61E-03	1.12E-03	7.74E-04	5.36E-04	3.71E-04
54	3.58E-04	2.81E-04	2.21E-04	1.74E-04	1.36E-04	1.07E-04	8.40E-05	6.60E-05	5.18E-05	4.07E-05
55	4.87E-04	4.17E-04	3.56E-04	3.04E-04	2.59E-04	2.21E-04	1.88E-04	1.60E-04	1.36E-04	1.16E-04
56	3.08E-03	2.36E-03	1.80E-03	1.38E-03	1.05E-03	7.98E-04	6.07E-04	4.62E-04	3.52E-04	2.68E-04
57	6.06E-03	4.98E-03	4.08E-03	3.34E-03	2.73E-03	2.23E-03	1.82E-03	1.49E-03	1.21E-03	9.92E-04
58	1.16E-03	8.88E-04	6.80E-04	5.21E-04	3.99E-04	3.05E-04	2.34E-04	1.79E-04	1.37E-04	1.05E-04
59	6.53E-03	4.95E-03	3.74E-03	2.83E-03	2.14E-03	1.62E-03	1.22E-03	9.25E-04	6.99E-04	5.28E-04
60	4.92E-03	3.75E-03	2.86E-03	2.17E-03	1.65E-03	1.25E-03	9.53E-04	7.24E-04	5.50E-04	4.18E-04
61	2.60E-02	2.00E-02	1.54E-02	1.18E-02	9.06E-03	6.95E-03	5.33E-03	4.09E-03	3.14E-03	2.41E-03
62	9.23E-04	6.78E-04	4.98E-04	3.65E-04	2.68E-04	1.96E-04	1.44E-04	1.05E-04	7.71E-05	5.65E-05
63	8.68E-03	6.00E-03	4.12E-03	2.82E-03	1.93E-03	1.32E-03	9.00E-04	6.15E-04	4.20E-04	2.87E-04
64	2.31E-03	1.46E-03	9.04E-04	5.53E-04	3.37E-04	2.05E-04	1.24E-04	7.51E-05	4.55E-05	2.76E-05
65	3.81E-02	2.87E-02	2.11E-02	1.53E-02	1.11E-02	7.99E-03	5.75E-03	4.14E-03	2.97E-03	2.14E-03
66	1.70E-04	1.38E-04	1.13E-04	9.16E-05	7.45E-05	6.05E-05	4.92E-05	3.99E-05	3.24E-05	2.64E-05
67	2.74E-02	2.35E-02	2.01E-02	1.71E-02	1.46E-02	1.24E-02	1.05E-02	8.97E-03	7.63E-03	6.49E-03
68	3.76E-04	2.91E-04	2.26E-04	1.75E-04	1.35E-04	1.05E-04	8.10E-05	6.27E-05	4.86E-05	3.76E-05
69	2.82E-03	2.32E-03	1.89E-03	1.54E-03	1.26E-03	1.02E-03	8.32E-04	6.77E-04	5.50E-04	4.47E-04
70	5.47E-03	4.06E-03	3.01E-03	2.23E-03	1.65E-03	1.22E-03	9.07E-04	6.71E-04	4.97E-04	3.68E-04
71	7.08E-03	5.22E-03	3.80E-03	2.76E-03	1.99E-03	1.44E-03	1.04E-03	7.48E-04	5.40E-04	3.89E-04
72	1.25E-03	9.31E-04	6.91E-04	5.13E-04	3.81E-04	2.82E-04	2.10E-04	1.55E-04	1.15E-04	8.56E-05
73	2.94E-04	3.56E-04	3.55E-04	3.26E-04	2.89E-04	2.53E-04	2.20E-04	1.91E-04	1.66E-04	1.43E-04
74	4.80E-04	3.50E-04	2.55E-04	1.86E-04	1.36E-04	9.89E-05	7.21E-05	5.26E-05	3.83E-05	2.79E-05
75	1.33E-02	1.04E-02	8.11E-03	6.30E-03	4.90E-03	3.81E-03	2.96E-03	2.30E-03	1.79E-03	1.39E-03
76	7.53E-04	5.61E-04	4.18E-04	3.11E-04	2.31E-04	1.72E-04	1.28E-04	9.54E-05	7.10E-05	5.28E-05
77	8.70E-04	7.42E-04	6.28E-04	5.28E-04	4.42E-04	3.69E-04	3.08E-04	2.56E-04	2.14E-04	1.78E-04
78	3.23E-03	4.83E-03	5.86E-03	6.15E-03	5.86E-03	5.23E-03	4.50E-03	3.79E-03	3.15E-03	2.59E-03
79	1.17E-01	8.33E-02	5.89E-02	4.15E-02	2.92E-02	2.06E-02	1.45E-02	1.02E-02	7.17E-03	5.04E-03
80	5.91E-04	4.40E-04	3.28E-04	2.44E-04	1.82E-04	1.35E-04	1.01E-04	7.49E-05	5.58E-05	4.15E-05
81	1.21E-03	8.66E-04	6.17E-04	4.39E-04	3.13E-04	2.23E-04	1.59E-04	1.13E-04	8.05E-05	5.73E-05
82	5.73E-02	3.91E-02	2.66E-02	1.81E-02	1.23E-02	8.40E-03	5.71E-03	3.89E-03	2.65E-03	1.80E-03
83	7.61E-03	5.78E-03	4.39E-03	3.33E-03	2.53E-03	1.92E-03	1.46E-03	1.11E-03	8.39E-04	6.37E-04
84	7.35E-03	5.42E-03	3.99E-03	2.94E-03	2.17E-03	1.60E-03	1.18E-03	8.66E-04	6.38E-04	4.70E-04
85	3.04E-03	2.44E-03	1.95E-03	1.56E-03	1.25E-03	9.96E-04	7.95E-04	6.34E-04	5.06E-04	4.04E-04
86	2.23E-03	1.76E-03	1.39E-03	1.10E-03	8.69E-04	6.86E-04	5.42E-04	4.28E-04	3.38E-04	2.67E-04
87	6.62E-03	5.90E-03	5.01E-03	4.16E-03	3.41E-03	2.77E-03	2.24E-03	1.82E-03	1.47E-03	1.18E-03
88	2.90E-03	2.30E-03	1.81E-03	1.43E-03	1.13E-03	8.88E-04	6.99E-04	5.51E-04	4.33E-04	3.41E-04
89	2.04E-04	1.32E-04	8.58E-05	5.56E-05	3.60E-05	2.34E-05	1.51E-05	9.81E-06	6.36E-06	4.12E-06
90	1.30E-03	1.04E-03	8.29E-04	6.60E-04	5.26E-04	4.18E-04	3.33E-04	2.65E-04	2.11E-04	1.68E-04
91	3.71E-04	3.23E-04	2.80E-04	2.42E-04	2.09E-04	1.80E-04	1.56E-04	1.34E-04	1.16E-04	9.99E-05
92	3.02E-03	2.42E-03	1.93E-03	1.54E-03	1.22E-03	9.74E-04	7.75E-04	6.17E-04	4.91E-04	3.91E-04
93	8.14E-03	5.85E-03	4.19E-03	3.01E-03	2.15E-03	1.54E-03	1.10E-03	7.90E-04	5.66E-04	4.05E-04
94	5.93E-04	4.53E-04	3.46E-04	2.64E-04	2.01E-04	1.53E-04	1.16E-04	8.84E-05	6.73E-05	5.12E-05
95	8.62E-04	7.11E-04	5.85E-04	4.81E-04	3.95E-04	3.24E-04	2.66E-04	2.18E-04	1.79E-04	1.47E-04
96	2.79E-03	2.20E-03	1.73E-03	1.36E-03	1.06E-03	8.36E-04	6.56E-04	5.15E-04	4.04E-04	3.17E-04
97	1.23E-04	9.06E-05	6.64E-05	4.87E-05	3.56E-05	2.61E-05	1.91E-05	1.40E-05	1.03E-05	7.51E-06
98	1.29E-03	8.91E-04	6.14E-04	4.23E-04	2.91E-04	2.00E-04	1.38E-04	9.49E-05	6.53E-05	4.49E-05
99	2.38E-04	1.99E-04	1.66E-04	1.38E-04	1.15E-04	9.60E-05	7.99E-05	6.65E-05	5.54E-05	4.61E-05
100	8.70E-04	6.57E-04	4.96E-04	3.74E-04	2.82E-04	2.13E-04	1.60E-04	1.21E-04	9.11E-05	6.87E-05

Table F.4.14. Probabilistic Modeling Results for C-720 Building Area (fixed degradation scenario) - Property Boundary POE (conc in mg/L)

RUN	0 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	30 yrs	35 yrs	40 yrs	45 yrs
1	0.00E+00	0.00E+00	0.00E+00	1.73E-06	2.74E-04	3.58E-04	3.76E-04	3.41E-04	2.98E-04	2.56E-04
2	0.00E+00	0.00E+00	4.14E-07	9.12E-04	1.57E-03	1.57E-03	1.29E-03	9.96E-04	7.50E-04	5.58E-04
3	0.00E+00	0.00E+00	9.24E-10	6.22E-04	4.30E-03	6.46E-03	5.88E-03	4.58E-03	3.39E-03	2.47E-03
4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.93E-08	1.52E-05	6.72E-04	7.79E-03
5	0.00E+00	0.00E+00	0.00E+00	1.05E-06	1.11E-03	3.45E-03	4.85E-03	5.23E-03	4.69E-03	3.92E-03
6	0.00E+00	0.00E+00	0.00E+00	4.76E-08	3.59E-05	5.57E-05	7.07E-05	7.20E-05	6.45E-05	5.55E-05
7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.39E-12	5.21E-05	2.13E-04	2.47E-04	2.42E-04
8	0.00E+00	0.00E+00	1.65E-10	4.05E-04	1.59E-03	2.18E-03	2.02E-03	1.65E-03	1.29E-03	9.90E-04
9	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.03E-05	1.18E-03	2.07E-03	2.50E-03	2.43E-03	2.16E-03
10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.43E-09	1.90E-05	1.41E-03	8.92E-03	1.64E-02
11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.29E-12	2.23E-06	2.23E-04	9.65E-04
12	0.00E+00	0.00E+00	0.00E+00	1.66E-08	1.13E-04	6.94E-04	1.13E-03	1.20E-03	1.05E-03	8.72E-04
13	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.27E-04	5.80E-04	7.10E-04	7.09E-04	6.39E-04
14	0.00E+00	0.00E+00	0.00E+00	1.40E-07	2.03E-04	1.90E-03	4.06E-03	4.74E-03	4.09E-03	3.14E-03
15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.62E-07	1.80E-04	1.85E-03	4.01E-03	5.34E-03	5.57E-03
16	0.00E+00	0.00E+00	1.03E-12	1.36E-04	3.15E-03	6.74E-03	8.18E-03	6.91E-03	5.12E-03	3.61E-03
17	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.68E-07	7.16E-03	1.37E-02	1.17E-02	9.76E-03
18	0.00E+00	0.00E+00	1.11E-05	6.60E-04	9.26E-04	8.53E-04	6.85E-04	5.26E-04	3.96E-04	2.95E-04
19	0.00E+00	0.00E+00	0.00E+00	7.81E-07	1.54E-04	2.37E-04	2.59E-04	2.35E-04	2.01E-04	1.67E-04
20	0.00E+00	0.00E+00	0.00E+00	7.28E-11	1.19E-05	7.56E-04	2.61E-03	3.10E-03	2.68E-03	2.10E-03
21	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.33E-07	8.83E-05	1.10E-03	3.35E-03	5.35E-03	5.87E-03
22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.89E-06	6.55E-04	6.44E-03	1.59E-02	2.13E-02	2.08E-02
23	0.00E+00	0.00E+00	0.00E+00	4.83E-09	7.07E-03	6.39E-03	5.15E-03	4.00E-03	3.06E-03	2.32E-03
24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.10E-11	1.36E-06	1.54E-04	1.56E-03	4.74E-03	7.61E-03
25	0.00E+00	0.00E+00	0.00E+00	3.72E-13	6.23E-05	1.63E-04	1.45E-04	1.24E-04	1.05E-04	8.85E-05
26	0.00E+00	0.00E+00	0.00E+00	1.85E-05	7.66E-03	2.48E-02	3.43E-02	3.32E-02	2.80E-02	2.26E-02
27	0.00E+00	0.00E+00	0.00E+00	7.64E-05	3.17E-04	3.64E-04	3.57E-04	3.20E-04	2.77E-04	2.35E-04
28	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.52E-06	3.33E-04	4.31E-04	3.79E-04	3.24E-04	2.74E-04
29	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.39E-09	4.32E-06	2.42E-04	1.84E-03	4.78E-03	6.69E-03
30	0.00E+00	0.00E+00	4.43E-04	5.72E-04	5.07E-04	4.05E-04	3.11E-04	2.35E-04	1.76E-04	1.32E-04
31	0.00E+00	0.00E+00	4.87E-04	1.34E-03	1.42E-03	1.13E-03	8.37E-04	5.99E-04	4.22E-04	2.96E-04
32	0.00E+00	0.00E+00	0.00E+00	1.36E-10	1.18E-05	1.02E-03	6.26E-03	1.26E-02	1.43E-02	1.22E-02
33	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.05E-08	1.21E-04	4.71E-03	2.78E-02	6.14E-02	7.75E-02
34	0.00E+00	0.00E+00	0.00E+00	8.43E-05	1.24E-02	4.28E-02	5.51E-02	4.79E-02	3.68E-02	2.71E-02
35	0.00E+00	0.00E+00	0.00E+00	1.01E-03	3.09E-03	4.23E-03	4.05E-03	3.44E-03	2.82E-03	2.27E-03
36	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.92E-04	1.09E-03	1.40E-03	1.49E-03	1.36E-03	1.20E-03
37	0.00E+00	0.00E+00	5.88E-04	6.24E-03	8.35E-03	6.94E-03	5.17E-03	3.71E-03	2.63E-03	1.86E-03
38	0.00E+00	0.00E+00	0.00E+00	2.44E-05	1.63E-03	3.82E-03	4.22E-03	3.52E-03	2.69E-03	2.00E-03
39	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.56E-12	3.11E-07	5.15E-05	7.18E-04	2.77E-03	5.29E-03
40	0.00E+00	0.00E+00	0.00E+00	1.14E-04	2.36E-03	3.32E-03	3.57E-03	3.22E-03	2.77E-03	2.33E-03
41	0.00E+00	0.00E+00	0.00E+00	7.97E-09	7.41E-05	1.36E-03	3.36E-03	3.97E-03	3.43E-03	2.63E-03
42	0.00E+00	0.00E+00	0.00E+00	2.09E-11	4.46E-04	6.85E-04	8.22E-04	7.83E-04	6.95E-04	6.01E-04
43	0.00E+00	0.00E+00	1.94E-06	1.76E-03	4.21E-03	4.92E-03	4.15E-03	3.17E-03	2.34E-03	1.69E-03
44	0.00E+00	0.00E+00	1.26E-03	3.44E-03	4.14E-03	3.46E-03	2.63E-03	1.93E-03	1.39E-03	9.97E-04
45	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.36E-12	7.94E-08	1.33E-05	2.57E-04	1.43E-03
46	0.00E+00	0.00E+00	4.32E-11	1.87E-04	2.87E-04	3.34E-04	3.11E-04	2.65E-04	2.17E-04	1.74E-04
47	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.11E-11	1.23E-06	1.30E-04	9.22E-04	1.98E-03	2.53E-03
48	0.00E+00	0.00E+00	0.00E+00	7.60E-06	9.17E-04	2.97E-03	4.34E-03	4.25E-03	3.48E-03	2.67E-03
49	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.22E-11	3.82E-08	2.71E-06	4.52E-05
50	0.00E+00	0.00E+00	1.26E-11	1.15E-04	1.34E-03	2.24E-03	2.16E-03	1.72E-03	1.29E-03	9.53E-04

Table F.4.14. Probabilistic Modeling Results for C-720 Building Area (fixed degradation scenario) - Property Boundary POE (conc in mg/L)

(continued)

RUN	0 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	30 yrs	35 yrs	40 yrs	45 yrs
51	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.31E-12	1.93E-06	1.48E-04	4.76E-04	5.98E-04
52	0.00E+00	0.00E+00	3.57E-06	1.76E-03	4.49E-03	4.96E-03	3.98E-03	2.94E-03	2.10E-03	1.48E-03
53	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.81E-07	3.95E-05	7.36E-04	3.53E-03	7.68E-03
54	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.00E-05	6.53E-04	5.73E-04	4.74E-04	3.81E-04	3.03E-04
55	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.69E-07	2.31E-04	3.64E-04	4.14E-04	3.88E-04	3.44E-04
56	0.00E+00	0.00E+00	0.00E+00	7.98E-06	8.78E-04	2.70E-03	4.40E-03	4.91E-03	4.36E-03	3.56E-03
57	0.00E+00	0.00E+00	0.00E+00	1.63E-04	3.41E-03	5.48E-03	6.55E-03	6.20E-03	5.40E-03	4.56E-03
58	0.00E+00	0.00E+00	1.62E-06	1.55E-03	2.42E-03	2.46E-03	2.09E-03	1.67E-03	1.31E-03	1.01E-03
59	0.00E+00	0.00E+00	0.00E+00	2.33E-05	3.98E-03	1.07E-02	1.28E-02	1.14E-02	9.18E-03	7.14E-03
60	0.00E+00	0.00E+00	0.00E+00	4.54E-11	1.94E-05	1.42E-03	5.51E-03	8.07E-03	8.06E-03	6.83E-03
61	0.00E+00	0.00E+00	0.00E+00	2.24E-05	8.23E-03	2.83E-02	4.02E-02	3.93E-02	3.30E-02	2.64E-02
62	0.00E+00	0.00E+00	1.13E-09	3.51E-04	1.61E-03	2.40E-03	2.32E-03	1.90E-03	1.47E-03	1.10E-03
63	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.85E-09	1.25E-05	5.93E-04	3.98E-03	9.87E-03	1.42E-02
64	0.00E+00	0.00E+00	0.00E+00	7.49E-07	4.78E-04	7.30E-03	2.64E-02	4.63E-02	5.31E-02	4.78E-02
65	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.81E-10	5.80E-07	5.23E-05	8.22E-04	4.47E-03
66	0.00E+00	0.00E+00	0.00E+00	6.18E-09	4.45E-05	1.33E-04	1.79E-04	1.83E-04	1.63E-04	1.38E-04
67	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.20E-04	9.45E-03	2.25E-02	2.81E-02	2.79E-02
68	0.00E+00	0.00E+00	1.18E-04	5.89E-04	8.48E-04	8.02E-04	6.69E-04	5.36E-04	4.21E-04	3.29E-04
69	0.00E+00	0.00E+00	0.00E+00	1.19E-05	1.71E-03	3.04E-03	3.87E-03	3.87E-03	3.42E-03	2.90E-03
70	0.00E+00	0.00E+00	0.00E+00	1.20E-04	5.74E-03	1.32E-02	1.48E-02	1.25E-02	9.76E-03	7.40E-03
71	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.51E-12	1.66E-07	2.63E-05	4.13E-04	1.93E-03	4.47E-03
72	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.07E-10	4.19E-05	1.33E-03	2.38E-03	2.09E-03	1.63E-03
73	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.31E-11
74	0.00E+00	0.00E+00	6.89E-06	1.17E-03	1.58E-03	1.43E-03	1.13E-03	8.56E-04	6.36E-04	4.67E-04
75	0.00E+00	0.00E+00	0.00E+00	1.88E-11	2.78E-05	2.66E-03	1.19E-02	1.96E-02	2.10E-02	1.84E-02
76	0.00E+00	0.00E+00	9.53E-04	1.96E-03	2.12E-03	1.76E-03	1.38E-03	1.05E-03	7.87E-04	5.89E-04
77	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.91E-07	2.28E-04	5.88E-04	6.85E-04	7.28E-04	6.96E-04
78	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.11E-10
79	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.10E-09	1.98E-05	2.21E-03	2.67E-02	9.56E-02	1.67E-01
80	0.00E+00	0.00E+00	3.81E-04	1.54E-03	1.95E-03	1.71E-03	1.36E-03	1.04E-03	7.85E-04	5.88E-04
81	0.00E+00	0.00E+00	5.03E-06	2.01E-03	4.05E-03	4.14E-03	3.32E-03	2.49E-03	1.81E-03	1.31E-03
82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.17E-08	9.02E-04	4.24E-02	1.33E-01	1.45E-01	1.13E-01
83	0.00E+00	0.00E+00	1.45E-05	7.55E-03	1.46E-02	1.60E-02	1.37E-02	1.09E-02	8.50E-03	6.53E-03
84	0.00E+00	0.00E+00	2.80E-04	1.14E-02	1.95E-02	1.89E-02	1.53E-02	1.17E-02	8.77E-03	6.52E-03
85	0.00E+00	0.00E+00	0.00E+00	4.28E-06	1.60E-03	3.55E-03	4.69E-03	4.68E-03	4.08E-03	3.40E-03
86	0.00E+00	0.00E+00	7.84E-05	2.46E-03	3.70E-03	3.71E-03	3.19E-03	2.61E-03	2.10E-03	1.68E-03
87	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.63E-10	4.86E-07	2.15E-05	2.07E-04
88	0.00E+00	0.00E+00	2.94E-10	1.34E-03	3.06E-03	4.11E-03	4.02E-03	3.45E-03	2.84E-03	2.29E-03
89	0.00E+00	0.00E+00	1.12E-05	1.35E-03	1.67E-03	1.30E-03	9.02E-04	6.00E-04	3.93E-04	2.56E-04
90	0.00E+00	0.00E+00	0.00E+00	8.51E-08	3.67E-04	1.52E-03	2.08E-03	2.05E-03	1.77E-03	1.46E-03
91	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.45E-08	1.58E-05	1.35E-04
92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.80E-07	1.57E-04	1.64E-03	3.46E-03	4.13E-03	3.88E-03
93	0.00E+00	0.00E+00	0.00E+00	2.93E-11	9.86E-06	1.19E-03	7.91E-03	1.55E-02	1.71E-02	1.44E-02
94	0.00E+00	0.00E+00	0.00E+00	3.20E-05	6.45E-04	1.12E-03	1.26E-03	1.11E-03	9.05E-04	7.13E-04
95	0.00E+00	0.00E+00	0.00E+00	2.48E-07	4.50E-04	8.32E-04	9.94E-04	9.40E-04	8.19E-04	6.93E-04
96	0.00E+00	0.00E+00	0.00E+00	1.15E-06	1.01E-03	3.32E-03	4.38E-03	4.13E-03	3.47E-03	2.81E-03
97	0.00E+00	0.00E+00	3.52E-05	1.99E-04	3.37E-04	3.54E-04	2.94E-04	2.28E-04	1.72E-04	1.27E-04
98	0.00E+00	0.00E+00	0.00E+00	1.23E-06	5.42E-04	2.72E-03	4.02E-03	3.78E-03	2.94E-03	2.14E-03
99	0.00E+00	0.00E+00	0.00E+00	1.27E-04	2.53E-04	3.33E-04	3.36E-04	3.00E-04	2.59E-04	2.19E-04
100	0.00E+00	0.00E+00	3.76E-11	5.60E-04	2.06E-03	2.16E-03	1.84E-03	1.47E-03	1.14E-03	8.69E-04

Table F.4.14. Probabilistic Modeling Results for C-720 Building Area (fixed degradation scenario) - Property Boundary POE (conc in mg/L)

(continued)

RUN	50 yrs	55 yrs	60 yrs	65 yrs	70 yrs	75 yrs	80 yrs	85 yrs	90 yrs	95 yrs
1	2.18E-04	1.85E-04	1.56E-04	1.32E-04	1.11E-04	9.39E-05	7.92E-05	6.68E-05	5.63E-05	4.75E-05
2	4.13E-04	3.05E-04	2.25E-04	1.66E-04	1.22E-04	8.99E-05	6.62E-05	4.88E-05	3.59E-05	2.65E-05
3	1.78E-03	1.27E-03	9.13E-04	6.53E-04	4.67E-04	3.34E-04	2.39E-04	1.71E-04	1.22E-04	8.74E-05
4	3.77E-02	1.01E-01	1.76E-01	2.28E-01	2.39E-01	2.16E-01	1.79E-01	1.41E-01	1.07E-01	8.07E-02
5	3.17E-03	2.52E-03	1.99E-03	1.56E-03	1.22E-03	9.50E-04	7.41E-04	5.77E-04	4.49E-04	3.49E-04
6	4.68E-05	3.90E-05	3.24E-05	2.68E-05	2.22E-05	1.83E-05	1.51E-05	1.24E-05	1.03E-05	8.47E-06
7	2.18E-04	1.92E-04	1.67E-04	1.45E-04	1.26E-04	1.09E-04	9.39E-05	8.10E-05	6.99E-05	6.03E-05
8	7.54E-04	5.72E-04	4.33E-04	3.28E-04	2.48E-04	1.87E-04	1.42E-04	1.07E-04	8.09E-05	6.11E-05
9	1.86E-03	1.58E-03	1.33E-03	1.12E-03	9.36E-04	7.83E-04	6.54E-04	5.46E-04	4.56E-04	3.81E-04
10	1.68E-02	1.38E-02	1.05E-02	7.82E-03	5.77E-03	4.24E-03	3.12E-03	2.29E-03	1.68E-03	1.23E-03
11	1.23E-03	1.10E-03	9.21E-04	7.63E-04	6.30E-04	5.19E-04	4.27E-04	3.51E-04	2.89E-04	2.38E-04
12	7.04E-04	5.63E-04	4.47E-04	3.55E-04	2.81E-04	2.22E-04	1.76E-04	1.39E-04	1.10E-04	8.73E-05
13	5.61E-04	4.86E-04	4.19E-04	3.61E-04	3.10E-04	2.66E-04	2.28E-04	1.95E-04	1.67E-04	1.43E-04
14	2.30E-03	1.65E-03	1.17E-03	8.26E-04	5.82E-04	4.09E-04	2.87E-04	2.02E-04	1.42E-04	9.96E-05
15	5.03E-03	4.28E-03	3.54E-03	2.89E-03	2.33E-03	1.88E-03	1.51E-03	1.21E-03	9.69E-04	7.75E-04
16	2.49E-03	1.71E-03	1.17E-03	7.94E-04	5.41E-04	3.68E-04	2.51E-04	1.71E-04	1.16E-04	7.90E-05
17	8.04E-03	6.58E-03	5.38E-03	4.39E-03	3.58E-03	2.92E-03	2.38E-03	1.94E-03	1.58E-03	1.29E-03
18	2.20E-04	1.63E-04	1.21E-04	8.95E-05	6.63E-05	4.91E-05	3.64E-05	2.69E-05	2.00E-05	1.48E-05
19	1.38E-04	1.12E-04	9.16E-05	7.44E-05	6.04E-05	4.90E-05	3.97E-05	3.22E-05	2.61E-05	2.11E-05
20	1.59E-03	1.18E-03	8.68E-04	6.35E-04	4.64E-04	3.38E-04	2.46E-04	1.79E-04	1.30E-04	9.49E-05
21	5.17E-03	4.10E-03	3.09E-03	2.29E-03	1.67E-03	1.21E-03	8.80E-04	6.37E-04	4.61E-04	3.34E-04
22	1.76E-02	1.40E-02	1.09E-02	8.41E-03	6.44E-03	4.93E-03	3.76E-03	2.87E-03	2.19E-03	1.67E-03
23	1.75E-03	1.32E-03	9.94E-04	7.48E-04	5.63E-04	4.24E-04	3.19E-04	2.40E-04	1.81E-04	1.36E-04
24	8.46E-03	7.69E-03	6.33E-03	4.99E-03	3.86E-03	2.96E-03	2.26E-03	1.73E-03	1.32E-03	1.00E-03
25	7.45E-05	6.26E-05	5.25E-05	4.41E-05	3.70E-05	3.11E-05	2.61E-05	2.19E-05	1.84E-05	1.54E-05
26	1.79E-02	1.40E-02	1.09E-02	8.50E-03	6.60E-03	5.13E-03	3.98E-03	3.09E-03	2.40E-03	1.86E-03
27	1.97E-04	1.65E-04	1.37E-04	1.13E-04	9.36E-05	7.73E-05	6.38E-05	5.26E-05	4.34E-05	3.58E-05
28	2.30E-04	1.92E-04	1.60E-04	1.34E-04	1.11E-04	9.29E-05	7.75E-05	6.46E-05	5.38E-05	4.49E-05
29	6.53E-03	5.25E-03	3.84E-03	2.70E-03	1.86E-03	1.27E-03	8.64E-04	5.88E-04	3.99E-04	2.71E-04
30	9.85E-05	7.35E-05	5.48E-05	4.09E-05	3.05E-05	2.27E-05	1.70E-05	1.26E-05	9.43E-06	7.03E-06
31	2.07E-04	1.45E-04	1.01E-04	7.04E-05	4.91E-05	3.42E-05	2.39E-05	1.67E-05	1.16E-05	8.10E-06
32	9.26E-03	6.68E-03	4.72E-03	3.31E-03	2.30E-03	1.60E-03	1.11E-03	7.74E-04	5.38E-04	3.74E-04
33	7.16E-02	5.67E-02	4.20E-02	3.02E-02	2.15E-02	1.52E-02	1.07E-02	7.56E-03	5.33E-03	3.75E-03
34	1.97E-02	1.42E-02	1.02E-02	7.27E-03	5.20E-03	3.72E-03	2.66E-03	1.90E-03	1.36E-03	9.74E-04
35	1.82E-03	1.45E-03	1.15E-03	9.16E-04	7.27E-04	5.77E-04	4.58E-04	3.63E-04	2.88E-04	2.29E-04
36	1.04E-03	8.92E-04	7.62E-04	6.49E-04	5.53E-04	4.70E-04	3.99E-04	3.39E-04	2.88E-04	2.45E-04
37	1.30E-03	9.16E-04	6.43E-04	4.51E-04	3.16E-04	2.22E-04	1.56E-04	1.09E-04	7.68E-05	5.38E-05
38	1.46E-03	1.07E-03	7.74E-04	5.61E-04	4.07E-04	2.95E-04	2.14E-04	1.55E-04	1.12E-04	8.14E-05
39	6.62E-03	6.42E-03	5.43E-03	4.29E-03	3.30E-03	2.50E-03	1.88E-03	1.41E-03	1.05E-03	7.88E-04
40	1.94E-03	1.60E-03	1.32E-03	1.09E-03	8.95E-04	7.36E-04	6.05E-04	4.97E-04	4.08E-04	3.35E-04
41	1.94E-03	1.41E-03	1.01E-03	7.27E-04	5.21E-04	3.73E-04	2.67E-04	1.91E-04	1.37E-04	9.82E-05
42	5.14E-04	4.37E-04	3.70E-04	3.13E-04	2.65E-04	2.24E-04	1.89E-04	1.60E-04	1.35E-04	1.14E-04
43	1.21E-03	8.63E-04	6.14E-04	4.36E-04	3.09E-04	2.20E-04	1.56E-04	1.11E-04	7.84E-05	5.56E-05
44	7.12E-04	5.08E-04	3.62E-04	2.58E-04	1.84E-04	1.31E-04	9.31E-05	6.63E-05	4.73E-05	3.37E-05
45	3.79E-03	6.30E-03	7.71E-03	7.75E-03	6.95E-03	5.85E-03	4.79E-03	3.86E-03	3.10E-03	2.48E-03
46	1.38E-04	1.09E-04	8.62E-05	6.78E-05	5.33E-05	4.19E-05	3.29E-05	2.59E-05	2.03E-05	1.59E-05
47	2.51E-03	2.21E-03	1.86E-03	1.53E-03	1.24E-03	1.01E-03	8.16E-04	6.59E-04	5.33E-04	4.31E-04
48	1.99E-03	1.46E-03	1.07E-03	7.77E-04	5.63E-04	4.08E-04	2.96E-04	2.14E-04	1.55E-04	1.12E-04
49	2.90E-04	9.62E-04	2.00E-03	2.98E-03	3.47E-03	3.40E-03	2.96E-03	2.39E-03	1.84E-03	1.38E-03
50	6.96E-04	5.06E-04	3.67E-04	2.66E-04	1.93E-04	1.40E-04	1.01E-04	7.35E-05	5.32E-05	3.86E-05

Table F.4.14. Probabilistic Modeling Results for C-720 Building Area (fixed degradation scenario) - Property Boundary POE (conc in mg/L)

(continued)

RUN	50 yrs	55 yrs	60 yrs	65 yrs	70 yrs	75 yrs	80 yrs	85 yrs	90 yrs	95 yrs
51	5.79E-04	5.18E-04	4.53E-04	3.92E-04	3.38E-04	2.90E-04	2.49E-04	2.14E-04	1.83E-04	1.57E-04
52	1.04E-03	7.28E-04	5.09E-04	3.56E-04	2.49E-04	1.74E-04	1.22E-04	8.50E-05	5.94E-05	4.15E-05
53	1.03E-02	1.03E-02	8.68E-03	6.60E-03	4.79E-03	3.39E-03	2.37E-03	1.65E-03	1.15E-03	7.94E-04
54	2.39E-04	1.88E-04	1.48E-04	1.16E-04	9.11E-05	7.15E-05	5.62E-05	4.41E-05	3.46E-05	2.72E-05
55	2.98E-04	2.57E-04	2.20E-04	1.88E-04	1.60E-04	1.37E-04	1.16E-04	9.91E-05	8.44E-05	7.19E-05
56	2.81E-03	2.18E-03	1.67E-03	1.28E-03	9.78E-04	7.45E-04	5.67E-04	4.32E-04	3.28E-04	2.50E-04
57	3.80E-03	3.13E-03	2.57E-03	2.11E-03	1.72E-03	1.41E-03	1.15E-03	9.39E-04	7.67E-04	6.27E-04
58	7.79E-04	5.98E-04	4.59E-04	3.51E-04	2.69E-04	2.06E-04	1.58E-04	1.21E-04	9.24E-05	7.08E-05
59	5.47E-03	4.16E-03	3.15E-03	2.39E-03	1.81E-03	1.37E-03	1.03E-03	7.80E-04	5.90E-04	4.46E-04
60	5.44E-03	4.22E-03	3.24E-03	2.47E-03	1.88E-03	1.43E-03	1.09E-03	8.28E-04	6.29E-04	4.77E-04
61	2.07E-02	1.61E-02	1.24E-02	9.54E-03	7.33E-03	5.62E-03	4.32E-03	3.31E-03	2.54E-03	1.95E-03
62	8.20E-04	6.05E-04	4.45E-04	3.27E-04	2.40E-04	1.76E-04	1.29E-04	9.43E-05	6.91E-05	5.06E-05
63	1.45E-02	1.21E-02	9.09E-03	6.47E-03	4.50E-03	3.10E-03	2.12E-03	1.45E-03	9.94E-04	6.79E-04
64	3.81E-02	2.87E-02	2.11E-02	1.53E-02	1.11E-02	7.99E-03	5.75E-03	4.14E-03	2.97E-03	2.14E-03
65	1.22E-02	2.09E-02	2.56E-02	2.52E-02	2.15E-02	1.68E-02	1.26E-02	9.28E-03	6.74E-03	4.87E-03
66	1.14E-04	9.37E-05	7.65E-05	6.23E-05	5.07E-05	4.12E-05	3.35E-05	2.72E-05	2.21E-05	1.80E-05
67	2.51E-02	2.19E-02	1.89E-02	1.62E-02	1.38E-02	1.17E-02	9.99E-03	8.50E-03	7.23E-03	6.15E-03
68	2.55E-04	1.98E-04	1.53E-04	1.19E-04	9.18E-05	7.11E-05	5.50E-05	4.26E-05	3.30E-05	2.55E-05
69	2.42E-03	1.99E-03	1.63E-03	1.34E-03	1.09E-03	8.87E-04	7.21E-04	5.87E-04	4.77E-04	3.88E-04
70	5.53E-03	4.12E-03	3.06E-03	2.27E-03	1.68E-03	1.25E-03	9.23E-04	6.83E-04	5.06E-04	3.75E-04
71	6.50E-03	6.91E-03	6.05E-03	4.78E-03	3.59E-03	2.64E-03	1.92E-03	1.39E-03	1.01E-03	7.26E-04
72	1.24E-03	9.26E-04	6.90E-04	5.13E-04	3.80E-04	2.82E-04	2.10E-04	1.56E-04	1.15E-04	8.56E-05
73	4.34E-08	1.74E-06	1.60E-05	5.86E-05	1.20E-04	1.69E-04	1.90E-04	1.87E-04	1.73E-04	1.54E-04
74	3.42E-04	2.50E-04	1.82E-04	1.33E-04	9.68E-05	7.06E-05	5.15E-05	3.75E-05	2.73E-05	1.99E-05
75	1.51E-02	1.20E-02	9.41E-03	7.35E-03	5.72E-03	4.45E-03	3.46E-03	2.69E-03	2.09E-03	1.62E-03
76	4.39E-04	3.27E-04	2.44E-04	1.82E-04	1.35E-04	1.01E-04	7.48E-05	5.57E-05	4.15E-05	3.09E-05
77	6.25E-04	5.45E-04	4.68E-04	3.97E-04	3.34E-04	2.80E-04	2.34E-04	1.96E-04	1.63E-04	1.36E-04
78	1.28E-08	4.06E-07	5.25E-06	3.54E-05	1.47E-04	4.22E-04	9.10E-04	1.57E-03	2.26E-03	2.81E-03
79	1.89E-01	1.67E-01	1.30E-01	9.54E-02	6.84E-02	4.85E-02	3.42E-02	2.41E-02	1.70E-02	1.20E-02
80	4.39E-04	3.27E-04	2.44E-04	1.81E-04	1.35E-04	1.00E-04	7.48E-05	5.57E-05	4.14E-05	3.08E-05
81	9.35E-04	6.68E-04	4.76E-04	3.39E-04	2.42E-04	1.72E-04	1.23E-04	8.73E-05	6.21E-05	4.42E-05
82	8.07E-02	5.60E-02	3.84E-02	2.63E-02	1.79E-02	1.22E-02	8.30E-03	5.65E-03	3.84E-03	2.62E-03
83	4.98E-03	3.79E-03	2.88E-03	2.19E-03	1.66E-03	1.26E-03	9.56E-04	7.26E-04	5.51E-04	4.18E-04
84	4.82E-03	3.56E-03	2.62E-03	1.93E-03	1.42E-03	1.05E-03	7.72E-04	5.69E-04	4.19E-04	3.09E-04
85	2.78E-03	2.24E-03	1.80E-03	1.44E-03	1.16E-03	9.23E-04	7.37E-04	5.88E-04	4.69E-04	3.74E-04
86	1.33E-03	1.05E-03	8.33E-04	6.58E-04	5.20E-04	4.11E-04	3.24E-04	2.56E-04	2.02E-04	1.60E-04
87	7.96E-04	1.76E-03	2.73E-03	3.33E-03	3.46E-03	3.22E-03	2.81E-03	2.37E-03	1.96E-03	1.60E-03
88	1.82E-03	1.45E-03	1.14E-03	9.02E-04	7.11E-04	5.60E-04	4.41E-04	3.48E-04	2.74E-04	2.15E-04
89	1.66E-04	1.08E-04	6.99E-05	4.53E-05	2.93E-05	1.90E-05	1.23E-05	7.99E-06	5.18E-06	3.35E-06
90	1.19E-03	9.52E-04	7.61E-04	6.07E-04	4.84E-04	3.85E-04	3.07E-04	2.44E-04	1.94E-04	1.54E-04
91	2.39E-04	2.43E-04	2.17E-04	1.89E-04	1.65E-04	1.42E-04	1.23E-04	1.06E-04	9.17E-05	7.92E-05
92	3.30E-03	2.71E-03	2.19E-03	1.76E-03	1.40E-03	1.12E-03	8.91E-04	7.09E-04	5.64E-04	4.49E-04
93	1.10E-02	8.06E-03	5.83E-03	4.20E-03	3.01E-03	2.16E-03	1.55E-03	1.11E-03	7.93E-04	5.68E-04
94	5.52E-04	4.24E-04	3.24E-04	2.48E-04	1.89E-04	1.44E-04	1.09E-04	8.32E-05	6.33E-05	4.82E-05
95	5.78E-04	4.79E-04	3.95E-04	3.25E-04	2.67E-04	2.19E-04	1.80E-04	1.47E-04	1.21E-04	9.92E-05
96	2.24E-03	1.77E-03	1.39E-03	1.10E-03	8.62E-04	6.77E-04	5.32E-04	4.17E-04	3.27E-04	2.57E-04
97	9.39E-05	6.90E-05	5.06E-05	3.71E-05	2.72E-05	1.99E-05	1.46E-05	1.07E-05	7.82E-06	5.73E-06
98	1.51E-03	1.05E-03	7.29E-04	5.03E-04	3.47E-04	2.39E-04	1.64E-04	1.13E-04	7.79E-05	5.36E-05
99	1.84E-04	1.54E-04	1.29E-04	1.07E-04	8.94E-05	7.45E-05	6.20E-05	5.16E-05	4.30E-05	3.58E-05
100	6.60E-04	4.99E-04	3.77E-04	2.84E-04	2.14E-04	1.62E-04	1.22E-04	9.19E-05	6.93E-05	5.23E-05

Table F.4.15. Probabilistic Modeling Results for C-720 Building Area (fixed degradation scenario) - Ohio River POE (conc in mg/L)

RUN	0 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	30 yrs	35 yrs	40 yrs	45 yrs
1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.54E-13	3.98E-06	1.03E-04	1.47E-04
2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.16E-10	8.84E-07
3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
6	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.40E-12
7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
8	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.20E-11
9	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
13	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
14	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
16	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
17	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.45E-09	6.48E-06	1.48E-04
19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
21	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
23	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.34E-11	2.11E-05	1.82E-03
24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
26	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
27	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.90E-07	5.49E-05	1.20E-04
28	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
29	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
30	0.00E+00	0.00E+00	0.00E+00	2.36E-05	2.11E-04	2.46E-04	2.12E-04	1.67E-04	1.28E-04	9.66E-05
31	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.42E-08	6.02E-05	4.52E-04	6.20E-04
32	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
33	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
34	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
35	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.25E-09	1.40E-05
36	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.59E-10	9.18E-06
37	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.03E-06	3.37E-04	2.23E-03
38	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
39	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.33E-09	1.46E-05
41	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
42	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.26E-08	2.38E-05
43	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.03E-10	9.38E-07
44	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.25E-07	3.57E-04	1.18E-03	1.54E-03	1.33E-03
45	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
46	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.90E-13	6.76E-08	1.49E-05
47	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
48	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
49	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table F.4.15. Probabilistic Modeling Results for C-720 Building Area (fixed degradation scenario) - Ohio River POE (conc in mg/L)

(continued)

RUN	0 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	30 yrs	35 yrs	40 yrs	45 yrs
51	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
52	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.69E-12	1.77E-07
53	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
54	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.66E-07
55	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
56	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.03E-11	1.44E-06
58	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.22E-09	1.45E-05	3.63E-04
59	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
60	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
61	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
62	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.40E-13
63	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
64	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
65	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
66	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
67	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
68	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.72E-09	6.14E-05	2.43E-04	3.46E-04	3.32E-04
69	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.66E-11
70	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
71	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
72	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
73	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
74	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.40E-08	3.54E-05
75	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
76	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.47E-08	2.51E-04	6.48E-04	7.61E-04	6.51E-04	5.12E-04
77	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
78	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
79	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
80	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.55E-13	4.22E-06	3.24E-04	7.20E-04	8.10E-04
81	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.31E-09	4.30E-06
82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
83	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.13E-08	6.18E-05	1.60E-03
84	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.11E-07	2.78E-04	2.92E-03
85	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
86	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.22E-10	1.05E-04	7.66E-04	1.16E-03	1.19E-03
87	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
88	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.37E-11	2.29E-06	1.99E-04
89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.10E-08
90	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
91	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
93	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
94	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
95	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
96	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
97	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.65E-09	1.16E-05	7.29E-05	1.32E-04
98	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
99	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.67E-07	6.02E-05	1.15E-04	1.46E-04
100	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table F.4.15. Probabilistic Modeling Results for C-720 Building Area (fixed degradation scenario) - Ohio River POE (conc in mg/L)

(continued)

RUN	50 yrs	55 yrs	60 yrs	65 yrs	70 yrs	75 yrs	80 yrs	85 yrs	90 yrs	95 yrs
1	1.64E-04	1.52E-04	1.34E-04	1.16E-04	9.86E-05	8.37E-05	7.08E-05	5.98E-05	5.05E-05	4.26E-05
2	7.37E-05	4.10E-04	6.55E-04	6.54E-04	5.43E-04	4.21E-04	3.17E-04	2.36E-04	1.75E-04	1.29E-04
3	7.12E-12	3.41E-08	7.24E-06	1.69E-04	8.87E-04	1.84E-03	2.20E-03	1.96E-03	1.53E-03	1.13E-03
4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	0.00E+00	0.00E+00	0.00E+00	2.72E-09	6.39E-07	2.30E-05	2.05E-04	6.82E-04	1.23E-03	1.57E-03
6	1.50E-08	1.62E-06	1.04E-05	1.86E-05	2.35E-05	2.45E-05	2.23E-05	1.93E-05	1.64E-05	1.37E-05
7	0.00E+00	0.00E+00	0.00E+00	1.34E-10	1.39E-07	7.06E-06	4.57E-05	8.86E-05	1.04E-04	1.01E-04
8	3.45E-07	3.36E-05	2.94E-04	6.97E-04	8.94E-04	8.43E-04	6.95E-04	5.46E-04	4.20E-04	3.20E-04
9	0.00E+00	0.00E+00	3.02E-12	1.05E-08	2.08E-06	5.25E-05	3.04E-04	6.94E-04	9.64E-04	1.04E-03
10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
12	0.00E+00	0.00E+00	0.00E+00	1.04E-12	1.24E-09	1.71E-07	4.81E-06	4.04E-05	1.41E-04	2.70E-04
13	0.00E+00	3.24E-12	3.78E-08	7.22E-06	8.82E-05	2.16E-04	2.76E-04	2.80E-04	2.56E-04	2.25E-04
14	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.42E-10	4.06E-08	1.46E-06	1.99E-05
15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.69E-12	9.72E-10
16	0.00E+00	0.00E+00	0.00E+00	2.15E-09	4.73E-07	1.84E-05	1.93E-04	7.86E-04	1.67E-03	2.28E-03
17	0.00E+00	0.00E+00	0.00E+00	1.88E-11	1.12E-07	2.48E-05	5.68E-04	2.57E-03	4.10E-03	4.00E-03
18	3.26E-04	3.63E-04	3.12E-04	2.45E-04	1.87E-04	1.40E-04	1.04E-04	7.73E-05	5.73E-05	4.25E-05
19	5.47E-11	9.46E-08	5.53E-06	3.49E-05	6.63E-05	7.77E-05	7.43E-05	6.48E-05	5.45E-05	4.50E-05
20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.30E-10
21	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
23	2.89E-03	2.42E-03	1.90E-03	1.46E-03	1.11E-03	8.38E-04	6.32E-04	4.76E-04	3.59E-04	2.70E-04
24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
25	1.86E-11	7.70E-08	6.42E-06	4.00E-05	5.97E-05	5.52E-05	4.73E-05	4.01E-05	3.38E-05	2.84E-05
26	0.00E+00	0.00E+00	8.97E-11	1.29E-07	1.77E-05	4.22E-04	2.80E-03	7.73E-03	1.22E-02	1.37E-02
27	1.36E-04	1.32E-04	1.18E-04	1.02E-04	8.63E-05	7.24E-05	6.04E-05	5.01E-05	4.15E-05	3.43E-05
28	0.00E+00	0.00E+00	0.00E+00	5.98E-12	6.32E-09	6.65E-07	1.22E-05	5.98E-05	1.17E-04	1.34E-04
29	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
30	7.24E-05	5.42E-05	4.04E-05	3.02E-05	2.25E-05	1.68E-05	1.25E-05	9.33E-06	6.95E-06	5.19E-06
31	5.49E-04	4.19E-04	3.04E-04	2.16E-04	1.52E-04	1.06E-04	7.41E-05	5.17E-05	3.61E-05	2.52E-05
32	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
33	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
34	0.00E+00	0.00E+00	0.00E+00	5.96E-11	5.16E-08	6.79E-06	2.01E-04	1.88E-03	7.34E-03	1.51E-02
35	4.01E-04	1.22E-03	1.74E-03	1.76E-03	1.53E-03	1.26E-03	1.02E-03	8.15E-04	6.50E-04	5.17E-04
36	2.53E-04	4.84E-04	5.97E-04	6.10E-04	5.55E-04	4.88E-04	4.22E-04	3.62E-04	3.09E-04	2.63E-04
37	3.46E-03	3.14E-03	2.39E-03	1.73E-03	1.23E-03	8.70E-04	6.12E-04	4.30E-04	3.02E-04	2.12E-04
38	0.00E+00	0.00E+00	0.00E+00	1.85E-09	4.33E-07	1.73E-05	1.79E-04	6.93E-04	1.34E-03	1.64E-03
39	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
40	4.54E-04	1.14E-03	1.48E-03	1.50E-03	1.34E-03	1.15E-03	9.61E-04	7.98E-04	6.60E-04	5.44E-04
41	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.41E-11	5.05E-09	2.42E-07
42	1.91E-04	2.87E-04	3.25E-04	3.06E-04	2.70E-04	2.33E-04	1.99E-04	1.69E-04	1.44E-04	1.21E-04
43	1.01E-04	7.94E-04	1.72E-03	2.04E-03	1.79E-03	1.39E-03	1.03E-03	7.46E-04	5.35E-04	3.82E-04
44	1.02E-03	7.55E-04	5.46E-04	3.91E-04	2.80E-04	1.99E-04	1.42E-04	1.01E-04	7.22E-05	5.14E-05
45	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
46	7.56E-05	1.07E-04	1.15E-04	1.04E-04	8.75E-05	7.13E-05	5.71E-05	4.53E-05	3.58E-05	2.82E-05
47	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
48	0.00E+00	0.00E+00	0.00E+00	4.73E-11	2.32E-08	1.79E-06	3.33E-05	2.14E-04	6.37E-04	1.12E-03
49	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
50	0.00E+00	4.79E-11	5.13E-08	4.50E-06	6.48E-05	2.69E-04	5.03E-04	5.80E-04	5.12E-04	4.02E-04

Table F.4.15. Probabilistic Modeling Results for C-720 Building Area (fixed degradation scenario) - Ohio River POE (conc in mg/L)

(continued)

RUN	50 yrs	55 yrs	60 yrs	65 yrs	70 yrs	75 yrs	80 yrs	85 yrs	90 yrs	95 yrs
51	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
52	3.93E-05	5.29E-04	1.54E-03	2.07E-03	1.86E-03	1.42E-03	1.03E-03	7.32E-04	5.15E-04	3.61E-04
53	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
54	7.04E-05	2.40E-04	2.27E-04	1.89E-04	1.52E-04	1.21E-04	9.56E-05	7.53E-05	5.92E-05	4.65E-05
55	0.00E+00	2.47E-10	3.16E-07	1.34E-05	6.47E-05	1.07E-04	1.20E-04	1.15E-04	1.02E-04	8.89E-05
56	0.00E+00	0.00E+00	2.80E-10	1.47E-07	9.00E-06	1.15E-04	5.10E-04	1.16E-03	1.75E-03	1.96E-03
57	1.85E-04	1.03E-03	1.81E-03	2.21E-03	2.18E-03	1.93E-03	1.64E-03	1.37E-03	1.13E-03	9.30E-04
58	8.18E-04	9.56E-04	8.59E-04	7.02E-04	5.54E-04	4.31E-04	3.32E-04	2.55E-04	1.96E-04	1.50E-04
59	0.00E+00	0.00E+00	0.00E+00	7.63E-09	1.70E-06	6.24E-05	5.90E-04	2.09E-03	3.81E-03	4.57E-03
60	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.80E-11	1.05E-08
61	0.00E+00	0.00E+00	0.00E+00	1.77E-08	4.12E-06	1.56E-04	1.52E-03	5.67E-03	1.10E-02	1.41E-02
62	1.51E-08	4.81E-06	1.08E-04	4.74E-04	8.62E-04	9.90E-04	8.85E-04	7.08E-04	5.42E-04	4.06E-04
63	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
64	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
65	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
66	0.00E+00	0.00E+00	1.42E-10	4.98E-08	1.78E-06	1.26E-05	3.16E-05	4.59E-05	5.03E-05	4.70E-05
67	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.43E-09	3.79E-07	2.05E-05	3.19E-04
68	2.78E-04	2.23E-04	1.75E-04	1.37E-04	1.06E-04	8.24E-05	6.38E-05	4.94E-05	3.82E-05	2.96E-05
69	2.70E-07	4.66E-05	4.68E-04	1.11E-03	1.54E-03	1.67E-03	1.55E-03	1.34E-03	1.13E-03	9.32E-04
70	0.00E+00	0.00E+00	9.52E-10	5.29E-07	3.54E-05	4.91E-04	2.20E-03	4.56E-03	5.78E-03	5.48E-03
71	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
72	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.47E-11	4.06E-09	2.78E-07
73	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
74	3.26E-04	5.58E-04	5.56E-04	4.57E-04	3.51E-04	2.62E-04	1.93E-04	1.42E-04	1.03E-04	7.55E-05
75	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.18E-13	2.22E-09	1.79E-07
76	3.91E-04	2.94E-04	2.20E-04	1.64E-04	1.22E-04	9.12E-05	6.79E-05	5.05E-05	3.76E-05	2.80E-05
77	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.05E-10	2.00E-07	6.63E-06	5.30E-05	1.54E-04	2.41E-04
78	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
79	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
80	6.92E-04	5.44E-04	4.15E-04	3.13E-04	2.34E-04	1.75E-04	1.30E-04	9.70E-05	7.22E-05	5.37E-05
81	2.13E-04	9.97E-04	1.60E-03	1.57E-03	1.26E-03	9.45E-04	6.89E-04	4.96E-04	3.55E-04	2.53E-04
82	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
83	4.30E-03	5.59E-03	5.18E-03	4.25E-03	3.34E-03	2.58E-03	1.97E-03	1.50E-03	1.14E-03	8.68E-04
84	5.79E-03	6.27E-03	5.27E-03	4.09E-03	3.08E-03	2.30E-03	1.70E-03	1.26E-03	9.26E-04	6.82E-04
85	0.00E+00	3.89E-10	4.47E-07	3.25E-05	3.42E-04	1.05E-03	1.70E-03	1.98E-03	1.90E-03	1.64E-03
86	1.03E-03	8.48E-04	6.83E-04	5.45E-04	4.33E-04	3.43E-04	2.71E-04	2.14E-04	1.69E-04	1.33E-04
87	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
88	7.81E-04	1.22E-03	1.35E-03	1.21E-03	1.02E-03	8.27E-04	6.62E-04	5.26E-04	4.16E-04	3.29E-04
89	5.95E-06	1.37E-04	4.40E-04	5.20E-04	4.16E-04	2.91E-04	1.94E-04	1.27E-04	8.30E-05	5.39E-05
90	0.00E+00	0.00E+00	0.00E+00	1.31E-09	3.39E-07	1.30E-05	1.20E-04	4.04E-04	7.08E-04	8.45E-04
91	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
92	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.66E-11
93	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
94	0.00E+00	1.08E-09	4.99E-07	1.95E-05	1.39E-04	3.46E-04	4.89E-04	5.07E-04	4.45E-04	3.62E-04
95	1.43E-10	3.23E-07	2.18E-05	1.48E-04	2.95E-04	3.62E-04	3.56E-04	3.16E-04	2.69E-04	2.25E-04
96	0.00E+00	0.00E+00	2.28E-12	6.50E-09	1.23E-06	3.72E-05	2.90E-04	8.77E-04	1.44E-03	1.64E-03
97	1.52E-04	1.31E-04	1.03E-04	7.81E-05	5.81E-05	4.29E-05	3.16E-05	2.32E-05	1.70E-05	1.24E-05
98	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.06E-11	1.27E-08	7.70E-07	1.49E-05	1.16E-04
99	1.44E-04	1.28E-04	1.10E-04	9.33E-05	7.83E-05	6.55E-05	5.47E-05	4.56E-05	3.80E-05	3.16E-05
100	9.74E-09	4.79E-06	1.31E-04	5.41E-04	8.00E-04	7.78E-04	6.50E-04	5.14E-04	3.97E-04	3.02E-04

APPENDIX F
ATTACHMENT 5

STABILITY PLOTS

Deleted: Att F5-1¶
06-064(E)/041406

Deleted: Page Break

THIS PAGE INTENTIONALLY LEFT BLANK.

Deleted: Att F5-1
06-064(E)/041406

APPENDIX F
ATTACHMENT 5

STABILITY PLOTS

1. SWMU 1 STABILITY PLOTS

Formatted: Centered

The following plots show the stability in the time of the peak median concentration and the values of the peak median concentration, peak mean concentrations (based on untransformed data), and peak mean concentrations (based on log transformed data) at the property boundary. The stability plots compare the final concentration statistic based on all results from 100 realizations of the probability runs of the SESOIL/AT123D fate and transport model in comparison to the accumulated statistical concentrations from 1 to 10 realizations, 1 to 20 realizations, 1-30 realizations, 1-40 realizations, 1-50 realizations, 1 to 60 realizations, 1 to 70 realizations, 1-80 realizations, and 1 to 90 realizations. The comparison provides a measure of the stability of the predicted concentration statistic (i.e., mean, median, geometric mean) for 100 probability runs at the time of peak concentration.

Deleted: The values presented were calculated after 10, 20, 30, 40, 50, 60, 70, 80, 90, and 100 iterations of the SESOIL/AT123D fate and transport model.

Deleted:

Deleted: <sp>

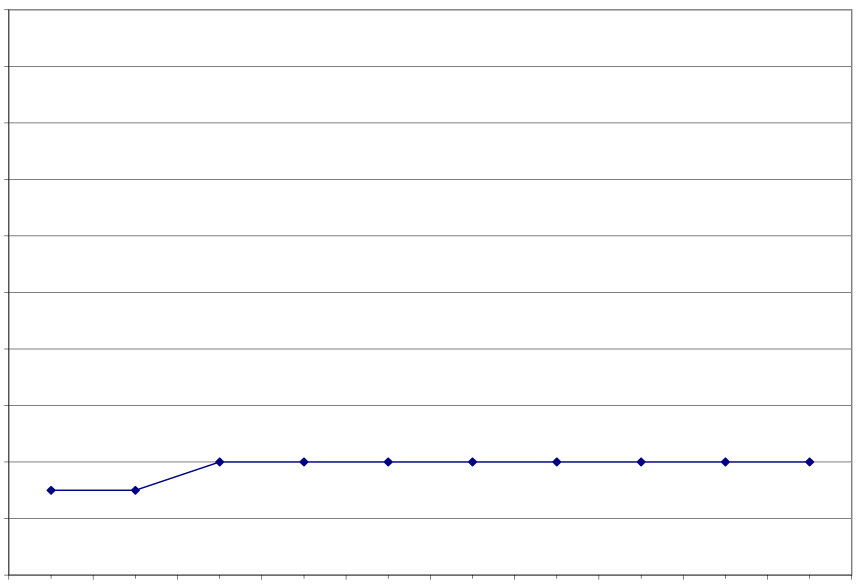


Figure F.5.1. Variation in time of peak TCE concentration over 100 SWMU 1 model realizations for the variable degradation scenario.

Deleted: results

Deleted: iterations

Deleted: Att F5-1¶

Formatted: Font: 11 pt

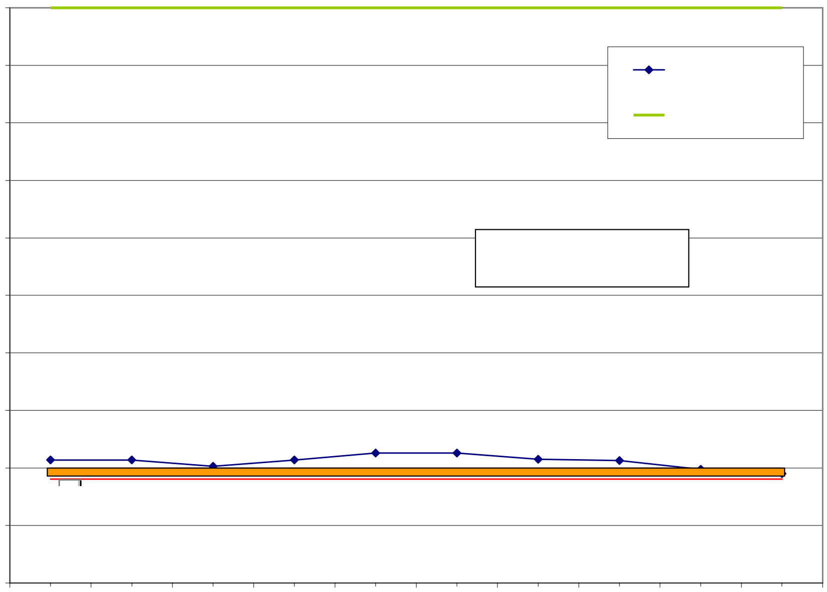


Figure F.5.2. Variation in peak median TCE concentration (Year 20) over 100 SWMU 1 model realizations for the variable degradation scenario

Deleted: <sp>

Deleted: results

Deleted: iterations

Deleted: .

Deleted: <sp>

Deleted: Att F5-1¶

Formatted: Font: 11 pt

Figure F.5.3. Variation in peak mean TCE concentration (Year 20; untransformed data) over 100 SWMU 1 model realizations for the variable degradation scenario.

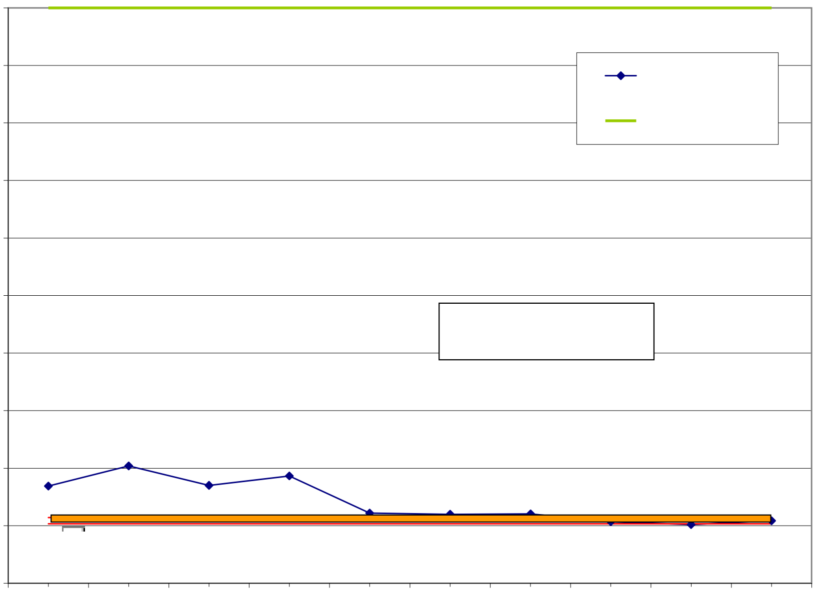


Figure F.5.4. Variation in peak mean TCE concentration (Year 20; transformed data) over 100 SWMU 1 model realizations for the variable degradation scenario.

Deleted: results

Deleted: iterations

Deleted: .

Deleted: <sp>

Deleted: results

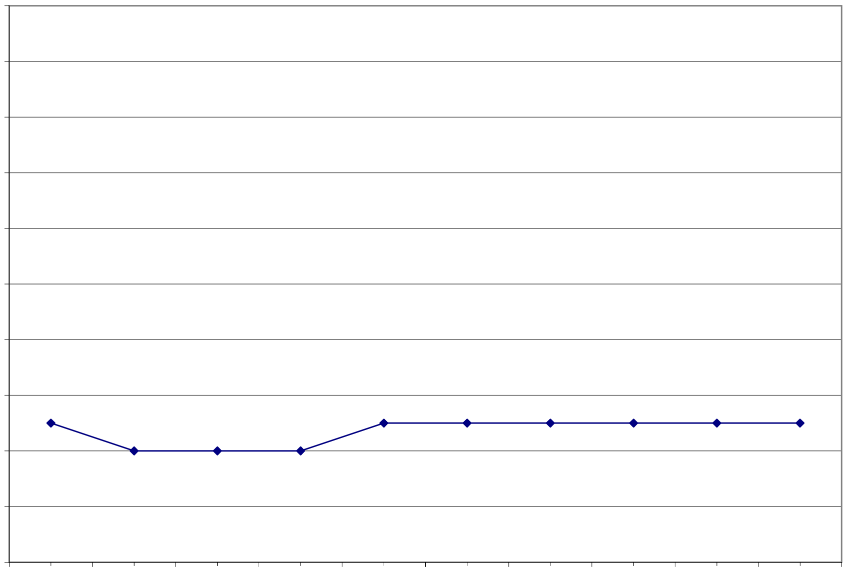
Deleted: iterations

Deleted: .

Formatted: Normal, Left

Deleted: Att F5-1¶

Formatted: Font: 11 pt

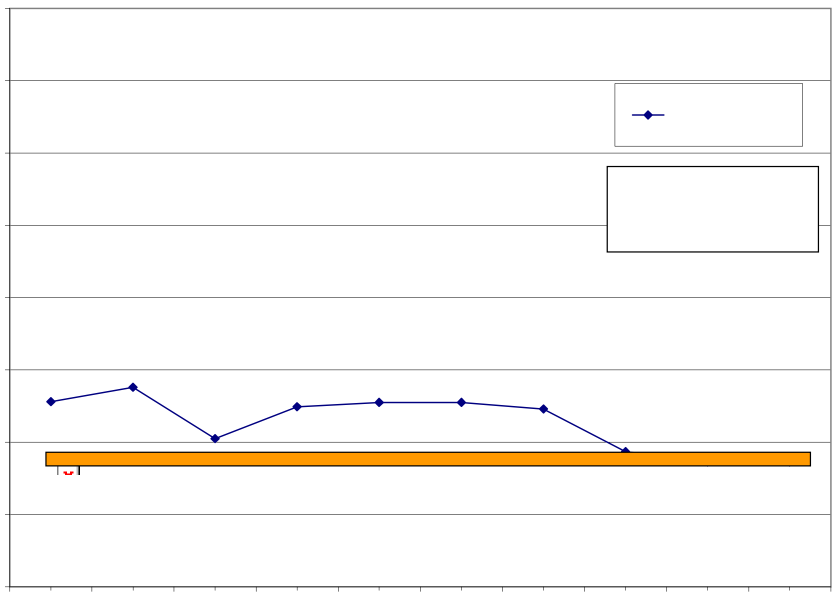


Deleted: <sp>

Figure F.5.5. Variation in time of peak TCE concentration over 100 SWMU 1 model realizations for the fixed degradation scenario.

Deleted: Att F5-1¶

Formatted: Font: 11 pt



Deleted: <sp>

Formatted: Normal, Left

Figure F.5.6. Variation in peak median TCE concentration (Year 25) over 100 SWMU 1 model realizations for the fixed degradation scenario.

Formatted: Font: 10 pt, Bold

Formatted: Font: Bold

Formatted: Font: 10 pt, Bold

Formatted: Font: Bold

Formatted: Font: 10 pt, Bold

Formatted: Normal, Left

Deleted: Att F5-1¶

Formatted: Font: 11 pt

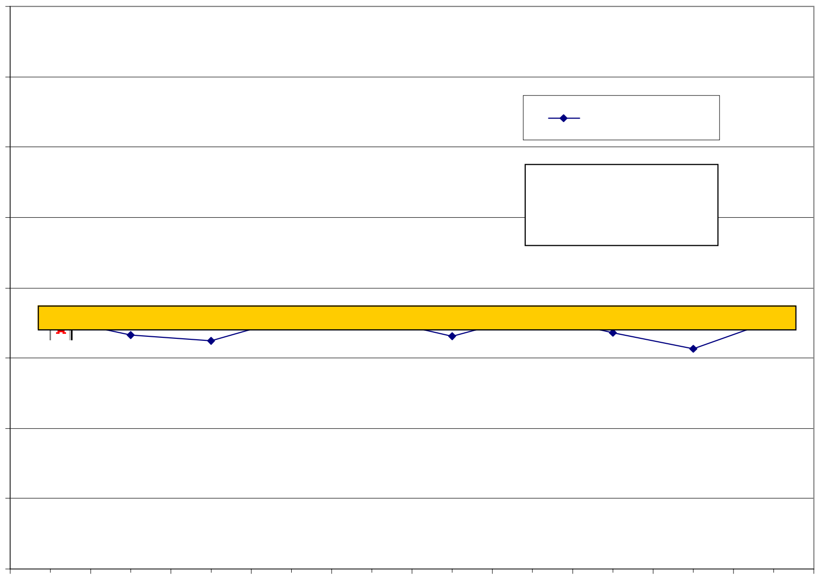


Figure F.5.7. Variation in peak mean TCE concentration (Year 25; untransformed data) over 100 SWMU 1 model realizations for the fixed degradation scenario.

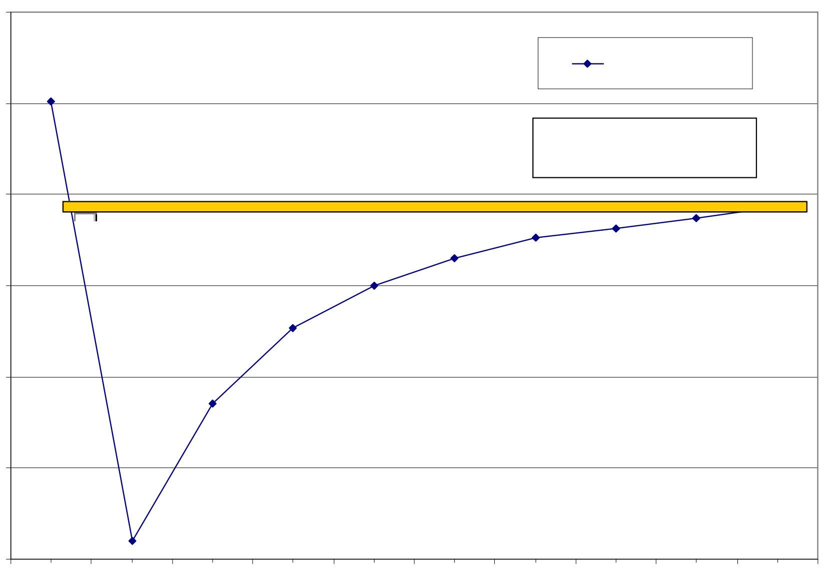


Figure F.5.8. Variation in peak mean TCE concentration (Year 25; transformed data) over 100 SWMU 1 model realizations for the fixed degradation scenario.

Deleted: <sp>
Formatted: Font: 10 pt, Bold
Formatted: Font: Bold
Formatted: Font: 10 pt, Bold
Formatted: Font: Bold
Formatted: Font: 10 pt, Bold
Deleted: <sp>
Formatted: Normal, Left
Formatted: Font: 10 pt, Bold
Formatted: Font: Bold
Formatted: Font: 10 pt, Bold
Formatted: Font: Bold
Formatted: Font: 10 pt, Bold
Formatted: Font: Bold
Formatted: Font: 10 pt, Bold
Formatted: Font: Bold
Formatted: Font: 10 pt, Bold
Deleted: ¶
Formatted: Centered
Deleted: Att F5-1¶
Formatted: Font: 11 pt

2. C-720 AREA STABILITY PLOTS

The following plots show the stability in the time of the peak median concentration and the values of the peak median concentration, peak mean concentrations (based on untransformed data), and peak mean concentrations (based on log transformed data) at the property boundary. The stability plots compare the final concentration statistic based on all results from 100 realizations of the probability runs of the SESOIL/AT123D fate and transport model in comparison to the accumulated statistical concentrations from 1 to 10 realizations, 1 to 20 realizations, 1-30 realizations, 1-40 realizations, 1-50 realizations, 1 to 60 realizations, 1 to 70 realizations, 1-80 realizations, and 1 to 90 realizations. The comparison provides a measure of the stability of the predicted concentration statistic (i.e., mean, median, geometric mean) for 100 probability runs at the time of peak concentration.

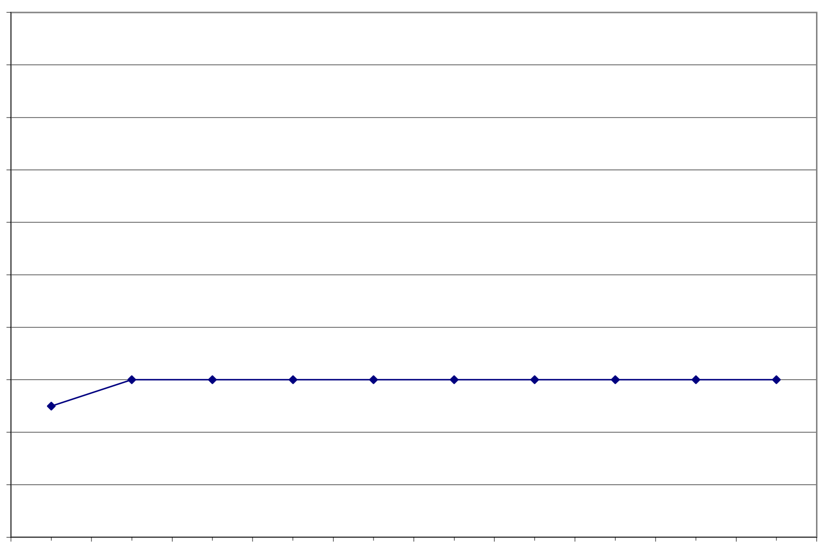


Figure F.5.9. Variation in time of peak TCE concentration over 100 C-720 Area model realizations for the variable degradation scenario.

Deleted: ¶
THIS PAGE INTENTIONALLY LEFT BLANK.¶
¶
Page Break

Formatted: Font: 14 pt, Bold

Deleted: The values presented were calculated after 10, 20, 30, 40, 50, 60, 70, 80, 90, and 100 iterations of the SESOIL/AT123D fate and transport model.

Deleted: <sp>

Deleted: 5

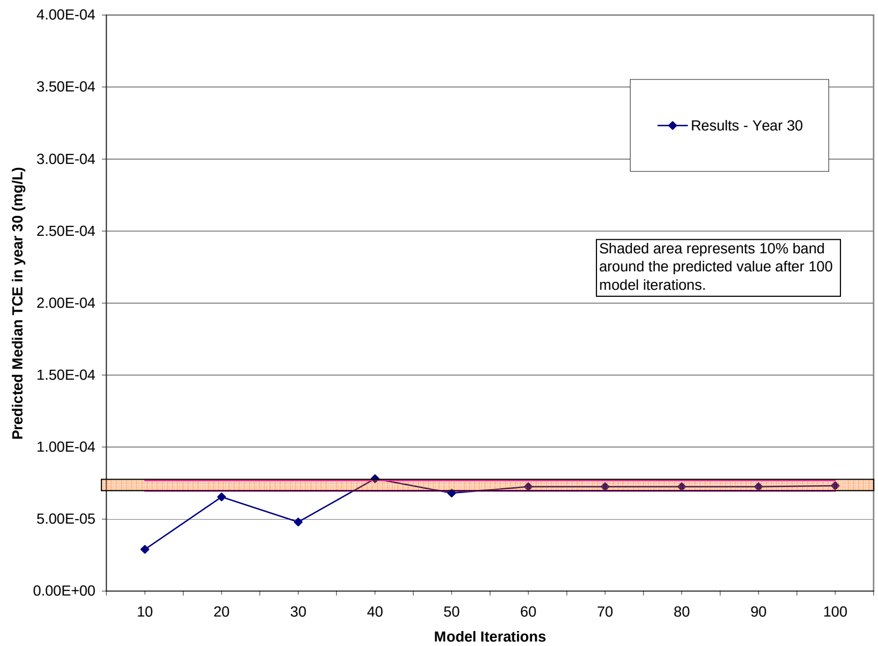
Deleted: results

Deleted: iterations

Deleted: .

Deleted: Att F5-1¶

Formatted: Font: 11 pt



Deleted: <sp>

Figure F.5.10. Variation in peak median TCE concentration (Year 30) over C-720 Area model realizations for the variable degradation scenario

Deleted: 6

Deleted: results

Deleted: iterations

Formatted: Font: 10 pt

Deleted: .

Deleted: Att F5-1¶

Formatted: Font: 11 pt

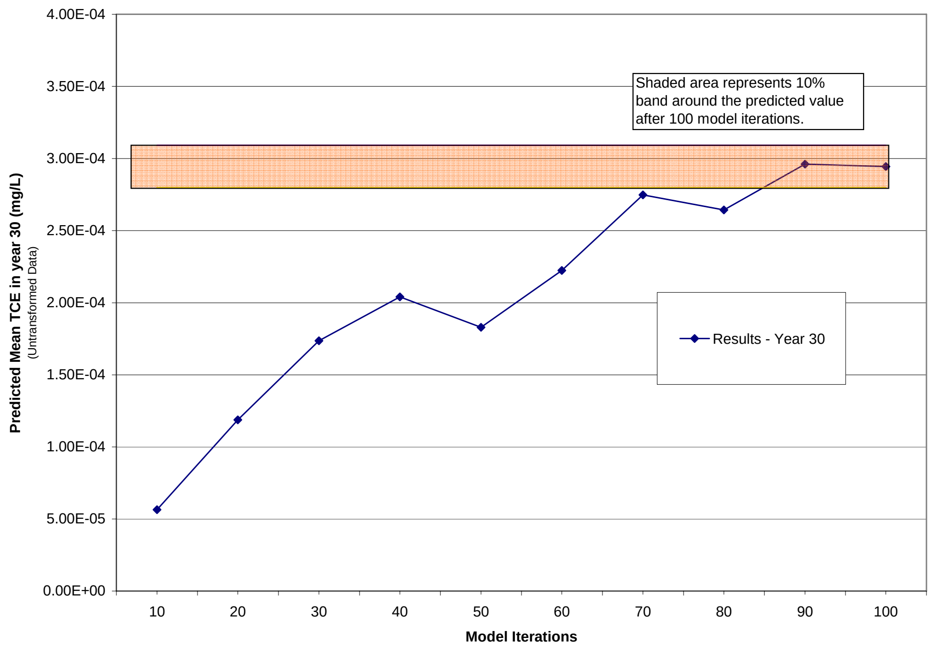


Figure F.5.11. Variation in peak mean TCE concentration (Year 30, untransformed data) over 100 C-720 Area model realizations for the variable degradation scenario.

Deleted: 7
Deleted: results
Deleted: ;
Deleted: iterations
Deleted: .

Deleted: Att F5-1¶
Formatted: Font: 11 pt

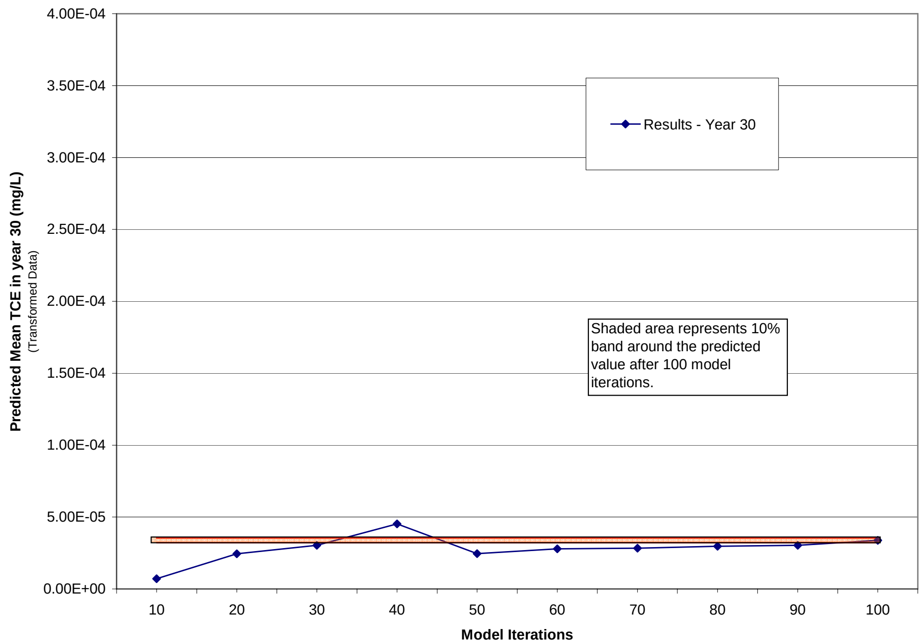


Figure F.5.12. Variation in peak mean TCE concentration (Year 30, transformed data) over 100 C-720 Area model realizations for the variable degradation scenario.

Deleted: 8

Deleted: results

Deleted: ;

Deleted: iterations

Deleted: .

Formatted: Left

Formatted: Normal, Left

Deleted: Att F5-1¶

Formatted: Font: 11 pt

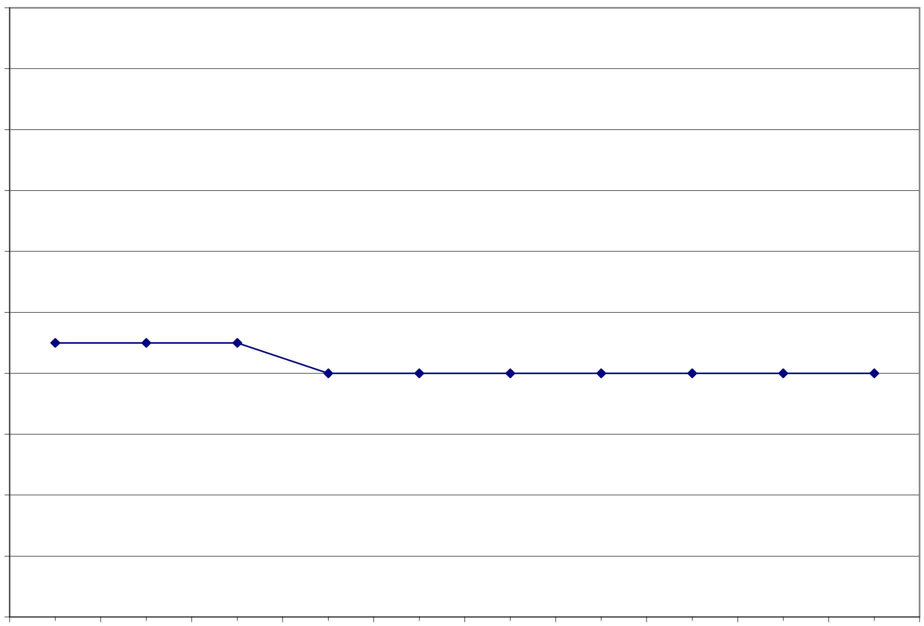


Figure F.5.13. Variation in time of peak TCE concentration over 100 C-720 model realizations for the fixed degradation scenario.

Deleted: <sp>

Formatted: Normal, Left

Formatted: Font: 10 pt, Bold

Formatted: Font: Bold

Formatted: Font: 10 pt, Bold

Formatted: Font: Bold

Formatted: Font: 10 pt, Bold

Formatted: Font: Bold

Formatted: Font: 10 pt, Bold

Formatted: Font: Bold

Formatted: Font: 10 pt

Deleted: Att F5-1¶

Formatted: Font: 11 pt

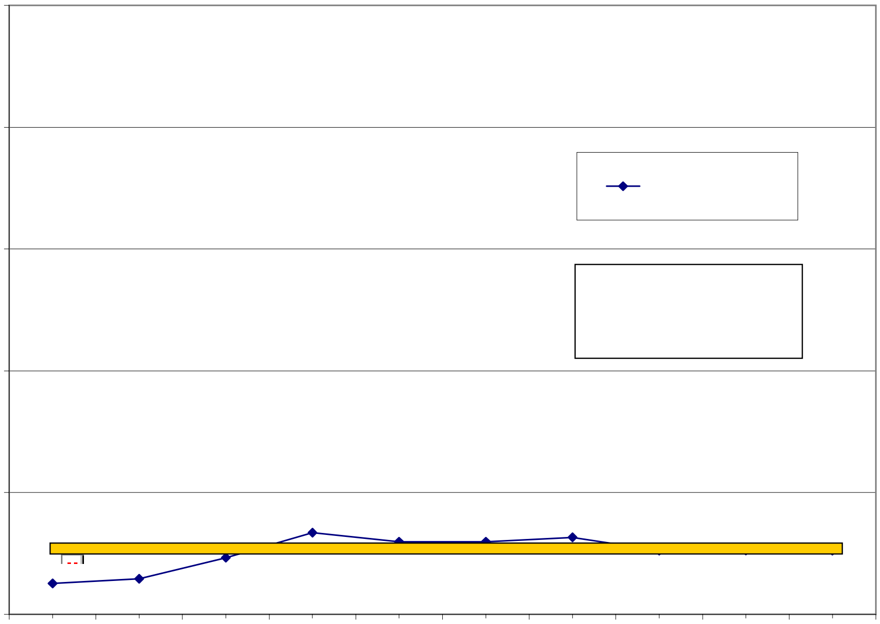


Figure F.5.14. Variation in peak median TCE concentration (Year 40) over 100 C-720 model realizations for the fixed degradation scenario.

Deleted: <sp>

Formatted: Normal, Left

Formatted: Font: 10 pt, Bold

Formatted: Font: Bold

Formatted: Font: 10 pt, Bold

Formatted: Font: Bold

Formatted: Font: 10 pt, Bold

Formatted: Font: Bold

Formatted: Font: 10 pt, Bold

Formatted: Normal, Left

Deleted: Att F5-1¶

Formatted: Font: 11 pt

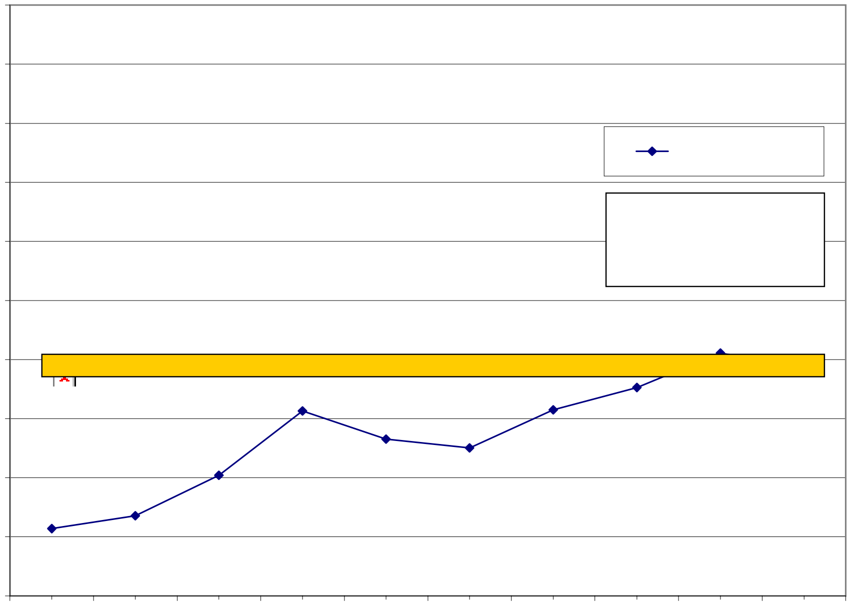


Figure F.5.15. Variation in peak mean TCE concentration (Year 30, transformed data) over 100 C-720 Area model realizations for the fixed degradation scenario.

Deleted: <sp>

Deleted: ;

Formatted: Normal, Left

Deleted: Att F5-1¶

Formatted: Font: 11 pt

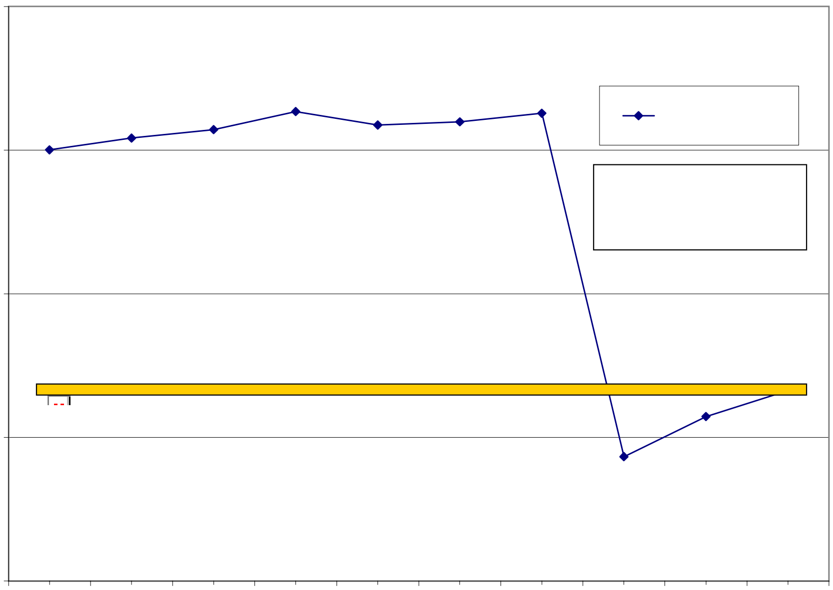


Figure F.5.16. Variation in peak mean TCE concentration (Year 40; transformed data) over 100 C-720 area model realizations for the fixed degradation scenario.

Deleted: <sp>

Formatted: Normal, Left

Formatted: Font: 10 pt, Bold

Formatted: Font: Bold

Formatted: Font: 10 pt, Bold

Formatted: Font: Bold

Formatted: Font: 10 pt, Bold

Formatted: Font: Bold

Formatted: Font: 10 pt, Bold

Deleted: ¶
¶
Page Break
¶
THIS PAGE INTENTIONALLY LEFT BLANK.¶
¶
Section Break (Next Page)

Deleted: SWMU 4 Stability Plots¶
¶
The following plots show the stability in the time of the peak median concentration and the values of the peak median concentration, peak mean concentrations (based on untransformed data), and peak mean concentrations (based on log transformed data) at the property boundary. The values presented were calculated after 10, 20, 30, 40, 50, 60, 70, 80, 90, and 100 iterations of the SESOIL/AT123D fate and transport model. ¶ ... [1]

Deleted: ¶
THIS PAGE INTENTIONALLY LEFT BLANK.¶
¶

Deleted: Att F5-1¶

Formatted: Font: 11 pt

APPENDIX F
ATTACHMENT 6

PGDP MODFLOW MODEL DESCRIPTION

THIS PAGE INTENTIONALLY LEFT BLANK.

APPENDIX F
ATTACHMENT 6

PGDP MODFLOW MODEL DESCRIPTION

The following is a brief synopsis of the most recent MODFLOW and MODPATH effort conducted by Jacobs Engineering in 1997. The figures and tables accompanying the synopsis are copied from *Groundwater-Water Flow Model Recalibration and Transport Model Construction at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1998). The referenced report can be found in its entirety on the compact disk (CD) following this attachment.

The current groundwater model consists of four model layers representing the Upper Continental Recharge System (UCRS) (the upper two layers), the Regional Gravel Aquifer (RGA) (Layer 3) and the McNairy (Layer 4). There are 126,920 cells in the model, 95,215 of which are active, that range in size from 50ft × 50ft to 425ft× 425ft.

Recharge to the model consists of infiltration from precipitation (6.6 in./yr) and anthropogenic sources such as leaking waterlines and drainage ditches (maximum of 26.3 in./yr) (Fig. F.6.1). Assigned UCRS model hydraulic conductivities range from 1.0 ft/d to 4.5 ft/d. RGA hydraulic conductivities are, as a whole, much higher than the UCRS values and range from 7.5 ft/d to 1,500 ft/d (Fig. F.6.2). McNairy hydraulic conductivities are less than the RGA values and range from 8 ft/d to 25 ft/d (Fig. F.6.3).

Model-predicted potentiometric surfaces for model layers 1 through 4, along with target locations and corresponding calibration residuals (ft), are presented in Figures F.6.4 through F.6.7. A tabular summary of target water levels (ft), model-predicted water levels (ft) and residuals (ft) is presented in Table F.6.1. Monitoring wells presented in Table F.6.1 are shown in Figure F.6.8. Calibration statistics for the residuals are summarized in Table F.6.2. In general, the model more closely matches RGA water levels than UCRS or McNairy water levels (Table F.6.3). The largest calibration residuals for the UCRS, RGA, and McNairy are -7.95 ft, 2.14 ft, and 2.14 ft, respectively. Particle traces originating at suspected source areas within the RGA are shown in Figure F.6.8.9 and reasonably follow the Northwest and Northeast Plumes paths. It should be noted that these particle traces represent predicted plume paths for the most recent PGDP flow model. Particle traces associated with previous flow models show slightly different plume paths. The difference is attributed primarily to the use of different hydraulic conductivity distributions and values which were changed during the calibration process to better match site water-level elevations and observed plume flow paths.

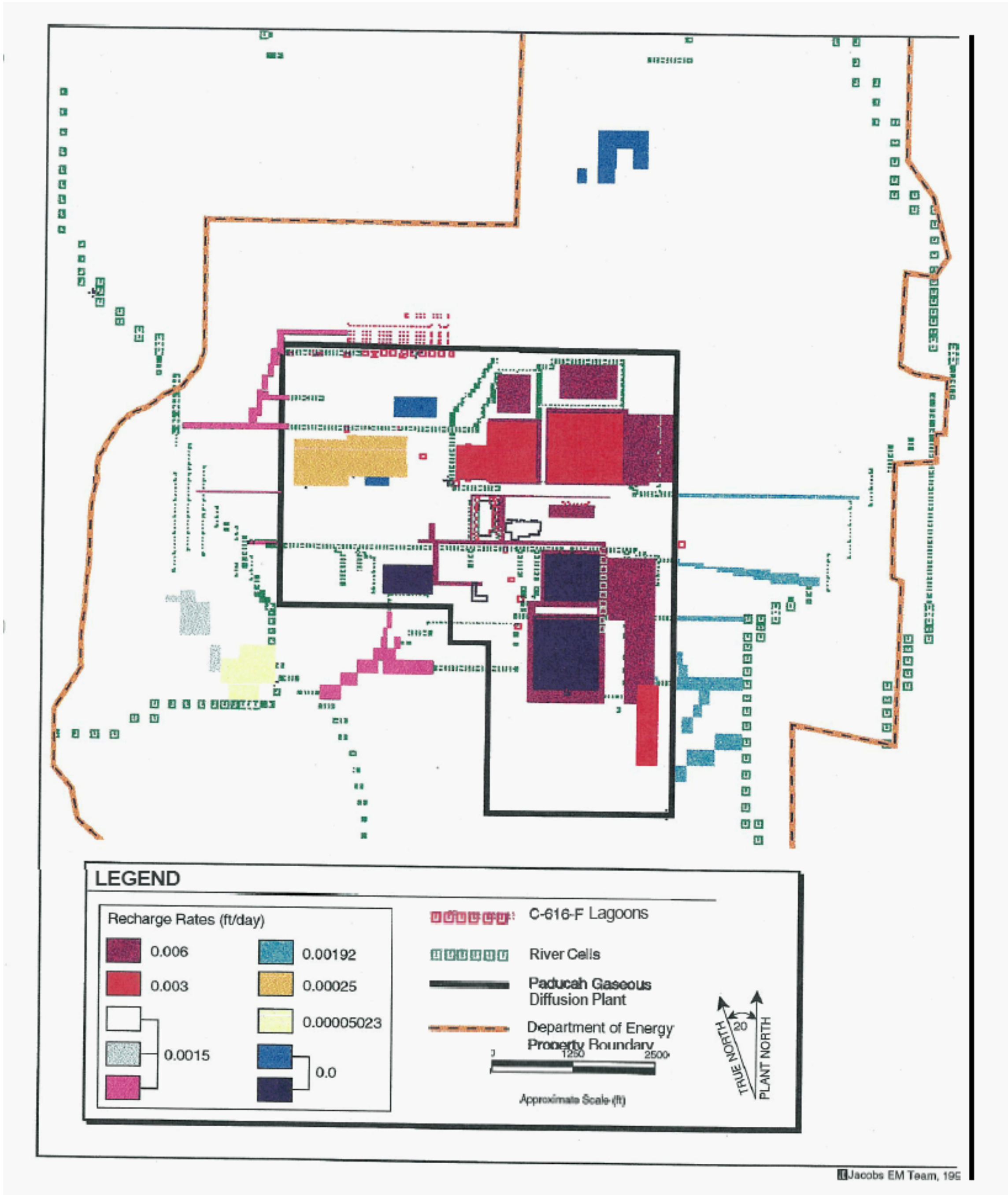


Fig. F.6.1. Recharge Zonation for Refined Model.

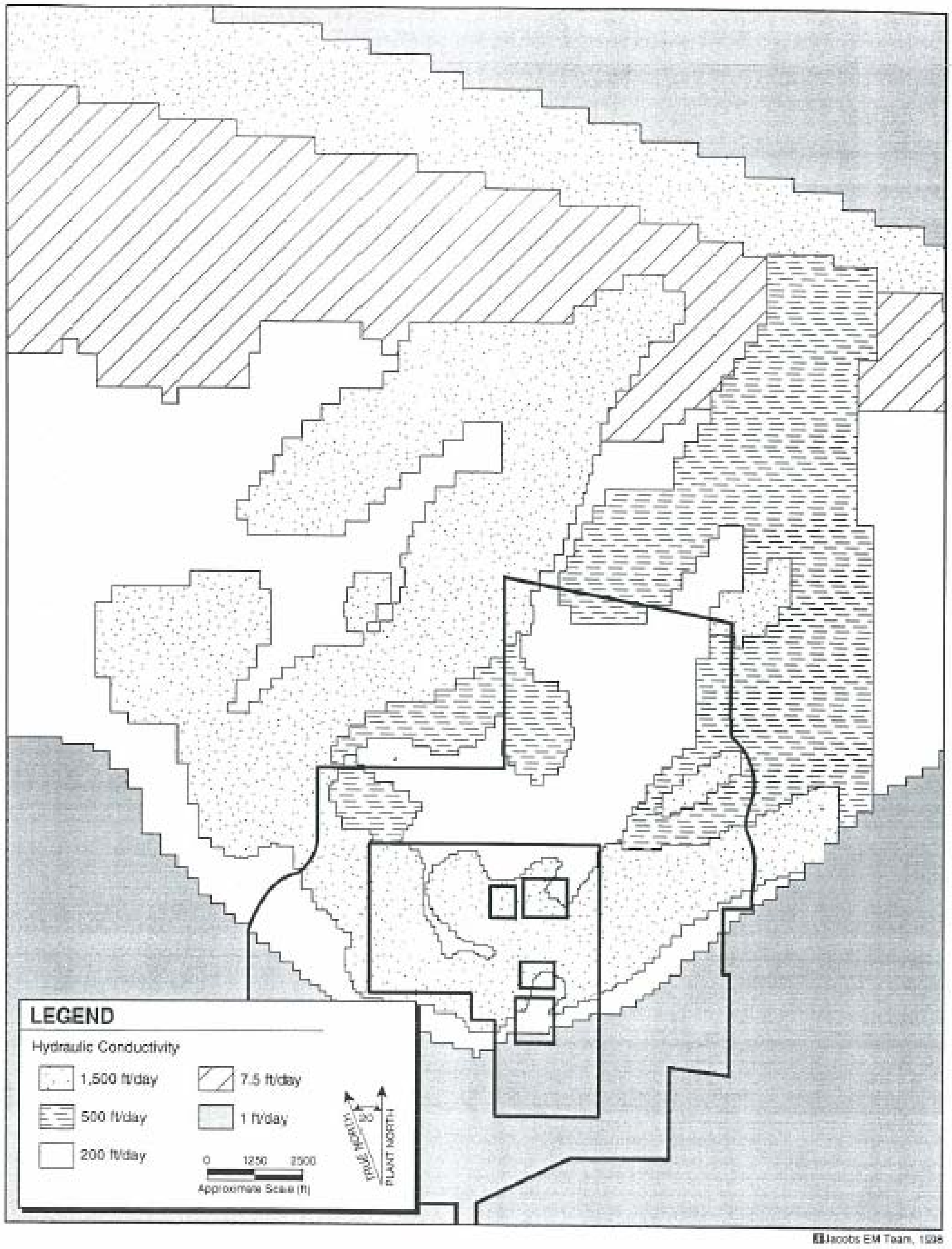


Fig. F.6.2. Regional Gravel Aquifer Hydraulic Conductivity Zonation for Refined Model.

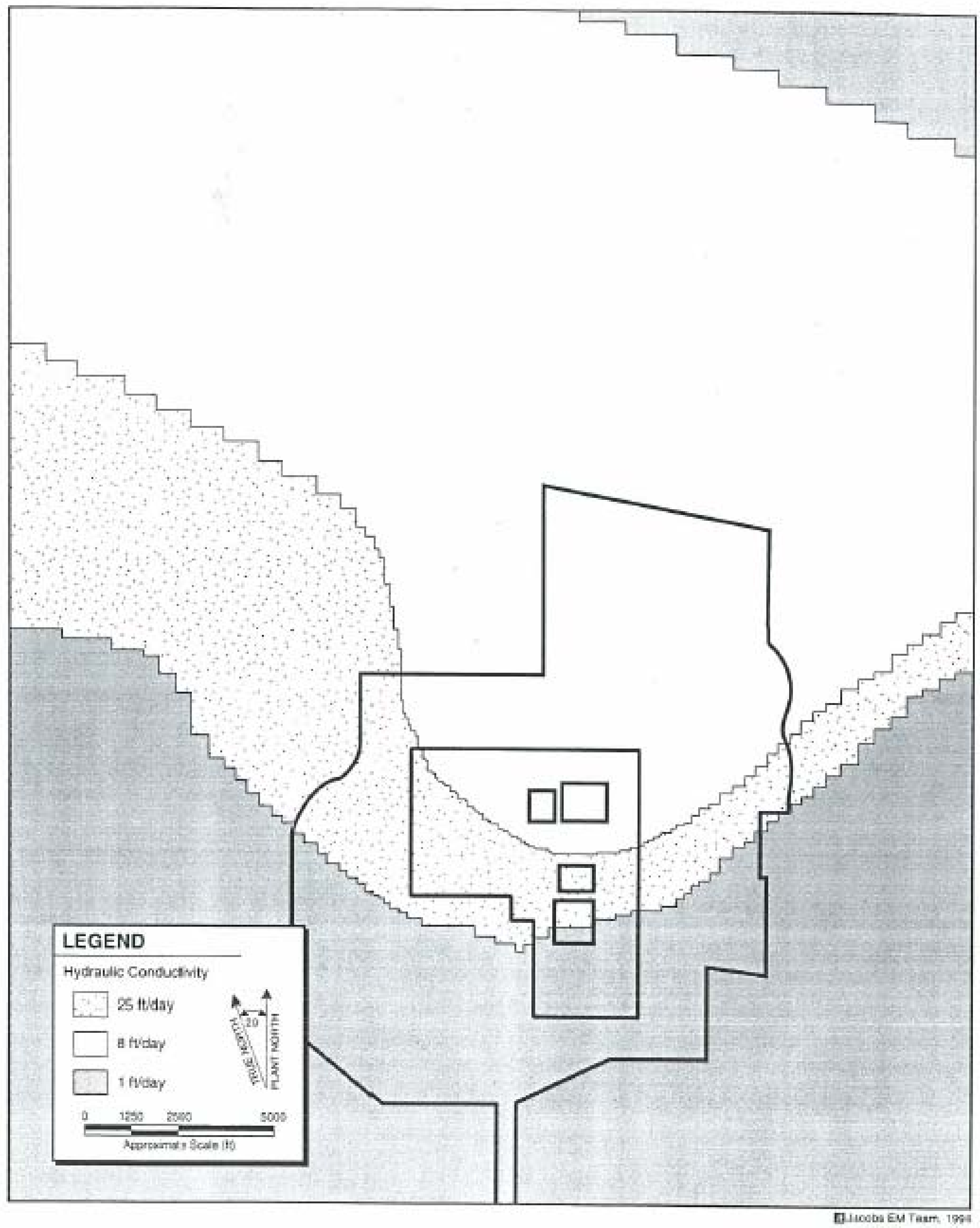


Fig. F.6.3. McNairy Formation Hydraulic Conductivity Zonation for Refined Model.

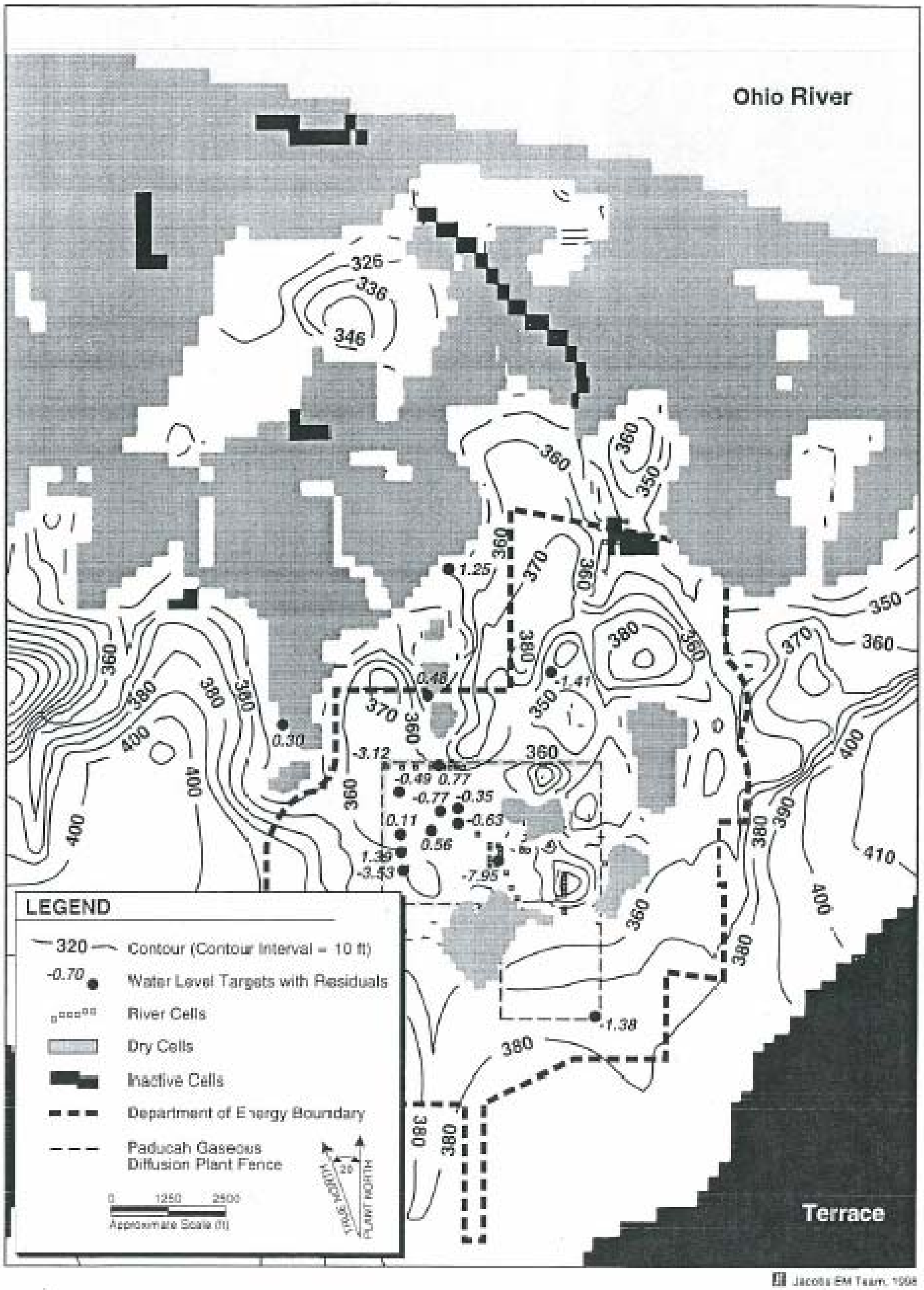


Fig. F.6.4. Simulated Hydraulic Heads in Model Layer 1 (Hydraulic Unit 2A) for Refined Model.

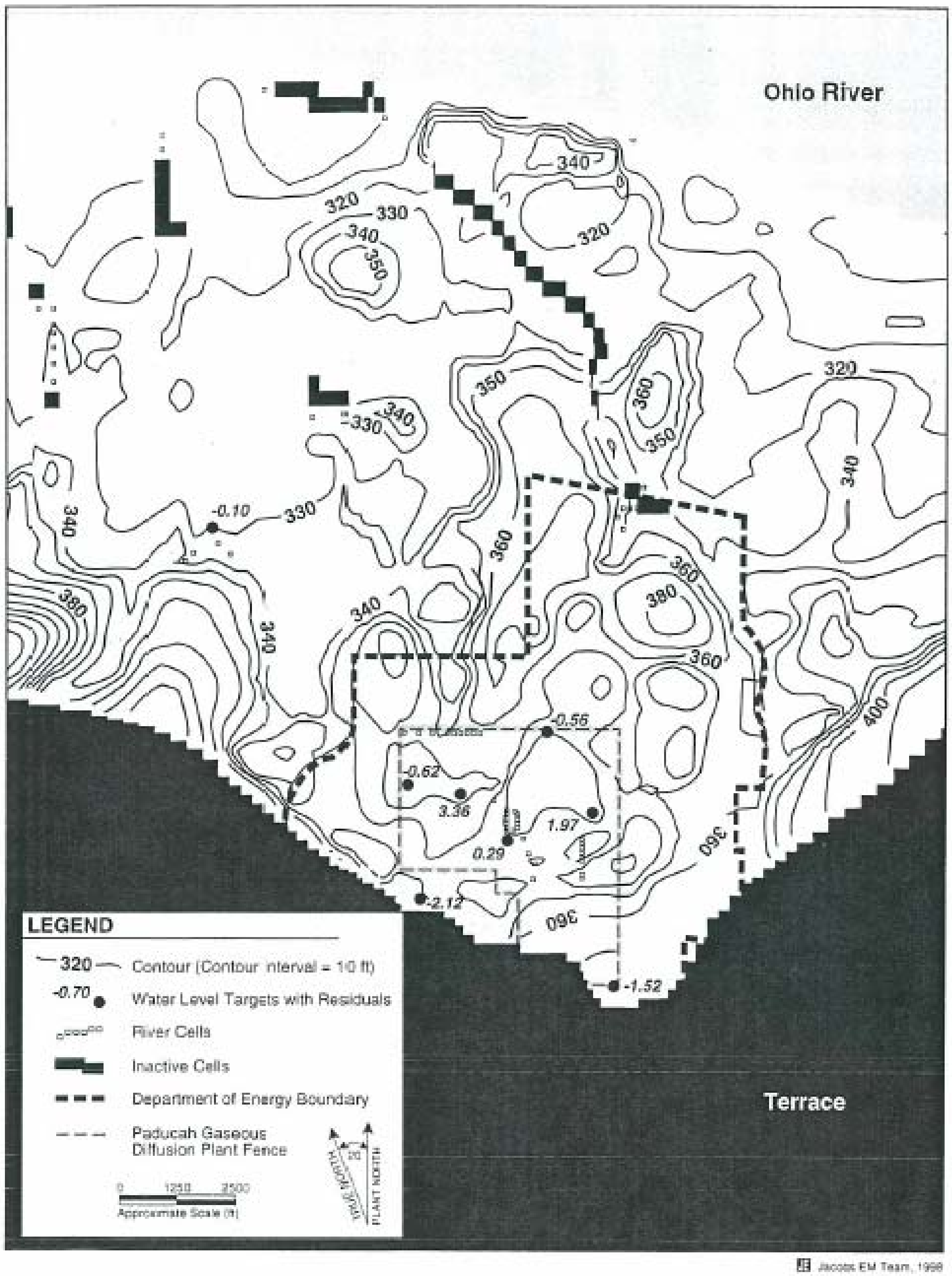


Fig. F.6.5. Simulated Hydraulic Heads in Model Layer 2 (Hydrogeologic Unit 2B) for Refined Model.

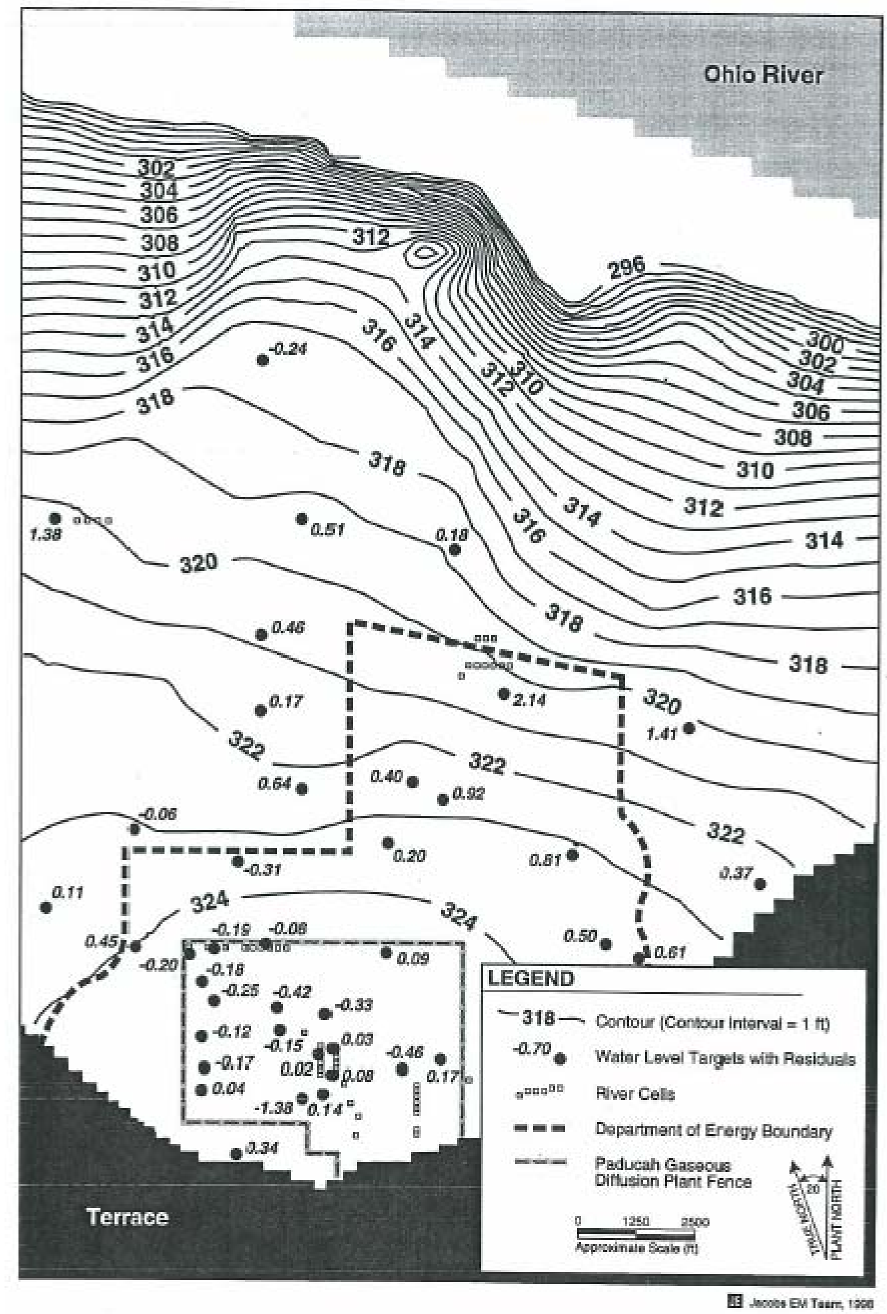


Fig. F.6.6. Simulated Hydraulic Heads in Model Layer 3 (Regional Gravel Aquifer) for Refined Model.

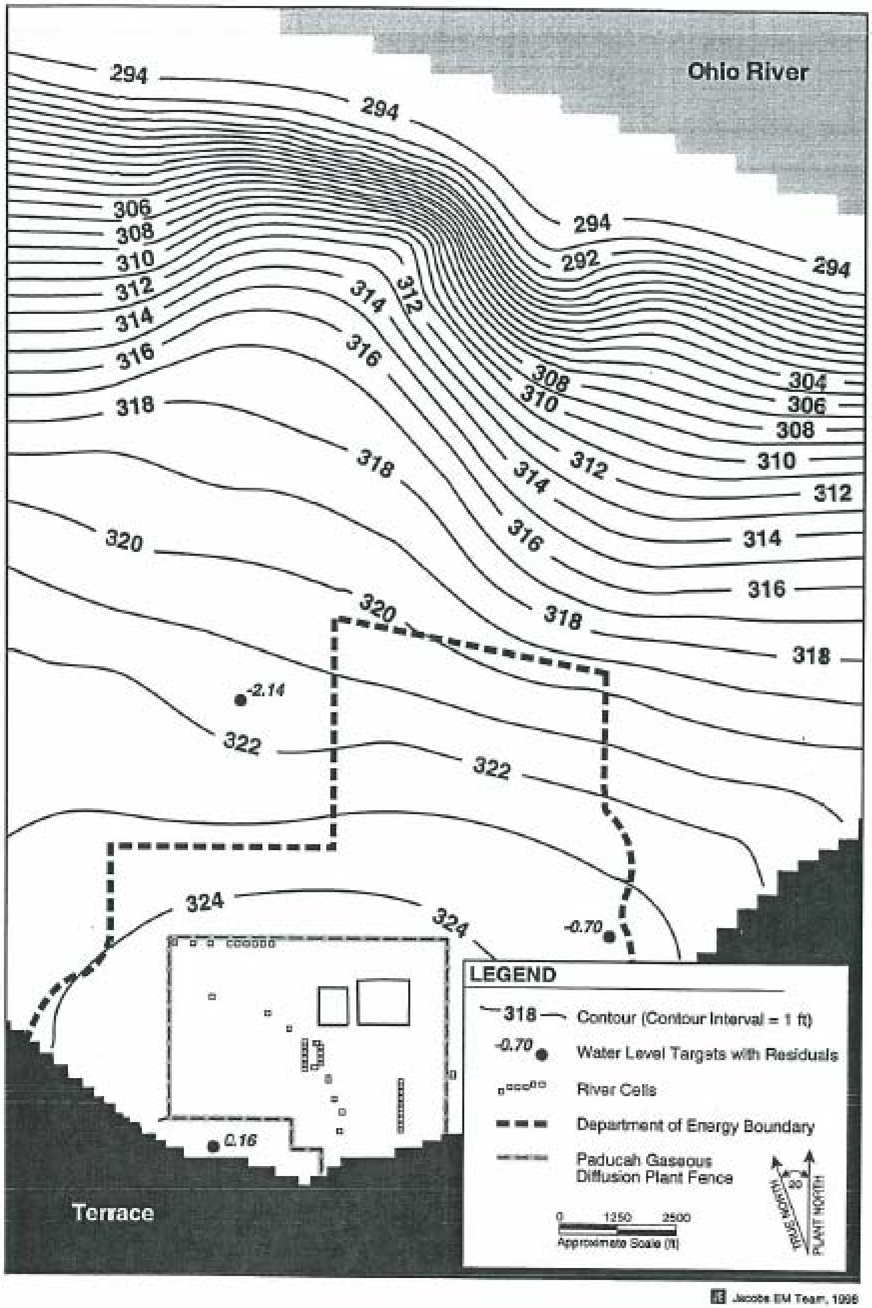


Fig. F.6.7. Simulated Hydraulic Heads in Model Layer 4 (McNairy Formation) for Refined Model.

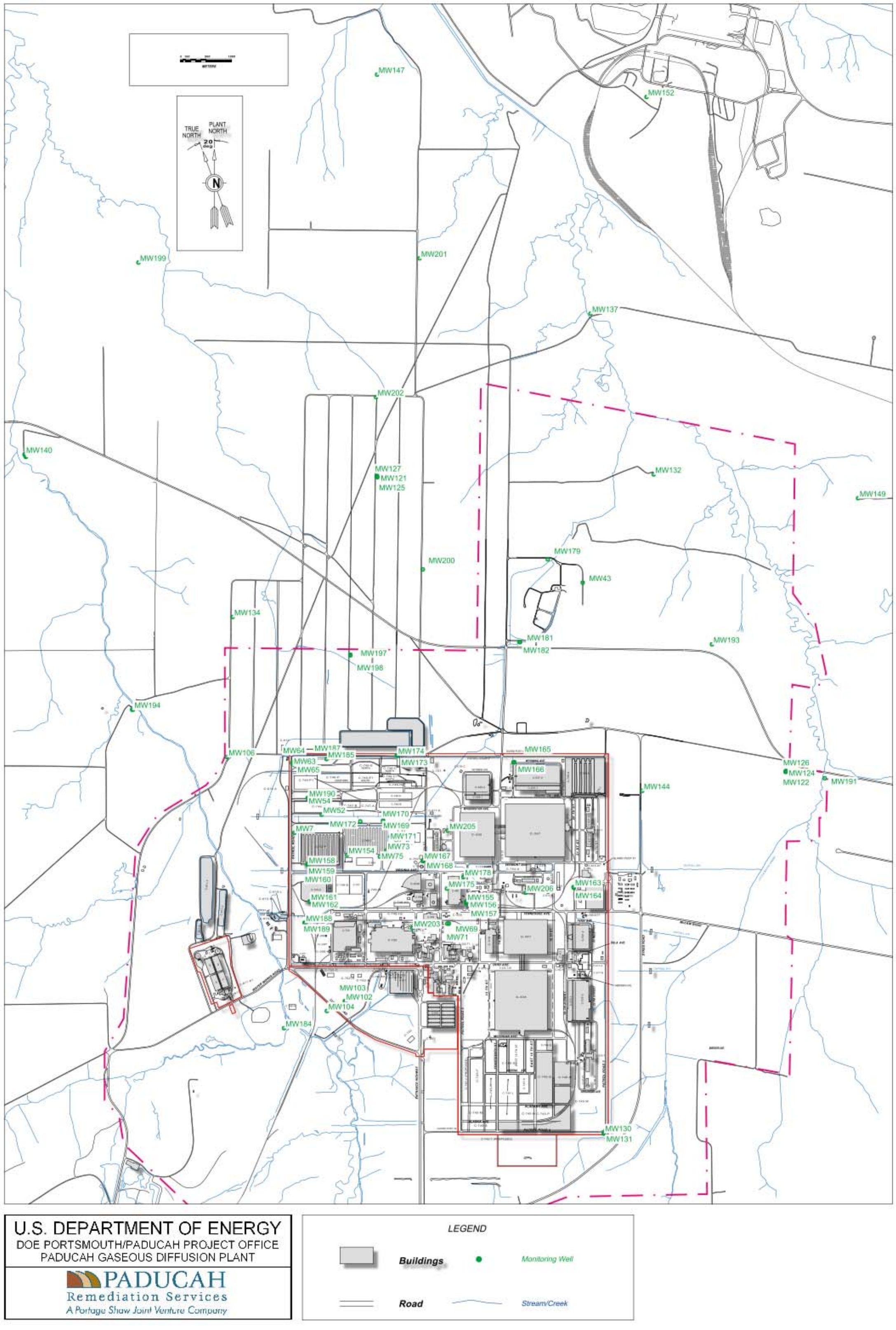


Fig. F.6.8. Monitoring Wells Used for Refined Model.

Table F.6.1. Summary of Model Residuals for Refined Model

Name	X	Y	Layer	Observed	Computed	Residual
MW-007	10788.54	13243.04	2	361.59	362.21	-0.62
MW-043	16115.5	17847.23	3	323.56	322.64	0.92
MW-052	11295.59	13579.74	3	324.19	324.44	-0.25
MW-054	11060.36	13885.99	3	324.17	324.35	-0.18
MW-063	10751.76	14542.56	3	323.98	324.18	-0.20
MW-064	10752.13	14527.54	1	363.21	366.33	-3.12
MW-065	10752.59	14512.42	3	323.97	324.19	-0.22
MW-069	13644.25	11572.96	2	341.74	342.03	-0.29
MW-071	13614.57	11573.14	3	325.04	324.90	0.14
MW-073	12486.97	12913.31	3	324.51	324.66	-0.15
MW-075	12370.09	12805.14	2	364.92	361.56	3.36
MW-103	11735.36	10146.46	3	325.61	325.27	0.34
MW-104	11390.73	9964.42	2	349.8	351.92	-2.12
MW-106	9548.6	14638.23	3	324.36	323.91	0.45
MW-124	19866.65	14373.68	3	324	323.50	0.50
MW-125	12324.69	19786.58	3	321.71	321.54	0.17
MW-126	19868.99	14383.97	3	323.79	323.48	0.31
MW-127	12323.39	19808.53	1	348.89	347.64	1.25
MW-130	16503.61	7723.28	2	371.9	373.42	-1.52
MW-131	16506.09	7708.36	1	371.98	373.36	-1.38
MW-132	17427.71	19839.65	3	322.8	320.66	2.14
MW-134	9652.5	17216.23	3	322.91	322.97	-0.06
MW-137	16260.75	22798.16	3	319.04	318.86	0.18
MW-142	5825	20177.05	3	322.53	322.07	0.46
MW-143	5831.4	20160.94	2	332.43	332.53	-0.10
MW-144	17217.4	14016.88	3	323.99	324.00	-0.01
MW-147	12318.22	27195.99	3	317.26	317.50	-0.24
MW-149	21227.17	19402.36	3	321.48	320.07	1.41
MW-150	22640.36	15887.1	3	322.93	322.56	0.37
MW-152	17294.86	26783.97	3	313.35	312.44	0.91
MW-154	11769.99	12837.01	1	363.89	363.33	0.56
MW-155	13962.5	11977.9	3	324.94	324.86	0.08
MW-156	13961.8	11943.6	3	324.89	324.86	0.03
MW-157	13961.8	11958.7	1	347.51	355.46	-7.95
MW-158	11030.5	12656.1	3	324.45	324.57	-0.12
MW-159	11050.4	12657.5	3	324.47	324.58	-0.11
MW-160	11041.6	12675.4	1	363.02	362.91	0.11
MW-161	11070.6	11980.6	3	324.5	324.67	-0.17
MW-162	11101.3	11980.5	1	360.27	358.88	1.39
MW-163	15946.5	12246.5	3	324.87	324.70	0.17
MW-164	15953.3	12231.7	2	336.99	335.02	1.97
MW-165	14851.8	14545.6	3	324.61	324.52	0.09

Table F.6.1. Summary of Model Residuals for Refined Model (continued)

Name	X	Y	Layer	Observed	Computed	Residual
MW-166	14835.2	14540.6	2	341.56	342.12	-0.56
MW-167	13165	12738.6	1	368.33	365.75	2.58
MW-168	13165	12722.5	3	324.31	324.72	-0.41
MW-169	12429.5	13455.9	3	324.2	324.62	-0.42
MW-170	12429.9	13471.5	1	362.85	363.20	-0.35
MW-171	12569.1	13175.8	1	365.31	364.68	0.63
MW-172	12009.6	13455.1	1	362.68	363.45	-0.77
MW-173	12697.5	14667.6	3	324.39	324.47	-0.08
MW-174	12680.3	14668.5	1	363.84	363.07	0.77
MW-175	13608.4	12219	3	324.82	324.80	0.02
MW-178	13913.9	12431.1	3	324.82	324.79	0.03
MW-179	15471	18275.2	3	323	322.60	0.40
MW-181	14944.7	16754.6	3	323.5	323.30	0.20
MW-182	14960.1	16754.5	1	355.67	357.08	-1.41
MW-184	10600.6	9650	1	359.09	359.09	0.00
MW-185	11385.6	14600.2	3	324.09	324.28	-0.19
MW-187	11133	14611.7	1	363.45	364.16	-0.71
MW-188	10986.7	11590.2	3	324.76	324.72	0.04
MW-189	10989.9	11590	1	354.86	358.39	-3.53
MW-190	11035.9	13885.2	1	366.21	366.70	-0.49
MW-191	20584.9	14247.6	3	323.89	323.28	0.61
MW-193	18503.3	16712.2	3	323.89	323.08	0.81
MW-194	7810	15512.9	3	323.49	323.38	0.11
MW-195	7794.1	15508.4	1	343.93	343.63	0.30
MW-197	11825	16510.4	3	323.14	323.45	-0.31
MW-198	11824.5	16522.1	1	342.99	342.51	0.48
MW-199	7910.9	23737.4	3	321.49	320.11	1.38
MW-200	13163.6	18090.6	3	322.8	322.16	0.64
MW-201	13103.5	23814.7	3	319.87	319.36	0.51
MW-202	12299.5	21260.5	3	321.36	320.90	0.46
MW-203	12972.7	11488.1	3	323.51	324.89	-1.38
MW-205	13627.2	13283.2	3	324.38	324.71	-0.33
MW-206	15063	12142.5	3	324.33	324.79	-0.46
MW-102	11720.18	10144.76	4	325.55	325.39	0.16
MW-121	12309.85	19808.83	4	319.4	321.54	-2.14
MW-122	19863.67	14364.37	4	322.75	323.45	-0.70
MW-140	5808.31	20205.78	4	319.96	322.04	-2.08

Table F.6.2. Calibration Statistics Summary for Refined Model

Measurement	Value
Residual Mean	-0.10
Residual Standard Deviation	1.38
Residual Sum of Squares	151.05
Absolute Residual Mean	0.79
Minimum Residual	-7.95
Maximum Residual	3.36
Head Range	58.63
Residual Standard Deviation/Head Range	0.02

Table F.6.3. Calibration Statistics Breakdown by Model Layer for Refined Model

Measurement	Layer 1 HU 2A	Layer 2 HU 2B	Layer 3 RGA HU 4/HU 5	Layer 4 McNairy HU 6
Number of Targets	19	8	48	4
Residual Mean	- 0.61	0.01	0.18	-1.19
Residual Standard Deviation	2.24	1.69	0.56	0.967
Residual Sum of Squares	102.45	22.74	16.42	9.42
Absolute Residual Mean	1.46	1.32	0.40	1.27
Minimum Residual	-7.95	-2.12	-1.38	-2.14
Maximum Residual	2.57	3.36	2.14	0.15
Head Range	28.99	39.47	12.26	6.15
Residual Standard Deviation/Head Range	0.077	0.042	0.045	0.157

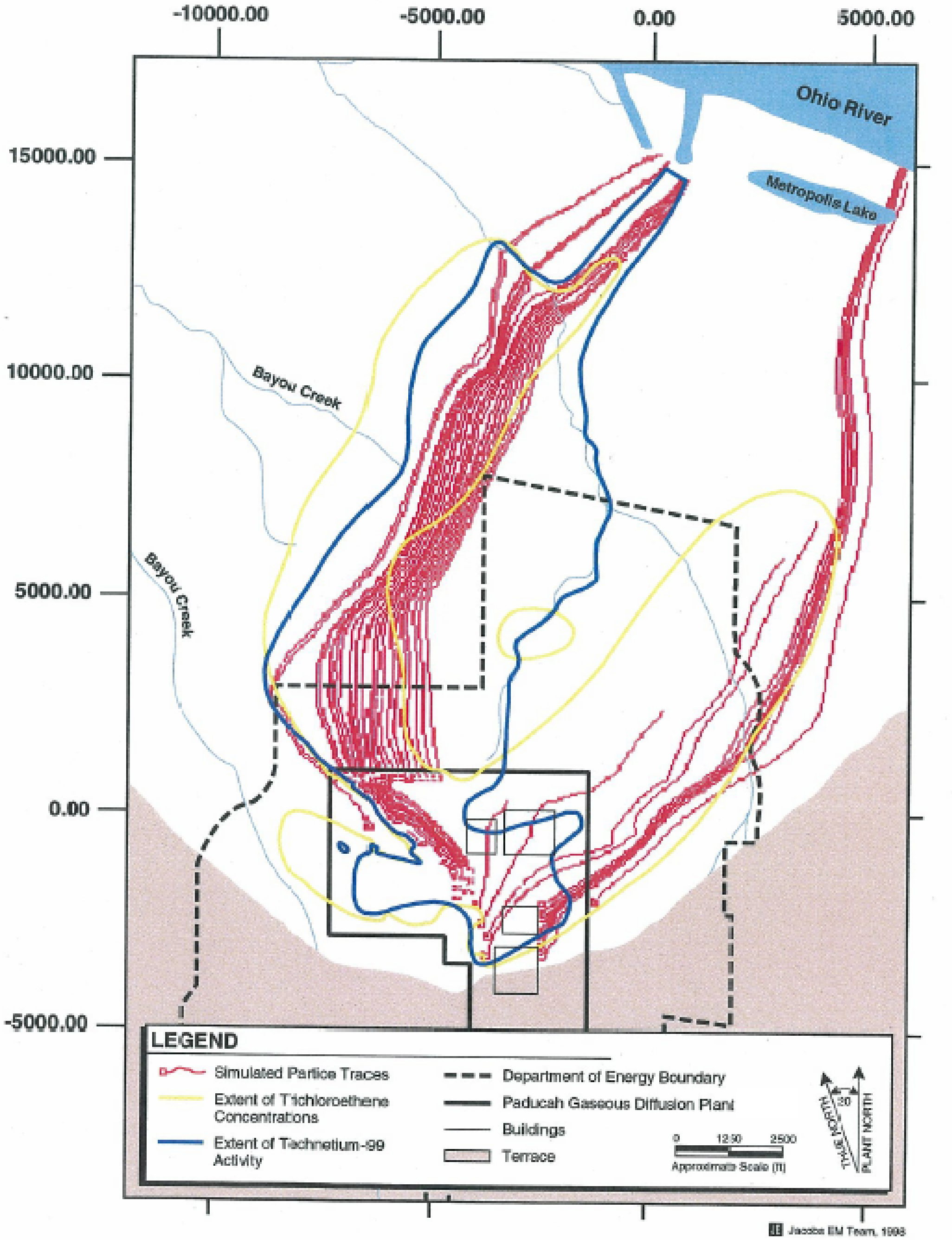


Fig. F.6.89. Simulated Particle Traces Within the Regional Gravel Aquifer for Refined Model.

THIS PAGE INTENTIONALLY LEFT BLANK.

APPENDIX G

BASELINE RISK ASSESSMENT

Deleted: 06-064(E)/041406
Deleted: 051
Deleted: 706

THIS PAGE INTENTIONALLY LEFT BLANK.

Deleted: 06-064(E)/041406

Deleted: 051

Deleted: 706

CONTENTS

Deleted: 06-064(E)/041406

Deleted: 06-064(E)/041406

Deleted: 06-064(E)/041406

Deleted: 06-064(E)/041406

TABLES

Deleted: 06-064(E)/041406

Deleted: 06-064(E)/041406

Deleted: 06-064(E)/041406

THIS PAGE INTENTIONALLY LEFT BLANK.

Deleted: 06-064(E)/041406

FIGURES

Deleted: 06-064(E)/041406

THIS PAGE INTENTIONALLY LEFT BLANK.

Deleted: 06-064(E)/041406

ACRONYMS

^{137}Cs	cesium-137
^{222}Rn	radon-222
^{234m}Pa	protactinium-234m
^{234}Th	thorium-234
^{237}Np	neptunium-237
^{238}U	uranium-238
^{239}Pu	plutonium-239
^{241}Am	americium-241
^{40}K	potassium-40
^{99}Tc	technetium-99
ABS	absorption factors
AT123D	Analytical, Transient One-, Two-, and Three-Dimensional model
ATSDR	Agency for Toxic Substances and Disease Registry
BAF	bioaccumulation factor
BERA	baseline ecological risk assessment
bgs	below ground surface
BHHRA	baseline human health risk assessment
BRA	baseline risk assessment
CAS	*Chemical Abstract Service*
CDI	chronic daily intake
CNS	central nervous system
COC	contaminant of concern
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
DCA	dichloroethane
DCE	dichloroethene
DHHS	Department of Health and Human Services
DNA	deoxyribonucleic acid
DOE	U. S. Department of Energy
ELCR	excess lifetime cancer risk
EPA	United States Environmental Protection Agency
EPC	exposure point concentrations
GI	gastrointestinal
GWOU	Groundwater Operable Unit
HEAST	Health Effects Assessment Summary Tables
HI	hazard index
HQ	hazard quotient
IARC	International Agency for Research on Cancer
ICRP	International Commission on Radiological Protection
IEUBK	Integrated Exposure Uptake Biokinetic (Model)
IRIS	Integrated Risk Information System
KDEP	Kentucky Department for Environmental Protection
LCD	Lower Continental Deposits
LET	linear energy transfer
LOAEL	lowest-observed-adverse-effects level
MCL	maximum contaminant levels
MEPAS	Multimedia Environmental Pollutant Assessment System
MMT	methylclopentadienyl manganese tricarbonyl
NCEA	National Center for Environmental Assessment

Deleted: ALAD aminolevulinic acid dehydrase¶
As arsenic¶

Deleted: BaP benzo(*a*)pyrene¶

Deleted: BRHS British Regional Heart Study¶

Deleted: CERCLA Comprehensive Environmental Response, Compensation, and Liability Act¶

Deleted: cPAH carcinogenic polycyclic aromatic hydrocarbon¶
Cr chromium¶

Deleted: HSDB Hazardous Substances Database¶

Deleted: IQ cognitive¶

Deleted: KDFWR Kentucky Department of Fish and Wildlife Resources¶
KOW Kentucky Ordnance Works¶

Deleted: Mo Molybdenum¶

Deleted: 06-064(E)/041406

NOAEL	no-observed-adverse-effects level
OREIS	Oak Ridge Environmental Information System
ORNL	Oak Ridge National Laboratory
OSWER	Office of Solid Waste and Emergency Response
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyl
PGDP	Paducah Gaseous Diffusion Plant
POC	pathways of concern
POE	point of exposure
PVC	polyvinyl chloride
RAGS	Risk Assessment Guidance for Superfund
RAIS	*Risk Assessment Information System*
RBC	red blood cell
RDA	Recommended Dietary Allowance
RfC	reference concentration
RfD	reference dose
RGA	Regional Gravel Aquifer
RGO	remedial goal option
RI	remedial investigation
RME	reasonable maximum exposure
SAS®	Statistical Analysis System
SERA	Screening Ecological Risk Assessment
SESOIL	Seasonal Soil Compartment model
SF	slope factor
SI	site investigation
SQL	Sample Quantitation Limit
SW Plume	Southwest Dissolved-Phase Plume
SWMU	solid waste management unit
TCE	trichloroethene
TIC	tentatively identified compound
TVA	Tennessee Valley Authority
UCD	Upper Continental Deposits
UCL	upper confidence limit
UCRS	Upper Continental Recharge System
USGS	United States Geological Survey
VC	vinyl chloride
VOC	volatile organic compound
WAG	Waste Area Grouping
WHO	World Health Organization
WKWMA	Western Kentucky Wildlife Management Area

Deleted: NFT Neurofibrillary tangle¶

Deleted: OU operable unit¶

Deleted: PRG preliminary remediation goal¶

Deleted: SADA Spatial Analysis and Decision Assistance Model¶

Deleted: Sb Antimony¶

Deleted:

Deleted: T&E threatened and endangered (species)¶

Deleted: TEF toxicity equivalency factor¶

Deleted: 06-064(E)/041406

PART 1 – BASELINE HUMAN HEALTH RISK ASSESSMENT

This baseline human health risk assessment (BHHRA) utilizes information collected during the recently completed site investigation (SI) of four potential sources to the Southwest Plume (Solid Waste Management Unit [SWMU] 210) and results of previous risk assessments for these sources in the Waste Area Grouping (WAG) 27 Remedial Investigation (RIs) (DOE 1999) to characterize the baseline risks posed to human health from contact with contaminants in soil and water at these sources and at locations to which contaminants may migrate. The sources included are the C-747-C Oil Land Farm (SWMU 1), areas near the C-720 Building, and a sewer line running from near the C-400 Building to Outfall 008 (part of SWMU 102) at the Paducah Gaseous Diffusion Plant (PGDP) in Paducah, Kentucky.

Deleted: and WAG 3

Deleted: s

Deleted: and DOE 2000a, respectively

Deleted: the C-747 Contaminated Burial Yard (SWMU 4),

The overall purpose of the Southwest Plume SI presented in the main text of this report was to collect information that could be used, along with information collected during previous RI (i.e., the WAG 27 RI), to define the nature and extent of the Southwest Plume and the presence, nature, and extent of contamination at the sources listed earlier. A primary focus of the SI was to collect additional information about subsurface soil and groundwater of the Regional Gravel Aquifer (RGA) to support the refinement of an assessment of risks to human health and the environment that began following the earlier RI. The information collected during the SI and the earlier RI and the results of this BHHRA will be used to determine if response actions to reduce risks are needed and, if needed, to screen among response action alternatives.

Deleted: s

Deleted: and 3 R

Deleted: s

Deleted: s

Deleted: s

Because the only new data collected for the sources were for subsurface soil and RGA groundwater, this BHHRA focuses on the assessment of risks resulting from the hypothetical household use of contaminated water drawn from the RGA at the source areas, within the boundaries of the Southwest Plume, and at points of exposure (POEs) at the PGDP plant boundary, PGDP property boundary, and near the Ohio River. Potential risks under other scenarios resulting from exposure to contaminated surface and subsurface soil identified are reported, but these risks were taken from the earlier assessments and were not reassessed as part of this BHHRA.

The methods and presentations used in this BHHRA are consistent with those presented in *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant* (DOE/OR/07-1506&D2) (DOE 2000b). The Risk Methods Document integrates the human health risk assessment guidance from the U. S. Environmental Protection Agency (EPA) and the Kentucky Department for Environmental Protection (KDEP) and incorporates instructions contained in regulatory agency comments on earlier risk assessments performed for the PGDP.

Consistent with the Risk Methods Document, this BHHRA is presented in nine sections. The first section reviews the results of previous risk assessments that are useful in understanding the risks posed to human health by contaminants at or migrating from the source areas. This section also presents sources of information that were used to complete the exposure assessment contained in this BHHRA. The second section describes the evaluation of data collected during the Southwest Plume SI and under other programs and identifies chemicals of potential concern (COPCs). The third section documents the exposure assessment for the sources, including the characterization of the exposure setting, identification of exposure pathways, consideration of land use, determination of potential receptors, delineation of exposure points and routes (including development of the conceptual site model), and calculation of chronic daily intakes (CDIs). The fourth section presents the toxicity assessment, including information on the noncarcinogenic (i.e., systemic toxicity or hazard) and carcinogenic effects of the COPCs and the uncertainties in the toxicity information. The fifth section reports the results of the risk characterization for current and future land use and identifies contaminants, pathways, and land use scenarios of concern.

Deleted: 06-064(E)/041406

The sixth section contains qualitative and quantitative analyses of the uncertainties affecting the results of the BHHRA. The seventh section summarizes the methods used in the BHHRA and presents the BHHRA's conclusions and observations. The eighth section uses the results of the BHHRA to develop site-specific risk-based remedial goal options (RGOs). The ninth section contains references. The overall risk assessment process is presented in Fig. G.1, and graphically displays the steps identified in the preceding section.

G.1 RESULTS OF PREVIOUS STUDIES

Several previous reports contain risk assessment results that are useful in understanding the risks to human health posed by exposure to contaminants at or migrating from the sources to the Southwest Plume. These reports include the following:

- *Results of the Site Investigation, Phase I at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (CH2M HILL 1991a);
- *Results of the Public Health and Ecological Assessment, Phase II* (CH2M Hill 1991b) [This report is Volume 6 of *Results of the Site Investigation, Phase II at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (CH2M HILL 1992)];
- *Remedial Investigation (RI) Addendum for Waste Area Grouping 23, PCB Sites, at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1994);
- *Final Remedial Action Report for Waste Area Grouping (WAG) 23 and Solid Waste Management Unit 1 of WAG 27 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1998a);
- *Remedial Investigation Report for WAG 27 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1999);
- *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 2001); and
- *Contaminant Migration from SWMU 1 and the C-720 Area at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (BJC 2003).

Deleted: <#>*Remedial Investigation Report for Waste Area Grouping 3 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 2000a); ¶

In addition to the previous risk assessments, several studies that discuss the environmental conditions around the sources to the Southwest Plume were used in the preparation of this BHHRA. These studies were primarily used to complete the exposure assessment step of the BHHRA and are not summarized in detail here. These reports include the following:

- *Environmental Investigations at the Paducah Gaseous Diffusion Plant and Surrounding Area, McCracken County, Kentucky* (COE 1994);
- *Integrated Remedial Investigation/Feasibility Study Work Plan for Waste Area Grouping 27 at Paducah Gaseous Diffusion Plant Paducah, Kentucky* (DOE 1998b); and

Deleted: 06-064(E)/041406

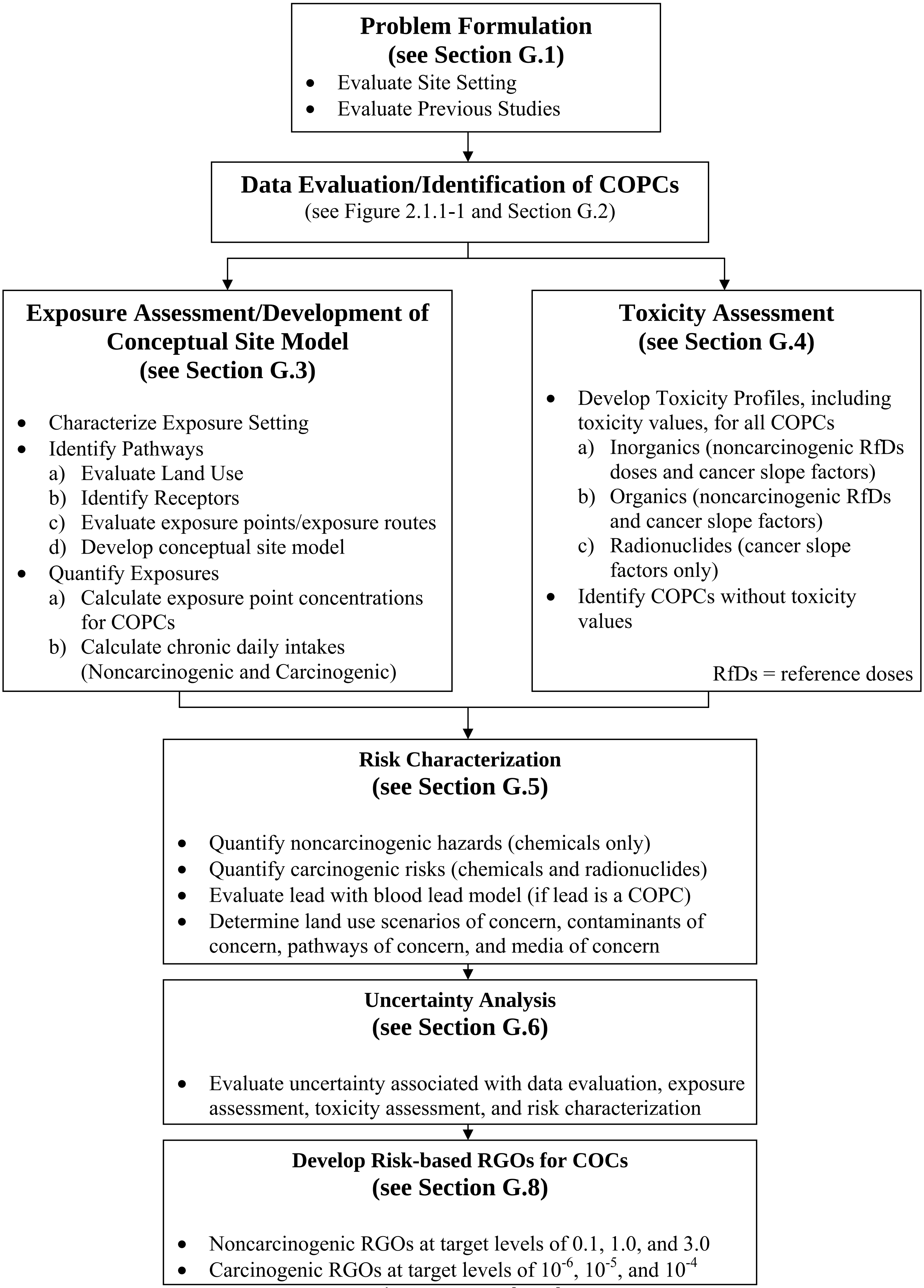


Fig. G.1. HHRA Flow Chart

- The remainder of this section of the BHHRA presents the results of four of the previous risk assessments and risk evaluations listed earlier. These assessments are in the following:

- *Remedial Investigation Report for WAG 27 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1999);

- *Feasibility Study for the Groundwater Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 2001); and

- *Contaminant Migration from SWMU 1 and the C-720 Area at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (BJC 2003).

These results are presented because they were from studies that used methods consistent with those prescribed in the Risk Methods Document and are the most recently completed. For results from other assessments listed earlier, please see the WAG 27 RI report, *Results of the Remedial Investigation Report for WAG 27 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1999a)

The WAG 27 RI report BHHRA contains results for SWMU 1 and the C-720 Building area. Data used in the BHHRA included all data collected from 1989 to the completion of the project in 1999. Scenarios assessed included the following:

- Current on-site industrial—direct contact with sediment and surface soil (soil found 0 to 1 ft below ground surface [bgs]);

- Future on-site industrial—direct contact with sediment, surface soil, and use of groundwater drawn from aquifers below SWMU 1 and the C-720 Building area;

- Future on-site excavation scenario—direct contact with surface soil combined with subsurface soil (soil found 0 to 15 ft bgs);

- Future on-site recreational user—direct contact with sediment and consumption of game exposed to contaminated surface soil;

- Future off-site recreational user—direct contact with surface water impacted by contaminants migrating from sources and consumption of game exposed to this surface water;

- Future on-site rural resident—direct contact with surface soil at and use of groundwater drawn from aquifers below the source areas, including consumption of vegetables that were posited to be raised in this area; and

- Future off-site rural resident—use in the home of groundwater drawn from the RGA at the U. S. Department of Energy (DOE) property boundary.

These are the major conclusions and observations of the WAG 27 RI report BHHRA.

- For both SWMU 1 and the C-720 Building area, the cumulative human health excess lifetime cancer risk (ELCR) and hazard index (HI) exceeded the accepted standards of the KDEP and the EPA for one or more scenarios when assessed using default exposure parameters. The scenarios for which risk exceeded *de minimis* levels (i.e., a cumulative ELCR of 1×10^{-6} or a cumulative HI of 1) are summarized in Table G.1. This information was taken from the risk summary tables presented in the BHHRA. (See Tables ES.3 and ES.6 in the WAG 27 RI report BHHRA. These tables present the

- **Deleted:** *Work Plan for Waste Area Grouping 3 Remedial Investigation/Feasibility Study at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1998c).¶
- **Deleted:**
- **Deleted:** <#>*Remedial Investigation Report for Waste Area Grouping 3 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 2000a); ¶
- **Formatted:** Normal
- **Deleted:** and WAG 3
- **Deleted:** *s*
- **Deleted:** . ¶
- **Deleted:** [
- **Deleted:** 06-064(E)/041406

cumulative risk values for each scenario, the contaminants of concern [COCs], and the pathways of concern [POCs].)

- Use of the provisional lead reference doses (RfDs) provided by KDEP resulted in total HIs that exceed 1,000. However, when this provisional value was not included in the risk characterization, total HIs were markedly reduced. (Note, because the risks calculated using the provisional lead RfD were determined to be uncertain, all observations presented in this summary do not include the quantitative contribution from lead.) Because of the uncertainty in the results using the provisional lead RfD, a better understanding of the risks presented by lead may be gained by considering the comparison of exposure point concentrations (EPCs) of lead in soil and groundwater to screening levels from KDEP and the EPA. In these comparisons (see Section 1.5.6 of the WAG 27 RI report BHHRA), the concentrations of lead in RGA and McNairy Formation groundwater, at SWMU 1 and the C-720 Building area, were greater than the KDEP screening levels. The EPA screening level also was exceeded by RGA and McNairy Formation groundwater EPCs at SWMU 1, but not at the C-720 Building area. The EPCs of lead in sediment and surface and subsurface soil did not exceed either screening level.

- The dermal contact with soil exposure route posed considerable risk, and most of this risk came from contact with metals in soil (primarily beryllium). In fact, for all land use scenarios evaluated, the HI and the ELCR posed through the soil and sediment dermal exposure route exceeded that posed by the ingestion route. As illustrated in Subsection 1.6 of the WAG 27 RI report BHHRA, this was a direct result of using dermal absorption factors (ABS values) that exceed gastrointestinal absorption values and, therefore, may be too conservative.

- The current land use scenario, industrial use, had risk that was above *de minimis* levels at SWMU 1, but not the C-720 Building area, where no ditches are present and contact with surface soil is not possible due to the presence of roads. At SWMU 1, the POC driving HI and ELCR was dermal contact with sediment. The COCs driving ELCR within this POC were beryllium and radionuclides (neptunium-237 [^{237}Np] and cesium-137 [^{137}Cs]). The COCs driving HI were various metals.

- The most plausible future land use scenario, industrial use, had risk that was above *de minimis* levels at each site. As discussed in the BHHRA, the future industrial land use scenario used in the assessment was identical to the current industrial land use scenario except that the future industrial land use scenario also evaluated use of RGA and McNairy Formation groundwater. Addition of groundwater as a medium of exposure added significantly to the risk for this scenario. If groundwater contribution is removed from the risk totals, the driving POCs are identical to the current industrial use scenario.

- Risks from use of groundwater (without the risk contribution of lead) drawn from both the RGA and the McNairy Formation exceeded *de minimis* levels for all scenarios. For the RGA, across all land uses at SWMU 1, the COCs contributing greater than 10% ELCR were arsenic, radon-222 (^{222}Rn), beryllium, and technetium-99 (^{99}Tc). The COCs contributing greater than 10% HI were various

Deleted: (
Deleted:),
Deleted: (
Deleted:).]
Deleted: also
Deleted: metals. For the
Deleted: 06-064(E)/041406

Table G.1. Scenarios for which human health risk exceeded *de minimis* levels in the WAG 27 RI report BHHRA[a]

Scenario	Location	
	SWMU 1	C-720 Building Area
Results for ELCR:		
Current On-site Industrial Worker		
Exposure to Soil	NA	NA
Exposure to Sediment	1×10^{-4}	NA
Future On-site Industrial Worker		
Exposure to Soil	NA	NA
Exposure to Sediment	1×10^{-4}	NA
Exposure to Groundwater[b]	2×10^{-3}	6×10^{-4}
Future On-site Excavation Worker		
Exposure to Soil	2×10^{-4}	8×10^{-5}
Future On-site Recreational User		
Exposure to Game	NA	NA
Exposure to Sediment	2×10^{-4}	NA
Future Off-site Recreational User		
Exposure to Surface Water	—	—
Future On-site Rural Resident		
Exposure to Soil	NA	NA
Exposure to Groundwater[b]	2×10^{-2}	6×10^{-3}
Future Off-site Rural Resident		
Exposure to Groundwater[c]	5×10^{-3}	9×10^{-4}
Results for systemic toxicity[d]:		
Current On-site Industrial Worker		
Exposure to Soil	NA	NA
Exposure to Sediment	2	NA
Future On-site Industrial Worker		
Exposure to Soil	NA	NA
Exposure to Sediment	2	NA
Exposure to Groundwater[b]	10	3
Future On-site Excavation Worker		
Exposure to Soil	2	—
Future On-site Recreational User		
Exposure to Game	NA	NA
Exposure to Sediment	3	NA
Future Off-site Recreational User		
Exposure to Surface Water[c]	—	—
Future On-site Rural Resident		
Exposure to Soil	NA	NA
Exposure to Groundwater[b]	200	50

Deleted: 06-064(E)/041406

Table G.1. Scenarios for which human health hazard exceeded *de minimis* levels in the WAG 27 RI report BHHRA[a] (continued)

Scenario	Location	
	SWMU 1	C-720 Building Area
Future Off-site Rural Resident Exposure to Groundwater[c]	60	200

Notes: Scenarios where risk exceeded the *de minimis* levels have the ELCR or HI presented. Scenarios where risk did not exceed a benchmark level are marked with a —. NA indicates that the scenario/land use combination is not appropriate. For soil at SWMU 1, a scenario/land use combination is not appropriate because surface soil at the site was addressed in a previous response action. For soil at the C-720 Building area, a scenario/land use combination is not appropriate because roads and other cover prevent contact with surface soil. Exposure to game at both sites is NA because there is no exposure to contaminated surface soil.

[a] Values for SWMU 1 are taken from Table ES.3 of the WAG 27 RI report BHHRA. Values for the C-720 Building area are taken from Table ES.6 of the WAG 27 RI report BHHRA. All values presented are rounded to one significant digit.

[b] The BHHRA assessed risks from use of water drawn from the RGA separately from use of water drawn from the McNairy Formation. The values reported here are for use of water from the RGA.

[c] Based on results of contaminant transport modeling. The value presented is the maximum ELCR or HI for a single chemical.

[d] Hazard values for child exposure are presented for the residential and recreational scenarios.

metals. For the McNairy, across all land uses at SWMU 1, the COCs contributing greater than 10% ELCR were beryllium, americium-241 (^{241}Am), and uranium-238 (^{238}U). The COCs contributing greater than 10% to HI were various metals. For the RGA, across all land uses at the C-720 Building area, the COCs contributing greater than 10% ELCR were beryllium, ^{241}Am, ^{237}Np, ^{238}U, 1,1-dichloroethene (1,1-DCE), and ^{99}Tc. The COCs contributing greater than 10% to HI were various metals, trichloroethene (TCE), and carbon tetrachloride. For the McNairy, across all land uses at the C-720 Building area, the COCs contributing greater than 10% ELCR were beryllium, ^{241}Am, ^{237}Np, and ^{238}U. The COCs contributing greater than 10% to HI were various metals.

- In this assessment, ELCR and HI to the excavation worker also exceeded *de minimis* levels. As with the industrial worker, dermal exposure was the driving POC for both ELCR and HI at both SWMU 1 and the C-720 Building area. The driving COCs were metals and polycyclic aromatic hydrocarbons (PAHs) at SWMU 1 and metals at the C-720 Building area.

- Risks from contaminants migrating through groundwater were determined using the Multimedia Environmental Pollutant Assessment System (MEPAS) model, and these risks exceeded *de minimis* levels. The COCs for SWMU 1 as determined by risk estimates for future residential groundwater users drawing water at the PGDP plant boundary POE were TCE, vinyl chloride (VC), and antimony. For the C-720 Building area, the COCs for the plant boundary POE were *trans*-1,2-dichloroethene (*trans*-1,2-DCE), TCE, VC, and antimony. Radionuclide COCs for the migration pathway were not identified at either site.

A complete summary allowing comparison between the originally developed ELCR and hazard values for each of the scenarios above is present in Attachment G2.

Deleted: risk

Deleted: i

Deleted: e

Deleted: <#>RESULTS OF THE REMEDIAL INVESTIGATION REPORT FOR WASTE AREA GROUPING 3 AT THE PADUCAH GASEOUS DIFFUSION PLANT, PADUCAH, KENTUCKY (DOE

Deleted: <#>2000A

Deleted: <#>2000a)¶
The WAG 3 RI report BHHRA contains results for SWMU 4. Data used in the BHHRA included all data collected from 1989 to the completion of the project in 2000. Scenarios assessed included the following:¶
<#>Current on-site industrial—direct contact with sediment and surface soil (soil found 0 to 1 ft bgs);¶
<#>Future on-site industrial—direct contact with sediment, surface soil, and use of groundwater drawn from aquifers below SWMU 4;¶
<#>Future on-site excavation scenario—direct contact with surface soil combined with subsurface soil (soil found 0 to 15 ft bgs);¶
<#>Future on-site recreational user—direct contact with sediment and consumption of game exposed to contaminated surface soil;¶
<#>Future off-site recreational user—direct contact with surface water impacted by contaminants migrating from sources and consumption of game exposed to this surface water;¶
<#>Future on-site rural resident—direct contact with surface soil at and use of groundwater drawn from aquifers below the source areas, including consumption of vegetables that were posited to be raised in this area;¶
<#>Future off-site rural resident—use in the home of groundwater drawn from the RGA at the DOE property boundary. ¶
These are the major conclusions and observations of the WAG 3 RI report BHHRA. ¶
<#>The cumulative ELCR and HI at SWMU 4 exceed the accepted standards of KDEP and EPA for several scenarios when assessed using default exposure parameters. The land use scenarios for which risks exceed *de minimis* levels are summarized in Table G.2. This information was taken from Table ES.3 in the WAG 3 RI report BHHRA.¶
<#>Use of the provisional lead RfDs provided by KDEP resulted in total HIs that exceed 1,000 for SWMU 4. However, when this provisional value was not included in the risk characterization, total HIs were markedly reduced. (Note, because the risks ... [1]

Deleted: 06-064(E)/041406

G1.1 RESULTS OF FEASIBILITY STUDY FOR THE GROUNDWATER OPERABLE UNIT AT THE PADUCAH GASEOUS DIFFUSION PLANT, PADUCAH, KENTUCKY (DOE 2001)

The feasibility study of the Groundwater Operable Unit (GWOU) included a sitewide BHHRA that considered risks from groundwater use and sources of contamination to groundwater. Attachment 11 to the BHHRA contains a risk characterization for the Southwest Plume and the sources to it developed using data collected during the previous WAG 27 RI.

Deleted: and WAG 3

Deleted: s

In Attachment 11, the sources to the Southwest Plume are listed as follows:

- the C-720 Building area;
- SWMU 1;
- SWMU 91 (UF_6 Cylinder Drop Test Area);
- SWMU 4;
- the C-310 Building area; and
- the southwest corner of the C-400 Building area.

The attachment only listed COCs in groundwater and migrating from the source for four of these locations. These were the C-720 Building area, SWMU 1, SWMU 91, and SWMU 4. The major COCs in RGA groundwater at each location and migrating from the location are presented in Tables G.3 and G.4, respectively.

Table G.2. Major COCs for rural residential use of RGA groundwater drawn at sources to the Southwest Plume

Deleted: 3

Location and Receptor	Total ELCR	COCs	% Total ELCR	Total HI	COCs	% Total HI
SWMU 4	7.0×10^{-3}	Beryllium	22	487	Iron	49
		1,1-DCE	15		Carbon tetrachloride	10
Future rural resident at current concentrations		TCE	20		TCE	29
		^{99}Tc	21			
SWMU 1	1.6×10^{-2}	Arsenic	53	152	Arsenic	47
Future rural resident at		^{99}Tc	18		Iron	19
current concentrations					Manganese	16
C-720 Building Area	6.0×10^{-3}	1,1-DCE	11	47.5	Iron	32
Future rural resident at		^{241}Am	14		Carbon tetrachloride	14
current concentrations		^{99}Tc	24		TCE	33
		^{238}U	24			
SWMU 91	8.2×10^{-3}	1,1-DCE	11	48.1	Iron	52
Future rural resident at		^{241}Am	33		Manganese	15
current concentrations		^{99}Tc	16		TCE	11
		^{238}U	18			

Notes:
ELCR values are for lifetime exposure. HIs are for exposure as a child.
ELCR values greater than 1×10^{-2} are approximate values.

Deleted: 06-064(E)/041406

Table G.3. Major COCs migrating from sources to the Southwest Plume to downgradient POEs through RGA groundwater

Deleted: 4

Source Area	Contaminant
SWMU 4	Arsenic; Cobalt; Copper; Iron; Manganese; Nickel; Vanadium; 1,1-DCE; 1,2-DCE (mixed isomers; Carbon tetrachloride; TCE; VC; ^{237}Np; ^{239}Pu; ^{99}Tc; ^{238}U
SWMU 1	Antimony; Manganese; TCE; VC
C-720 Building Area	Antimony; *trans*-1,2-DCE; TCE; VC
SWMU 91	Antimony; TCE

The overall conclusions for the source units considered in Attachment 11 were as follows:

- ELCRs to a hypothetical resident using RGA groundwater drawn at the source locations in the home exceed the *de minimis* level at all locations and range from 6×10^{-3} (C-720 Building area) to 2×10^{-2} (SWMU 1). HIs for a hypothetical resident also exceed the *de minimis* level at all locations and range from 50 (C-720 Building area) to 500 (SWMU 1).

- Contaminants migrating from major source areas of the Southwest Plume are TCE; TCE breakdown products (e.g., 1,2-DCE and VC); carbon tetrachloride; 1,1-DCE; several metals; and several radionuclides. (Only SWMU 4 is a source of radionuclides.)

- Although other contaminants are present, TCE is the defining contaminant of the Southwest Plume.

Attachment 11 also included a summary of ELCRs and HIs that could be posed to a hypothetical resident using groundwater drawn from 29 individual wells. Of these 29 wells, 9 were completed in the Upper Continental Deposits (UCD) and 20 were completed in the Lower Continental Deposits (LCD).[1] Results from this well-by-well analysis are as follows:

- Over all wells completed in the Upper Continental Recharge System (UCRS) (or UCD), ELCR over all COCs ranged from 1.1×10^{-6} to 4.8×10^{-2}. ELCR from TCE alone ranged from none to 4.8×10^{-2}. For wells in which TCE was not the primary COC, the primary COCs were ^{99}Tc, uranium isotopes, methylene chloride, and arsenic.

- Over all wells completed in the UCRS, ELCR over all COCs ranged from <1 to 6,000. HI from TCE alone ranged from none to 6,000. For wells in which TCE was not the primary COC, the primary COCs were iron and manganese.

- Over all wells completed in the RGA (or LCD), ELCR over all COCs ranged from 2×10^{-6} to 2×10^{-2}. ELCR from TCE alone ranged from 8×10^{-7} to 2×10^{-2}. For wells in which TCE was not the primary COC, the primary COCs were methylene chloride, ^{222}Rn, uranium isotopes, ^{239}Pu, ^{99}Tc, and arsenic.

- Over all wells completed in the RGA, HI over all COCs ranged from <1 to 100,000. HI from TCE ranged from <1 to 2,000. For wells in which TCE is not the primary COC, the primary COC was lead, which had an HI range from <1 to 100,000. The other primary COCs were arsenic (HI <1 to 20), cadmium (HI <1 to 2), chromium (HI <1 to 300), iron (HI <1 to 90), manganese (HI <1 to 30), and uranium (HI <1 to 10).

Deleted: alone

Deleted: s

Deleted: lead,

[1] Please see Section 3 of this BHHRA and Chapter 3 of the SI report for a discussion of the UCD and LCD. Generally, for the Southwest Plume, a well completed in the UCD is screened above 60 ft bgs and is considered to be a UCRS well, and a well completed in the LCD is screened between 60 and 100 ft bgs and is considered to be an RGA well.

Deleted: 06-064(E)/041406

G1.2 RESULTS OF CONTAMINANT MIGRATION FROM SWMU 1 AND THE C-720 AREA AT THE PADUCAH GASEOUS DIFFUSION PLANT, PADUCAH, KENTUCKY (BJC 2003)

This report presents fate and transport modeling used to reevaluate the migration of TCE from current sources at SWMU 1 and the C-720 Area. This analysis was initiated after it was observed that cleanup levels protective of a rural resident using groundwater drawn from a well at a POE at the PGDP property boundary were similar to or less than the average concentrations of TCE in these sources.

For this modeling, source terms for TCE in soil at SWMU 1 and the C-720 area were developed using data collected during the WAG 27 RI and baseline risk assessments (BRA) (DOE 1999). These source terms were developed by assigning soil results to one of five layers at each location and identifying source areas. One source zone was identified at SWMU 1 and 5 source zones were identified at the C-720 area. The location of these source zones at SWMU 1 and the C-720 area are presented in Figs. G.2 and G.3, respectively. The TCE concentrations found within each of these source areas are presented by source zone and depth in Tables G.4 and G.5.

Subsequent to the identification of the source zones, the Seasonal Soil Compartment (SESOIL) model (Bonazountas and Wagner 1984; GSC 1996a) was used to perform leachate modeling, and the Analytical, Transient One-, Two-, and Three-Dimensional (AT123D) model (Yeh 1981; GSC 1996b) was used to perform saturated flow and contaminant transport modeling to POEs at the source, the plant boundary, the PGDP property boundary, and at the Ohio River. Results from this modeling for each of the source zones and at three TCE degradation rates (i.e., no degradation, degradation with half-life of 26.6 years, and degradation with half-life of 4.5 years) are presented in Tables G.6 to G.8. Results for the source at SWMU 1 and for Source Zone 1 at the C-720 area (i.e., the largest source identified at the C-720 area and located at the southeast corner of the C-720 Building) also are presented in Figs. G.4 and G.5.

Results of transport modeling using SESOIL and AT123D and refined source terms showed that the estimated maximum TCE concentrations in groundwater at the PGDP property boundary from source zones at SWMU 1 and the C-720 area were unlikely to exceed the maximum contaminant level (MCL) for TCE under all degradation rates. However, the ELCR, but not the HI, posed by the maximum TCE concentrations at this POE developed in the modeling are slightly greater than the PGDP *de minimis* level for ELCR as shown in Tables G.9 and G.10.

Deleted: 5
Deleted: 6
Deleted: 7
Deleted: 9
Deleted: 10
Deleted: 1
Deleted: 06-064(E)/041406

Deleted: ¶

Formatted: Bullets and Numbering

G.2 IDENTIFICATION OF COPCS

This subsection describes the process used to determine the list of COPCs used in the BHHRA. Specifically, this subsection describes the sources of data, the procedures used to screen the data, and the methods used to derive EPCs under both current and future conditions. Additionally, this section describes the site characterization data used in the exposure assessment performed in Section 3.

G2.1 SOURCES OF DATA

Data used in the BHHRA describing current contaminant concentrations in groundwater at SWMU 1, the C-720 Building area, and the sewer line were from the recently completed Southwest Plume SI, the WAG 27 RI, and routine groundwater monitoring activities. Only groundwater data were assessed in the BHHRA because no new surface soil data were collected during the SI, and all subsurface soil data was collected at depths greater than 15 ft bgs and was focused at better source delimitation. When acquiring data from the PGDP Oak Ridge Environmental Information System (OREIS) database, only groundwater data collected from the RGA since January 1, 1999, was included. Additionally, for all but volatile organic compounds (VOCs), only results from developed wells were used. The sampling stations used in the assessment of groundwater contamination listed by source area are presented in Table G.11. A summary of the data over all sampling stations is in Table G.12. (Data summaries for the SWMU 1, C-720 area, and storm sewer source areas are presented in Attachment 1 to this appendix.)

Deleted: s

Deleted: and 4,

Deleted: , the WAG 3 RI

Deleted: 2

Deleted: 3

Deleted: SWMU 4,

Deleted: 06-064(E)/041406

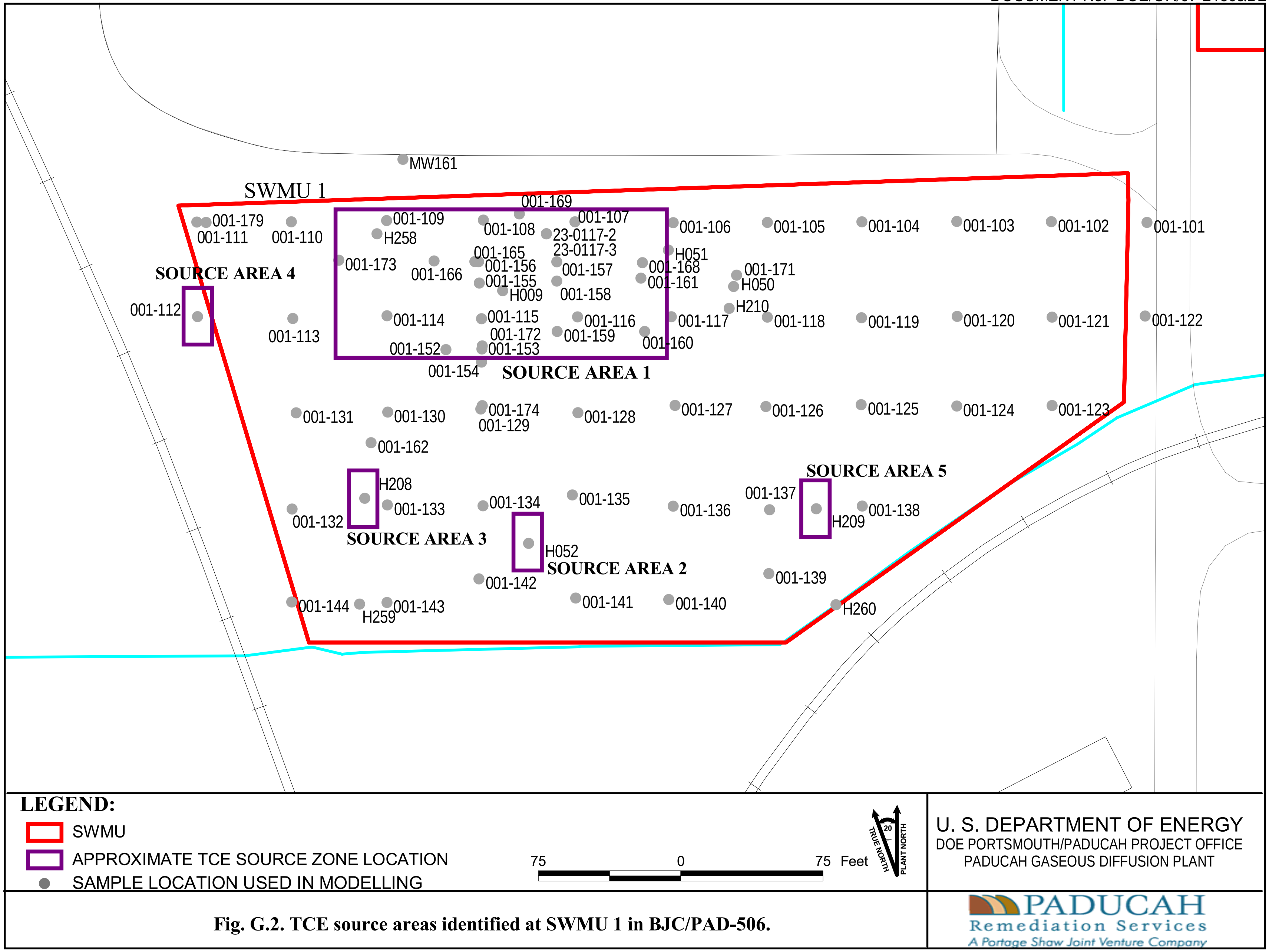


Fig. G.2. TCE source areas identified at SWMU 1 in BJC/PAD-506.

FIGURE No. \SIs\SWPlumeBHHRA1.apr
DATE 01-20-05

DOCUMENT No. DOE/OR/07-2180&D2

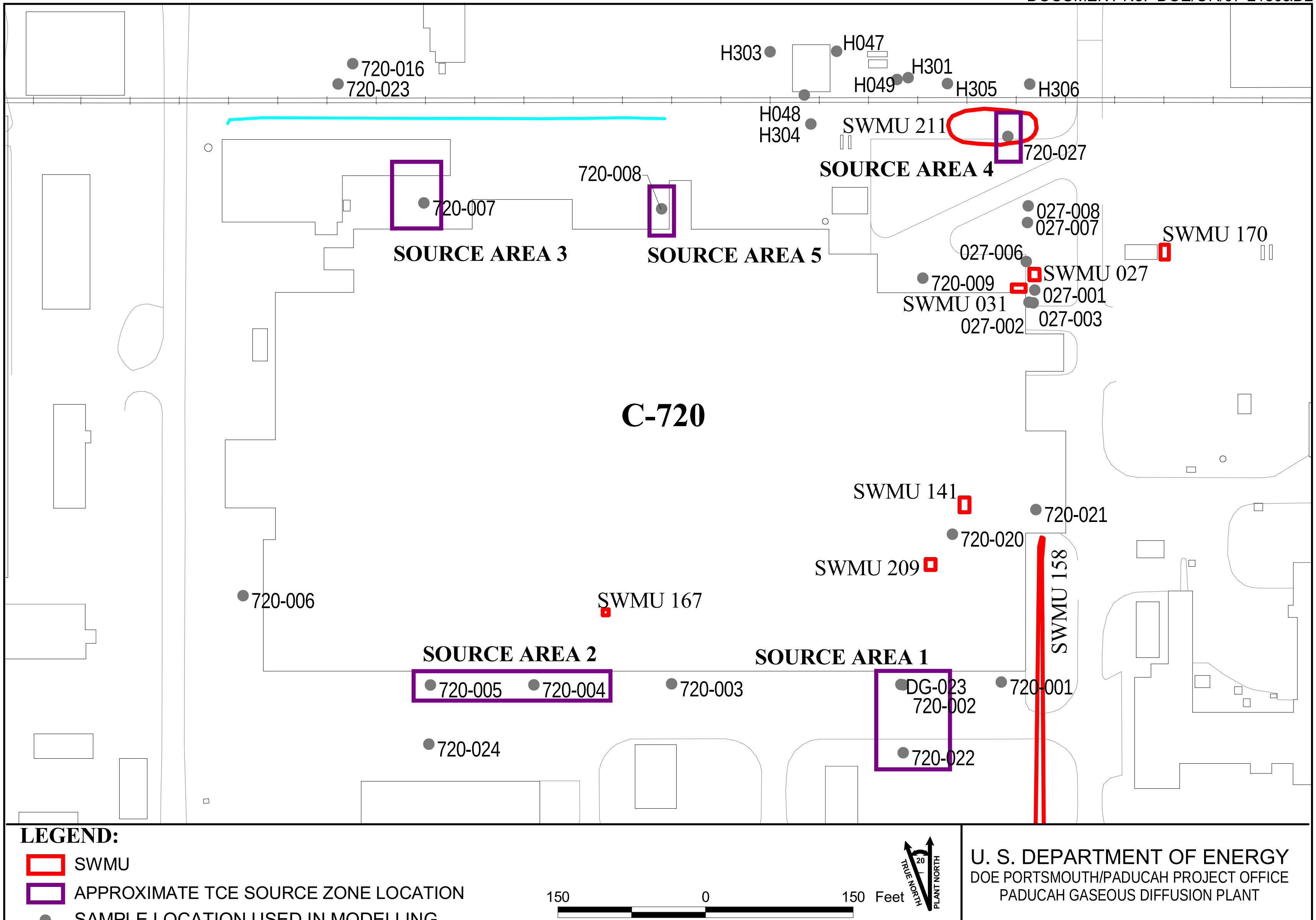


Fig. G.3. TCE source areas identified at C-720 Building in BJC/PAD-506.

U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH Remediation Services
A Portage Shaw Joint Venture Company

FIGURE No. \Sls\SWPlumeBHHRA1.apr
DATE 01-20-05

Table G.4. Summary statistics for TCE (mg/kg) in Source Zone 1 at SWMU 1

Deleted: 5

Depth	Number of Results	Minimum Result	Maximum Result	Arithmetic Mean	Geometric Mean[a]	Median
			All Results			
1 to 10 ft bgs	41	0.003	87	6.9	0.380	0.250
11 to 20 ft bgs	12	0.003	439	39.2	0.668	0.675
21 to 30 ft bgs	19	0.003	50	9.3	0.547	0.600
31 to 40 ft bgs	16	0.003	74	8.4	1.204	1.000
41 to 50 ft bgs	20	0.003	66	9.6	1.006	0.550
			Detects Only			
1 to 10 ft bgs	26	0.026	87	10.8	0.768	0.265
11 to 20 ft bgs	8	0.040	439	58.6	2.35	1.5
21 to 30 ft bgs	12	0.013	50	14.6	1.85	13.5
31 to 40 ft bgs	13	0.013	74	10.3	2.19	1.7
41 to 50 ft bgs	12	0.008	66	15.8	3.92	7.2

bgs = below ground surface

Note: Data set used to generate summary statistics is presented in Appendix A of BJC 2003.

[a]The geometric mean over all results was chosen as the source term concentration after it was determined that the Source Zone 1 data were log normally distributed.

Table G.5. Summary statistics for TCE (mg/kg) in all source zones at the C-720 Area

Deleted: 6

Depth	Source Area	Number of Results	Minimum Result	Maximum Result	Arithmetic Mean[a]
1 to 10 ft bgs	1	2	0.037	17	8.5
	2	1	2.7	2.7	2.7
11 to 20 ft bgs	1	3	0.110	19	8.0
	2	2	7.8	17	12.4
21 to 30 ft bgs	1	4	1.8	68	29.5
	2	4	1.3	6.3	2.7
	3	1	2.2	2.2	2.2
	4	3	0.5	8.1	4.5
	5	2	0.05	0.4	0.225
31 to 40 ft bgs	1	3	1.5	1.6	1.6
	3	2	0.8	14	7.4
	4	3	0.3	1.8	1.3
	5	1	1.6	1.6	1.6
41 to 50 ft bgs	1	3	0.273	1.3	0.92

bgs = below ground surface

Note: Data set used to generate summary statistics is presented in Appendix A of BJC 2003.

Results for source area/depth combinations not containing any detected results are not presented.

[a]The arithmetic mean was used as the source term.

Deleted: 06-064(E)/041406

Table G.6. TCE groundwater concentrations assuming no degradation

Deleted: 7

Source Zone	MCL (mg/L)	Maximum TCE Concentration at: Source Area (mg/L)	Fenceline (mg/L)	PGDP Property Boundary (mg/L)	Little Bayou Creek (mg/L)
		C-720			
Zone-1: TCE	5.00E-03	1.58E-01	2.05E-02	8.56E-03	3.26E-03
Zone-2: TCE	5.00E-03	6.50E-02	8.08E-03	3.40E-03	1.26E-03
Zone-3: TCE	5.00E-03	4.04E-02	5.01E-03	2.07E-03	7.84E-04
Zone-4: TCE	5.00E-03	1.30E-02	1.54E-03	6.38E-04	2.42E-04
Zone-5: TCE	5.00E-03	7.75E-03	9.59E-04	3.96E-04	1.50E-04
		SWMU 1			
Zone-1: TCE	5.00E-03	3.14E-02	1.70E-02	2.45E-03	7.26E-04

Table G.7. TCE groundwater concentrations assuming degradation half-life of 26.6 years

Deleted: 8

Source Zone	MCL (mg/L)	Maximum TCE Concentration at: Source Area (mg/L)	Fenceline (mg/L)	PGDP Property Boundary (mg/L)	Little Bayou Creek (mg/L)
		C-720			
Zone-1: TCE	5.00E-03	1.11E-01	1.33E-02	4.89E-03	8.58E-04
Zone-2: TCE	5.00E-03	3.73E-02	4.59E-03	1.70E-03	2.89E-04
Zone-3: TCE	5.00E-03	2.90E-02	3.18E-03	1.16E-03	2.01E-04
Zone-4: TCE	5.00E-03	4.87E-03	4.59E-04	1.62E-04	2.73E-05
Zone-5: TCE	5.00E-03	2.93E-03	2.88E-04	1.01E-04	1.71E-05
		SWMU 1			
Zone-1: TCE	5.00E-03	2.51E-02	1.21E-02	1.56E-03	2.09E-04

Table G.8. TCE groundwater concentrations assuming degradation half-life of 4.5 years

Deleted: 9

Source Zone	MCL (mg/L)	Maximum TCE Concentration at: Source Area (mg/L)	Fenceline (mg/L)	PGDP Property Boundary (mg/L)	Little Bayou Creek (mg/L)
		C-720			
Zone-1: TCE	5.00E-03	2.15E-02	1.95E-03	4.26E-04	1.80E-06
Zone-2: TCE	5.00E-03	3.66E-03	2.87E-04	5.72E-05	2.18E-07
Zone-3: TCE	5.00E-03	5.63E-03	3.43E-04	8.53E-05	3.74E-07
Zone-4: TCE	5.00E-03	1.81E-03	1.05E-04	2.53E-05	1.12E-07
Zone-5: TCE	5.00E-03	1.08E-03	6.57E-05	1.64E-05	7.17E-08
		SWMU 1			
Zone-1: TCE	5.00E-03	8.34E-03	3.21E-03	2.77E-04	7.31E-07

Deleted: 06-064(E)/041406

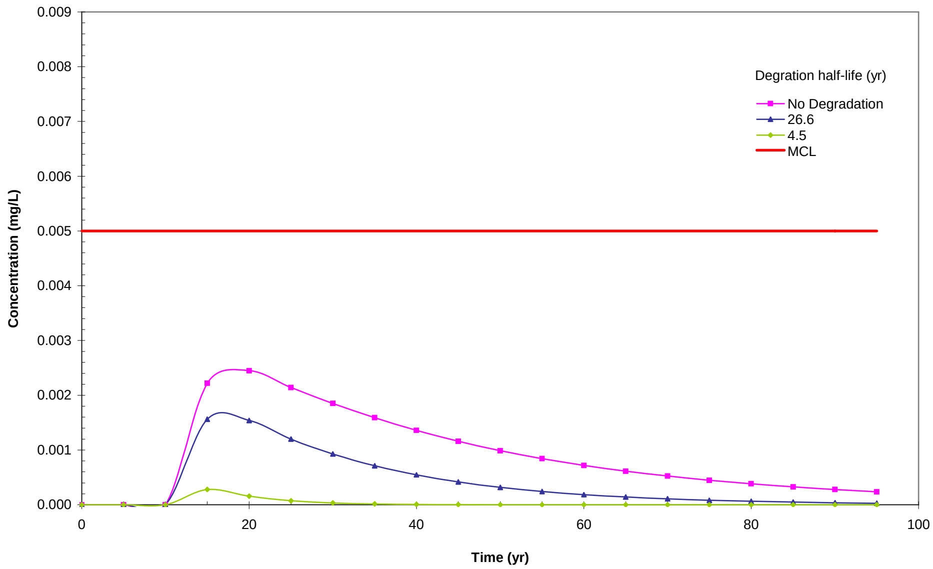


Fig. G.4. Concentrations of TCE in groundwater at the PGDP property boundary from migration from SWMU 1.

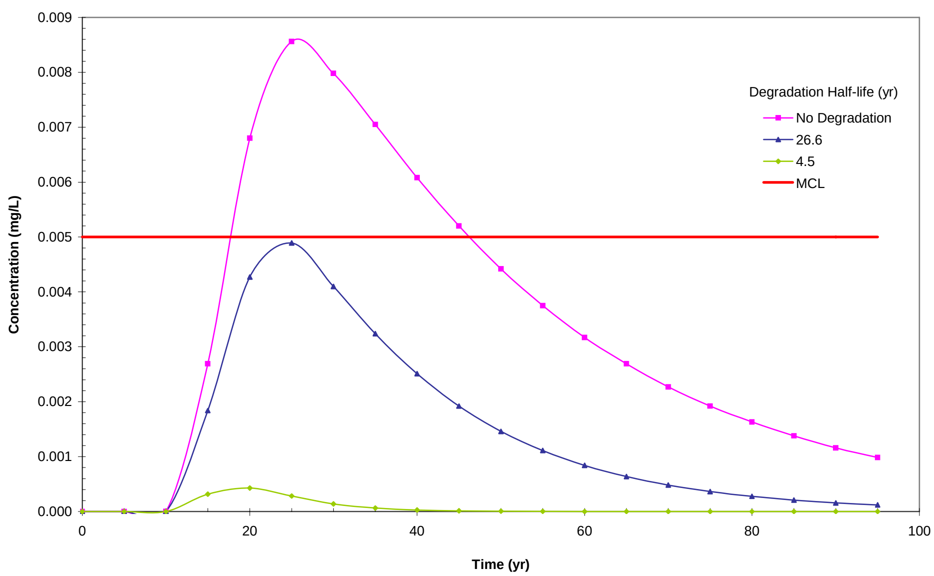


Fig. G.5. Concentrations of TCE in groundwater at the PGDP property boundary from migration from C-720 Source Zone 1.

Deleted: 06-064(E)/041406

Table G.9. Excess lifetime cancer risk posed by maximum TCE concentrations in groundwater predicted for the property boundary point of exposure

Deleted: 10

Source Zone	Maximum TCE Concentration			Excess Lifetime Cancer Risk[a]		
	No Degradation	Degradation Half-life of 26.6 Years	Degradation half-life of 4.5 Years	No Degradation	Degradation Half-life of 26.6 Years	Degradation half-life of 4.5 Years
			C-720 area			
Zone-1: TCE	8.56E-03	4.89E-03	4.26E-04	4.9×10^{-6}	2.8×10^{-6}	2.5×10^{-7}
Zone-2: TCE	3.40E-03	1.70E-03	5.72E-05	2.0×10^{-6}	9.8×10^{-7}	3.3×10^{-8}
Zone-3: TCE	2.07E-03	1.16E-03	8.53E-05	1.2×10^{-6}	6.7×10^{-7}	4.9×10^{-8}
Zone-4: TCE	6.38E-04	1.62E-04	2.53E-05	3.7×10^{-7}	9.4×10^{-8}	1.5×10^{-8}
Zone-5: TCE	3.96E-04	1.01E-04	1.64E-05	2.3×10^{-7}	5.8×10^{-8}	9.5×10^{-9}
			SWMU 1			
Zone-1: TCE	2.45E-03	1.56E-03	2.77E-04	1.4×10^{-6}	9.0×10^{-7}	1.6×10^{-7}

[a] Calculated using the cancer risk-based no action screening value for residential water use for TCE presented in Appendix A of the Risk Methods Document. This no action value, which is for lifetime use, was calculated using a target ELCR of 1 × 10-6 and is 1.73E-03 mg/L.

Table G.10. Hazard posed by maximum TCE concentrations in groundwater predicted for the property boundary point of exposure

Deleted: 1

Source Zone	Maximum TCE Concentration			Hazard[a]		
	No Degradation	Degradation Half-life of 26.6 Years	Degradation half-life of 4.5 Years	No Degradation	Degradation Half-life of 26.6 Years	Degradation half-life of 4.5 Years
			C-720 area			
Zone-1: TCE	8.56E-03	4.89E-03	4.26E-04	0.54	0.31	0.03
Zone-2: TCE	3.40E-03	1.70E-03	5.72E-05	0.21	0.11	<0.01
Zone-3: TCE	2.07E-03	1.16E-03	8.53E-05	0.13	0.07	0.01
Zone-4: TCE	6.38E-04	1.62E-04	2.53E-05	0.04	0.01	<0.01
Zone-5: TCE	3.96E-04	1.01E-04	1.64E-05	0.02	0.01	<0.01
			SWMU 1			
Zone-1: TCE	2.45E-03	1.56E-03	2.77E-04	0.15	0.10	0.02

[a] Calculated using the hazard-based no action screening value for residential water use for TCE presented in Appendix A of the Risk Methods Document. This no action value, which is for exposure as a child, was calculated using a target HI of 0.1 and is 1.60E-03 mg/L.

Deleted: 06-064(E)/041406

Deleted: 2

Table G.11. List of sampling stations used in the assessment of RGA groundwater contamination

Location[a]	Type[b]	Station Name	Location[a]	Type[b]	Station Name
SWMU 1	Boring	001-176	Other	Boring	720-029
SWMU 1	Well	MW161	Other	Boring	DG-001
C-720 Area	Boring	720-011	Other	Boring	DG-002
C-720 Area	Boring	720-018	Other	Boring	DG-003
C-720 Area	Boring	DG-015	Other	Boring	DG-016
C-720 Area	Well	MW203	Other	Boring	DG-017
SWMU 4	Boring	001-181	Other	Boring	DG-018
SWMU 4	Boring	004-019	Other	Boring	DG-019
SWMU 4	Boring	004-020	Other	Boring	DG-020
SWMU 4	Boring	004-021	Other	Boring	DG-022
SWMU 4	Boring	004-023	Other	Boring	DG-031
SWMU 4	Boring	004-024	Other	Well	MW158
SWMU 4	Boring	004-027	Other	Well	MW159
SWMU 4	Boring	004-028	Other	Well	MW188
SWMU 4	Boring	004-029	Other	Well	MW325
SWMU 4	Boring	004-058	Other	Well	MW326
SWMU 4	Boring	004-101	Other	Well	MW327
SWMU 4	Boring	004-101a	Other	Well	MW328
SWMU 4	Boring	004-102	Other	Well	MW329
SWMU 4	Boring	004-103	Other	Well	MW330
SWMU 4	Boring	004-104	Other	Well	MW333
SWMU 4	Boring	004-105	Other	Well	MW337
SWMU 4	Boring	004-106	Other	Well	MW338
SWMU 4	Boring	004-107	Other	Well	MW354
SWMU 4	Boring	004-108	Other	Well	MW401-PRT1
SWMU 4	Boring	004-109	Other	Well	MW401-PRT2
SWMU 4	Boring	004-110	Other	Well	MW401-PRT3
SWMU 4	Boring	720-026	Other	Well	MW401-PRT4
SWMU 4	Boring	DG-030	Other	Well	MW401-PRT5
SWMU 4	Well	MW226	Other	Well	MW401-PRT6
SWMU 4	Well	MW227	Other	Well	MW402-PRT1
Storm Sewer	Boring	001-177	Other	Well	MW402-PRT2
Other	Boring	001-175	Other	Well	MW402-PRT3
Other	Boring	001-178	Other	Well	MW402-PRT4
Other	Boring	001-180	Other	Well	MW402-PRT5
Other	Boring	001-182	Other	Well	MW402-PRT6
Other	Boring	001-183	Other	Well	MW403-PRT1
Other	Boring	001-184	Other	Well	MW403-PRT2
Other	Boring	091-001	Other	Well	MW403-PRT3
Other	Boring	091-002	Other	Well	MW403-PRT4
Other	Boring	210-001	Other	Well	MW403-PRT5
Other	Boring	210-002	Other	Well	MW403-PRT6
Other	Boring	210-003	Other	Well	MW404-PRT1
Other	Boring	210-004	Other	Well	MW404-PRT2
Other	Boring	210-005	Other	Well	MW404-PRT3
Other	Boring	210-006	Other	Well	MW404-PRT4
Other	Boring	210-007	Other	Well	MW404-PRT5
Other	Boring	210-008	Other	Well	MW404-PRT6
Other	Boring	210-009	Other	Well	MW67
Other	Boring	210-010	Other	Well	MW84
Other	Boring	720-010	Other	Well	MW86

Deleted: 06-064(E)/041406

Table G.11, List of sampling stations used in the assessment of RGA groundwater contamination (continued)

Deleted: 2

Location[a]	Type[b]	Station Name	Location[a]	Type[b]	Station Name
Other	Boring	720-012	Other	Well	MW87
Other	Boring	720-013	Other	Well	MW89
Other	Boring	720-014	Other	Well	MW90
Other	Boring	720-015	Other	Well	MW90A
Other	Boring	720-016	Other	Well	MW92
Other	Boring	720-017	Other	Well	MW93
Other	Boring	720-019	Other	Well	MW95
Other	Boring	720-028	Other	Well	MW95A

[a] "Other" indicates a sampling location within the boundaries of the Southwest Plume, but not associated with one of the 4 sources investigated as part of the SI.

[b] Only VOC results were used from samples collected from borings. Results for all analytes were used from samples collected from wells.

Deleted: 06-064(E)/041406

Table G.12. Summary of RGA groundwater data from the Southwest Plume used in the BHHRA[a]

Deleted: 3

Analyte	Frequency of Detection[b]	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected Value	Maximum Detected Value	Units
			Inorganic Chemicals (Metals)			
Aluminum	15/102	2.00E-01	3.04E+01	2.04E-01	3.04E+01	mg/L
Antimony	0/114	5.00E-03	2.00E-01			mg/L
Arsenic	9/244	1.00E-03	1.00E-03	1.00E-03	1.75E-02	mg/L
Barium	114/114			6.00E-02	6.43E-01	mg/L
Beryllium	1/114	1.00E-03	5.00E-03	7.80E-04	7.80E-04	mg/L
Boron	2/2			1.00E-02	1.00E-02	mg/L
Cadmium	0/248	1.00E-03	2.00E-02			mg/L
Calcium	118/118			1.18E+01	3.52E+01	mg/L
Chromium	37/246	2.00E-02	1.25E-01	2.00E-03	2.03E+00	mg/L
Cobalt	27/42	1.00E-03	5.00E-02	1.03E-03	2.11E-01	mg/L
Copper	8/118	2.00E-02	4.00E-01	9.90E-03	1.29E-01	mg/L
Iron	32/46	1.00E-01	2.00E-01	1.39E-01	3.12E+01	mg/L
Lead	1/248	3.00E-03	2.00E-01	5.56E-03	5.56E-03	mg/L
Magnesium	118/118			5.00E+00	1.38E+01	mg/L
Manganese	114/114			8.58E-03	4.25E+00	mg/L
Mercury	0/244	2.00E-04	2.00E-04			mg/L
Molybdenum	5/18	1.00E-03	4.00E-02	4.98E-03	5.98E-02	mg/L
Nickel	66/118	5.00E-03	8.60E-02	5.22E-03	1.42E+00	mg/L
Phosphorous	0/4	5.00E-02	5.00E-02			mg/L
Potassium	89/118	2.00E+00	6.12E+00	3.42E-01	9.20E+00	mg/L
Selenium	13/244	5.00E-03	5.00E-02	5.33E-03	5.00E-02	mg/L
Silicon	74/74			6.78E+00	6.28E+01	mg/L
Silver	0/114	1.00E-03	2.50E-02			mg/L
Sodium	102/102			1.18E+01	6.27E+01	mg/L
Thallium	0/98	2.00E-03	2.00E-01			mg/L
Uranium	9/339	1.00E-03	4.00E+01	1.00E-03	3.50E-01	mg/L
Vanadium	3/98	2.00E-02	1.28E-01	9.30E-02	1.28E-01	mg/L
Zinc	9/118	2.00E-02	1.15E+00	1.00E-02	6.95E-01	mg/L
			Organic Compounds			
1,1,1,2-Tetrachloroethane	0/31	1.00E-03	5.00E-03			mg/L
1,1,1-Trichloroethane	0/398	1.00E-03	5.00E+00			mg/L
1,1,2,2-Tetrachloroethane	0/231	1.00E-03	5.00E+00			mg/L
1,1,2-Trichloroethane	0/398	1.00E-03	5.00E+00			mg/L
1,1-Dichloroethane	4/398	1.00E-03	5.00E+00	1.30E-03	1.70E-02	mg/L
1,1-Dichloroethene	123/688	1.00E-03	5.00E+00	4.00E-05	3.40E-01	mg/L
1,2,3-Trichloropropane	0/31	1.00E-03	5.00E-03			mg/L
1,2-Dibromo-3-chloropropane	0/2	2.00E-03	2.00E-03			mg/L
1,2-Dibromoethane	0/31	1.00E-03	5.00E-03			mg/L
1,2-Dichloroethane	1/398	1.00E-03	5.00E+00	2.00E-01	2.00E-01	mg/L
1,2-Dichloropropane	0/231	1.00E-03	5.00E+00			mg/L
1,2-Dimethylbenzene	0/200	1.00E-03	5.00E+00			mg/L
1,4-Dioxane	0/2	2.00E-01	2.00E-01			mg/L
2-Butanone	4/231	5.00E-03	1.00E+01	6.00E-03	3.50E-02	mg/L
2-Chloro-1,3-butadiene	0/31	1.00E-03	5.00E-03			mg/L
2-Chloroethyl vinyl ether	0/29	2.81E-03	5.00E-03			mg/L

Deleted: 06-064(E)/041406

Table G.12. Summary of RGA groundwater data from the Southwest Plume used in the BHHRA[a] (continued)

Analyte	Frequency of Detection[b]	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected Value	Maximum Detected Value	Units
			Organic Compounds (continued)			
2-Hexanone	0/231	5.00E-03	5.00E+00			mg/L
2-Propanol	1/29	5.00E-02	5.00E-02	5.40E-01	5.40E-01	mg/L
4-Methyl-2-pentanone	0/231	5.00E-03	5.00E+00			mg/L
Acetone	17/231	5.00E-03	1.00E+01	5.00E-03	4.90E-02	mg/L
Acetonitrile	0/2	2.00E-02	2.00E-02			mg/L
Acrolein	0/31	2.00E-02	5.00E-02			mg/L
Acrylonitrile	0/31	2.00E-02	5.00E-02			mg/L
Allyl chloride	0/2	2.00E-03	2.00E-03			mg/L
Benzene	1/398	1.00E-03	5.00E+00	1.60E-02	1.60E-02	mg/L
Bromodichloromethane	1/398	1.00E-03	5.00E+00	1.00E-03	1.00E-03	mg/L
Bromoform	0/231	1.00E-03	5.00E+00			mg/L
Bromomethane	1/217	2.00E-03	2.00E-01	4.10E-03	4.10E-03	mg/L
Carbon disulfide	0/231	1.00E-03	5.00E+00			mg/L
Carbon tetrachloride	22/398	1.00E-03	5.00E+00	2.00E-03	1.20E-01	mg/L
Chlorobenzene	0/231	1.00E-03	5.00E+00			mg/L
Chloroethane	0/231	1.00E-03	5.00E+00			mg/L
Chloroform	37/398	1.00E-03	5.00E+00	1.00E-03	1.30E-01	mg/L
Chloromethane	1/231	2.00E-03	5.00E+00	1.00E-02	1.00E-02	mg/L
Dibromochloromethane	1/231	1.00E-03	5.00E+00	2.00E-03	2.00E-03	mg/L
Dibromomethane	0/31	1.00E-03	5.00E-03			mg/L
Dichlorodifluoromethane	0/31	2.00E-03	5.00E-03			mg/L
Ethyl cyanide	0/31	3.03E-03	1.00E-01			mg/L
Ethyl methacrylate	0/31	1.00E-03	5.00E-03			mg/L
Ethylbenzene	0/398	1.00E-03	5.00E+00			mg/L
Iodomethane	0/31	1.00E-03	5.00E-03			mg/L
Isobutanol	0/2	5.00E-02	5.00E-02			mg/L
Methacrylonitrile	0/31	1.00E-03	2.50E-02			mg/L
Methyl methacrylate	0/31	1.00E-03	5.00E-03			mg/L
Methylene chloride	4/231	1.00E-03	1.00E+01	1.00E-03	5.90E-01	mg/L
Pentachloroethane	0/2	2.00E-03	2.00E-03			mg/L
Styrene	0/231	1.00E-03	5.00E+00			mg/L
Tetrachloroethene	14/398	1.00E-03	5.00E+00	1.00E-03	4.00E-03	mg/L
Toluene	0/398	1.00E-03	5.00E+00			mg/L
Total Xylene	0/270	1.00E-03	3.00E+00			mg/L
Trans-1,4-Dichloro-2-butene	0/31	1.00E-03	5.00E-03			mg/L
Trichloroethene	752/881	5.00E-04	2.00E-01	5.00E-05	6.70E+01	mg/L
Trichlorofluoromethane	0/31	2.00E-03	5.00E-03			mg/L
Vinyl acetate	0/103	2.00E-03	5.00E-02			mg/L
Vinyl chloride	43/688	1.00E-03	1.00E+01	6.00E-05	4.00E-01	mg/L
cis-1,2-Dichloroethene	148/688	5.00E-04	1.00E+00	6.00E-05	1.20E+01	mg/L
cis-1,3-Dichloropropene	0/231	1.00E-03	5.00E+00			mg/L
m,p-Xylene	0/200	2.00E-03	1.00E+01			mg/L
trans-1,2-Dichloroethene	136/688	5.00E-04	5.00E+00	5.00E-05	1.10E-01	mg/L
trans-1,3-Dichloropropene	0/231	1.00E-03	5.00E+00			mg/L

Table G.12. Summary of RGA groundwater data from the Southwest Plume used in the BHHRA[a] (continued)

Deleted: 3

Analyte	Frequency of Detection[b]	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected Value	Maximum Detected Value	Units
			Radionuclides			
Americium-241	0/26	-5.20E+01	1.89E+01			pCi/L
Cesium-134	0/26	-1.54E+01	5.37E+00			pCi/L
Cesium-137	0/26	-4.62E+00	1.54E+01			pCi/L
Cobalt-60	0/26	-1.71E+01	1.65E+01			pCi/L
Neptunium-237	1/50	-9.56E-01	4.00E-01	3.85E+00	3.85E+00	pCi/L
Plutonium-238	0/26	-3.64E-01	1.73E-01			pCi/L
Plutonium-239/240	0/50	-6.59E-02	5.63E-02			pCi/L
Technetium-99	151/359	-2.06E+01	1.01E+02	1.66E+01	1.67E+03	pCi/L
Thorium-230	1/39	-5.56E-01	1.66E-01	4.96E-01	4.96E-01	pCi/L
Thorium-232	1/39	-7.63E-02	6.27E-02	1.57E-01	1.57E-01	pCi/L
Uranium-234	1/26	-1.18E-01	3.09E+02	5.66E+02	5.66E+02	pCi/L
Uranium-235	0/50	-1.97E+01	2.99E+01			pCi/L
Uranium-238	3/31	0.00E+00	4.39E-01	1.02E+00	7.58E+02	pCi/L

[a] Results shown are over all RGA water samples collected from borings or wells within the boundary of the Southwest Plume. Results for individual source areas are presented in Attachment 1 to this appendix.

[b] Number of detected results over total number of samples used in the BHHRA.

Deleted: 06-064(E)/041406

Although not directly assessed, subsurface soil data were used to complete environmental fate and transport modeling. The results of this modeling are summarized in Chapter 5 and presented in detail in Appendix F of the SI report. These results are used in the BHHRA to estimate future risks to contaminants in groundwater at the POEs to which contaminants may migrate.

G2.2 GENERAL DATA EVALUATION CONSIDERATIONS

This section describes the data evaluation steps that were used to ensure that the groundwater data were appropriate for use in BHHRAs. A general description of the seven steps used and their outcome in relation to the Southwest Plume BHHRA data set is provided in this section. A graphical presentation of this process is shown in Fig. G.6.

G2.2.1 Evaluation of Sampling

Data were examined to ensure that sampling methods were adequate for determining the nature and extent of contamination and were representative of site conditions. It was determined that samples selected from the PGDP OREIS database were collected using appropriate methods that were consistent with each project's work plan. Additionally, the spatial distribution of the groundwater samples at each of the sources was determined to be consistent with the conceptual site model developed for the source areas, and the spatial distribution of the subsurface soil samples at SWMU 1, the C-720 Building area, and the storm sewer were determined to be appropriate for development of a source terms in the environmental fate and transport modeling.

G2.2.2 Evaluation of Analytical Methods

Methods used to collect and analyze the selected groundwater and subsurface soil samples were evaluated to determine if they were those approved by EPA. As described in work plans and project reports, the analytical methods used for subsurface soil and groundwater samples meet these requirements.

G2.2.3 Evaluation of Sample Quantitation Limits

The sample quantitation limits (SQLs) used in the analyses of the selected groundwater samples were examined to determine if these limits were below the concentration at which the contaminant may pose a risk to human health. Generally, the SQLs for each analyte met this goal. Table G.13 presents a comparison between each undetected analyte's maximum SQLs for water for the complete Southwest Plume data set and the analyte's residential use no action screening value. As shown in that table, several analytes have SQLs that exceed their screening value. The implications of this finding upon risk characterization (presented in this BHHRA) are discussed in Section 6.

Deleted: 4

Consistent with the Risk Methods Document, if the maximum SQL for an analyte over all samples within a medium exceeded the no action screening value, then the data for that analyte was deemed of uncertain, and a qualitative assessment for that analyte is performed. In developing the qualitative assessment for such chemicals, the maximum SQL for the chemical is used in the qualitative assessment if historical or process knowledge indicated that the chemical could potentially be present. If historical or process knowledge indicates that the chemical is not expected to be present, one-half of the SQL is used in the qualitative assessment. The qualitative analysis is presented in Section 6.

Deleted: 06-064(E)/041406

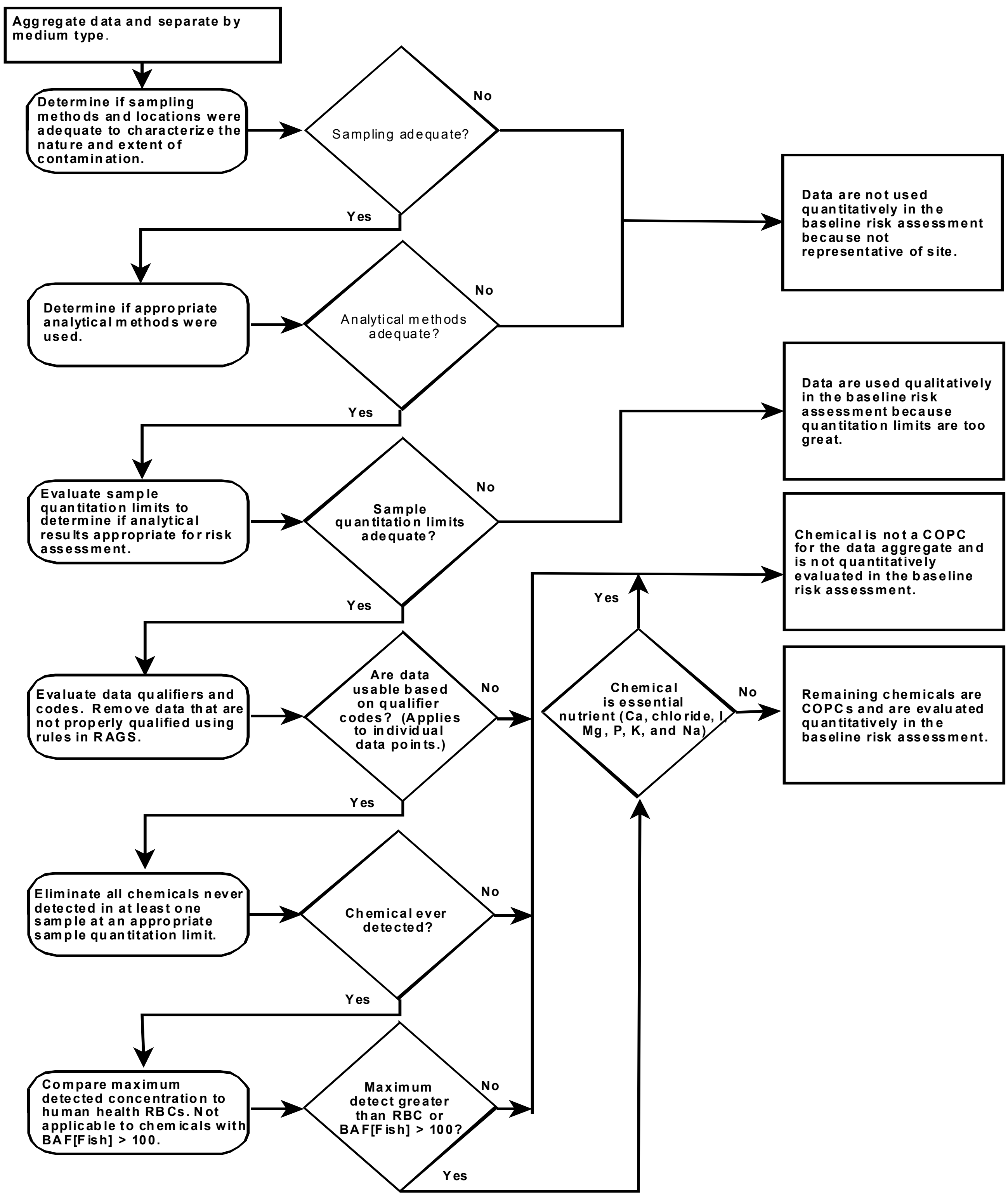


Fig. G.6. Steps Followed During Data Evaluation.

Table G.13. Comparison between undetected analyte's maximum SQLs and residential use no action screening value for water use[a]

Deleted: 4

Analyte	Frequency of Detection[b]	Maximum SQL[b]	HI-based No Action Screening Value[c]	ELCR-based No Action Screening Value[c]	HI Screening Value Exceeded?	ELCR Screening Value Exceeded?	Units
Inorganic Chemicals (Metals)							
Antimony	0/114	2.00E-01	5.64E-04		Yes		mg/L
Cadmium	0/248	2.00E-02	6.61E-04		Yes		mg/L
Mercury	0/244	2.00E-04	4.44E-04		No		mg/L
Phosphorous	0/4	5.00E-02	3.00E-05		Yes		mg/L
Silver	0/114	2.50E-02	7.50E-03		Yes		mg/L
Thallium	0/98	2.00E-01					mg/L
Organic Compounds							
1,1,1,2-Tetrachloroethane	0/31	5.00E-03	8.18E-03	5.10E-04	No	Yes	mg/L
1,1,1-Trichloroethane	0/398	5.00E+00	3.35E-02		Yes		mg/L
1,1,2,2-Tetrachloroethane	0/231	5.00E+00	1.64E-02	6.61E-05	Yes	Yes	mg/L
1,1,2-Trichloroethane	0/398	5.00E+00	1.10E-03	2.38E-04	Yes	Yes	mg/L
1,2,3-Trichloropropane	0/31	5.00E-03	1.26E-03	1.55E-06	Yes	Yes	mg/L
1,2-Dibromo-3-chloropropane	0/2	2.00E-03	1.57E-05	3.71E-05	Yes	Yes	mg/L
1,2-Dibromoethane	0/31	5.00E-03	1.57E-05	6.00E-07	Yes	Yes	mg/L
1,2-Dichloropropane	0/231	5.00E+00	3.13E-04	1.96E-04	Yes	Yes	mg/L
1,2-Dimethylbenzene	0/200	5.00E+00	4.39E-01		Yes		mg/L
1,4-Dioxane	0/2	2.00E-01		4.79E-03		Yes	mg/L
2-Chloro-1,3-butadiene	0/31	5.00E-03	6.57E-04		Yes		mg/L
2-Chloroethyl vinyl ether	0/29	5.00E-03					mg/L
2-Hexanone	0/231	5.00E+00					mg/L
4-Methyl-2-pentanone	0/231	5.00E+00	7.22E-03		Yes		mg/L
Acetonitrile	0/2	2.00E-02	3.52E-03		Yes		mg/L
Acrolein	0/31	5.00E-02	1.92E-06		Yes		mg/L
Acrylonitrile	0/31	5.00E-02	1.70E-04	4.26E-05	Yes	Yes	mg/L
Allyl chloride	0/2	2.00E-03	7.47E-02		No		mg/L
Bromoform	0/231	5.00E+00	3.01E-02	6.62E-03	Yes	Yes	mg/L
Carbon disulfide	0/231	5.00E+00	4.57E-02		Yes		mg/L
Chlorobenzene	0/231	5.00E+00	4.66E-03		Yes		mg/L
Chloroethane	0/231	5.00E+00	3.68E-01	4.61E-03	Yes	Yes	mg/L
Dibromomethane	0/31	5.00E-03	2.75E-03		Yes		mg/L
Dichlorodifluoromethane	0/31	5.00E-03	1.80E-02		No		mg/L
Ethyl cyanide	0/31	1.00E-01					mg/L
Ethyl methacrylate	0/31	5.00E-03	2.47E-02		No		mg/L
Ethylbenzene	0/398	5.00E+00	5.63E-02	4.68E-03	Yes	Yes	mg/L
Iodomethane	0/31	5.00E-03					mg/L
Isobutanol	0/2	5.00E-02	8.24E-02		No		mg/L
Methacrylonitrile	0/31	2.50E-02	4.65E-05		Yes		mg/L
Methyl methacrylate	0/31	5.00E-03	6.51E-02		No		mg/L
Pentachloroethane	0/2	2.00E-03					mg/L
Styrene	0/231	5.00E+00	5.65E-02		Yes		mg/L
Toluene	0/398	5.00E+00	3.38E-02		Yes		mg/L
Total Xylene	0/270	3.00E+00	6.53E-02		Yes		mg/L
Trans-1,4-Dichloro-2-butene	0/31	5.00E-03					mg/L
Trichlorofluoromethane	0/31	5.00E-03	5.77E-02		No		mg/L
Vinyl acetate	0/103	5.00E-02	1.89E-02		Yes		mg/L

Deleted: 06-064(E)/041406

Table G.13. Comparison between undetected analyte's maximum SQLs and residential use no action screening value for water use[a] (continued)

Deleted: 4

Analyte	Frequency of Detection[b]	Maximum SQL[b]	HI-based No Action Screening Value[c]	ELCR-based No Action Screening Value[c]	HI Screening Value Exceeded?	ELCR Screening Value Exceeded?	Units
cis-1,3-Dichloropropene	0/231	5.00E+00					mg/L
m,p-Xylene	0/200	1.00E+01					mg/L
trans-1,3-Dichloropropene	0/231	5.00E+00					mg/L
Radionuclides							
Americium-241	0/26	1.89E+01		3.71E-01		Yes	pCi/L
Cesium-134	0/26	5.37E+00		9.15E-01		Yes	pCi/L
Cesium-137	0/26	1.54E+01		1.27E+00		Yes	pCi/L
Cobalt-60	0/26	1.65E+01		2.46E+00		Yes	pCi/L
Plutonium-238	0/26	1.73E-01		2.95E-01		No	pCi/L
Plutonium-239/240	0/50	5.63E-02					pCi/L
Uranium-235	0/50	2.99E+01		5.38E-01		Yes	pCi/L

[a] Results shown are over all RGA water samples collected from borings or wells within the boundary of the Southwest Plume. Results for individual source areas are in Attachment 1 of this appendix.

[b] Number of detected results over total number of samples used in the BHHRA.

[c] Risk-based screening values are taken from Appendix A of the Risk Methods Document. The HI-based value is that for the child resident. The ELCR-based value is that for lifetime exposure. HI and ELCR target values used for the screening values are 0.1 and 1×10^{-6}, respectively.

Deleted: 06-064(E)/041406

G2.2.4 Evaluation of Data Qualifiers and Codes

The groundwater data used in the BHHRA were tagged with various qualifiers and codes. Tagged data were evaluated following rules in Exhibits 5-4 and 5-5 of the Risk Assessment Guidance for Superfund (RAGS). Generally, this resulted in the retention of all results for which the identity of the analyte was certain even if there was substantial uncertainty in the analyte concentration within an individual sample. The qualifiers and codes attached to the groundwater data used in the BHHRA are defined in Table G.14. (Note: consistent with the Risk Methods Document, radionuclides with negative activity values were used in the calculation of EPCs in this BHHRA.)

Deleted: -

Deleted: -

Deleted: 5

Table G.14. Definitions of qualifiers and codes present in the OREIS data set used for the BHHRA of the groundwater samples from the Southwest Plume

Deleted: 5

Qualifier	Definition	Data Used?
Field = RSLT_PRE (Result Prefix Qualifier)		
Blank	Result not qualified.	Yes
<	The actual value is below the given range limit.	Yes
Field = VALIDATI (Validation Qualifier)		
Blank	Result not qualified.	Yes
=	Validated result that is detected and unqualified.	Yes
DJ	Detected above the reported detection limit, the reported detection limit is approximated due to quality deficiency; Positively identified, the associated numerical value is the approximate concentration of the analyte in the sample.	
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.	Yes
R	Result rejected by validator.	No
U	The analyte was analyzed for, but was not detected above the reported sample quantitation limit.	Yes
UJ	The analyte, compound, or radionuclide was not detected above the reported detection limit, and the reported detection limit is approximated due to quality deficiency.	Yes
X	Not validated; refer to RSLTQUAL field for more information.	Yes
XV	Not validated; refer to RSLTQUAL field for more information.	Yes
Field = RSLTQUAL (Result Qualifier)		
Blank	Result not qualified.	Yes
*	Duplicate analysis is not within control limits.	Yes
A	SVOA/VOA: TIC (Tentatively Identified Compound) was suspected aldol condensation product; PPCB/SVOA/VOA: Suspected aldol-condensation product (pre-05/30/03 definition); RADS: Analyzed but not detected at the analyte quantitation limit. (LABORATORY_CODEs PORTS, PGDP, and PARGN)	
B	Inorganic: The result is less than the project contract required detection limit, but greater than the instrument detection limit.	Yes
	Organic: Found in blank sample.	Yes
D	Identified at secondary dilution.	Yes
E	Inorganic: Estimated value; matrix interference.	Yes
	Organic: Concentration exceeds calibration range of gas chromatograph/mass spectrometer.	Yes
J	Estimated value, tentatively identified compound, or less than specified detection limit.	Yes
M	METAL: Duplicate injection precision not met; RADS: Matrix Spike recovery is < 80% or > 120% (pre-05/30/03 definition).	Yes
N	Inorganic: Spike recovery not within control limits.	Yes
	Organic: Applied to TIC results, except generic characteristics.	Yes
T	Tracer recovery is less than 20% or greater than 105%.	
U	Not detected.	Yes
W	METAL: Post-digestion spike for atomic absorption out of control limit.	Yes
X	Flag one; defined in COMMENTS field.	Yes
Y	Chemical yield exceeds acceptance limits; Organic: matrix spike, matrix spike duplicate recovery, and/or relative percent difference failed acceptance criteria.	Yes

Deleted: GC/MS

Deleted: (TIC)

Deleted: AA(A

Deleted: A

Deleted:)

Deleted: MS

Deleted: MSD

Deleted: RPD

Deleted: 06-064(E)/041406

G2.2.5 Elimination of Chemicals Not Detected

Consistent with the Risk Methods Document, any analyte passing the earlier screens and not detected in at least one groundwater sample using an appropriate SQL was eliminated from the data set. These data are not considered further in this BHHRA.

G2.2.6 Examination of Toxicity of Detected Analytes

Each analyte's maximum detected concentration in the data set was compared to that analyte's residential use no action human health risk-based screening value for water in the Risk Methods Document. Consistent with the Risk Methods Document, this screen was not applied to those analytes known to accumulate significantly in biota (i.e., not used for analytes with a bioaccumulation factor for fish greater than 100).

G2.2.7 Examination of Analyte Maximum Concentrations for Essential Human Nutrients Detected in Site Samples to Recommended Dietary Allowances (RDAs) for Children

Seven analytes known to be essential nutrients and known to be toxic only at extremely high concentrations were removed from the groundwater data set. These analytes were calcium, chloride, iodine, magnesium, phosphorus, potassium, and sodium. Consistent with the Risk Methods Document, no other analytes were removed from the data set based upon the essential nutrient screen.

G2.2.8 Comparison of Analyte Maximum Concentrations and Activities Detected in Site Samples to Analyte Concentrations and Activities Detected in Background Samples

Consistent with the Risk Methods Document, a background screen was not used to develop the BHHRA data set. The uncertainty of not including the background screen when developing the data set is discussed in Section 6. A listing of analytes never detected above their background concentration is in Table G.16.

G2.3 RISK ASSESSMENT SPECIFIC DATA EVALUATION

This section discusses details associated with building the groundwater data set used to examine current and future risks to human health presented in this BHHRA.

G2.3.1 Current Conditions

The specific processes used to evaluate data and calculate EPCs under current conditions are described in this section. The Microsoft Access and Statistical Analysis System (SAS®, SAS 1990) computer programs were used to input and evaluate the data set. The following material summarizes the actions performed by various programs during the evaluation.

- *Check spelling of all analyte names and Chemical Abstract Service (CAS) registry numbers*. The analyte's names were checked to ensure that names and CAS numbers were uniform. This activity was performed so that the analyte names and CAS numbers in the data set matched those used in the PGDP toxicity database presented in the Risk Methods Document.

Deleted: 06-064(E)/041406

Table G.15. Comparison between maximum detected concentrations and provisional groundwater background concentrations[a]

Deleted: 6

Analyte	Frequency of Detection[b]	Maximum Detected Value	Background Concentration[c]	Background Concentration Exceeded?	Units
		Inorganic Chemicals (Metals)			
Aluminum	15/102	3.04E+01	2.19E+00	Yes	mg/L
Arsenic	9/244	1.75E-02	5.00E-03	Yes	mg/L
Barium	114/114	6.43E-01	2.35E-01	Yes	mg/L
Beryllium	1/114	7.80E-04	4.00E-03	No	mg/L
Boron	2/2	1.00E-02			mg/L
Calcium	118/118	3.52E+01	4.12E+01	No	mg/L
Chromium	37/246	2.03E+00	1.44E-01	Yes	mg/L
Cobalt	27/42	2.11E-01	4.50E-02	Yes	mg/L
Copper	8/118	1.29E-01	3.60E-02	Yes	mg/L
Iron	32/46	3.12E+01	5.03E+00	Yes	mg/L
Lead	1/248	5.56E-03	1.29E-01	No	mg/L
Magnesium	118/118	1.38E+01	1.63E+01	No	mg/L
Manganese	114/114	4.25E+00	1.19E-01	Yes	mg/L
Molybdenum	5/18	5.98E-02	5.00E-02	Yes	mg/L
Nickel	66/118	1.42E+00	6.82E-01	Yes	mg/L
Potassium	89/118	9.20E+00	5.20E+00	Yes	mg/L
Selenium	13/244	5.00E-02	5.00E-03	Yes	mg/L
Silicon	74/74	6.28E+01			mg/L
Sodium	102/102	6.27E+01	5.95E+01	Yes	mg/L
Uranium	9/339	3.50E-01	2.00E-03	Yes	mg/L
Vanadium	3/98	1.28E-01	1.34E-01	No	mg/L
Zinc	9/118	6.95E-01	5.40E-02	Yes	mg/L
		Organic Compounds			
1,1-Dichloroethane	4/398	1.70E-02			mg/L
1,1-Dichloroethene	123/688	3.40E-01			mg/L
1,2-Dichloroethane	1/398	2.00E-01			mg/L
2-Butanone	4/231	3.50E-02			mg/L
2-Propanol	1/29	5.40E-01			mg/L
Acetone	17/231	4.90E-02			mg/L
Benzene	1/398	1.60E-02			mg/L
Bromodichloromethane	1/398	1.00E-03			mg/L
Bromomethane	1/217	4.10E-03			mg/L
Carbon tetrachloride	22/398	1.20E-01			mg/L
Chloroform	37/398	1.30E-01			mg/L
Chloromethane	1/231	1.00E-02			mg/L
Dibromochloromethane	1/231	2.00E-03			mg/L
Methylene chloride	4/231	5.90E-01			mg/L
Tetrachloroethene	14/398	4.00E-03			mg/L
Trichloroethene	752/881	6.70E+01			mg/L
Vinyl chloride	43/688	4.00E-01			mg/L
cis-1,2-Dichloroethene	148/688	1.20E+01			mg/L
trans-1,2-Dichloroethene	136/688	1.10E-01			mg/L
		Radionuclides			
Neptunium-237	1/50	3.85E+00	8.00E-01	Yes	pCi/L
Technetium-99	151/359	1.67E+03	2.23E+01	Yes	pCi/L

Deleted: 06-064(E)/041406

Table G.15. Comparison between maximum detected concentrations and provisional groundwater background concentrations[a] (continued)

Deleted: 6

Analyte	Frequency of Detection[b]	Maximum Detected Value	Background Concentration[c]	Background Concentration Exceeded?	Units
Thorium-230	1/39	4.96E-01	1.10E+00	No	pCi/L
Thorium-232	1/39	1.57E-01			pCi/L
Uranium-234	1/26	5.66E+02	7.00E-01	Yes	pCi/L
Uranium-238	3/31	7.58E+02	7.00E-01	Yes	pCi/L

[a] Results shown are over all RGA water samples collected from borings or wells within the boundary of the Southwest Plume. Results for individual source areas are in Attachment 1 to this appendix.

[b] Number of detected results over total number of samples used in the BHHRA.

[c] Provisional background concentrations are taken from Appendix A of the Risk Methods Document. Blank cells indicate that a background concentration for the analyte does not exist.

- *Convert units of measure to a consistent basis.* The units of measure used for analyte classes (i.e., inorganic chemicals, organic compounds, and radionuclides) were assigned consistent units of measure. The units of measure used were mg/L for inorganic chemicals and organic compounds and pCi/L for radionuclides. This activity was performed so that the units of measure in the data set matched those found in the equations that are used to calculate CDIs as part of the BHHRA.

- *Categorize all sample results as detects or nondetects.* Each result was coded either detected or nondetected based upon the data qualifier codes present in the data set. This coding subsequently was used to calculate the frequency of detection statistics and to assign surrogate values to results listed as nondetects.

- *Assign values to results listed as nondetects.* Each result coded as a nondetect was assigned a value based upon two factors. The first of these factors was the sample SQL. The second of these factors was if the analyte was expected to be present based upon site history and process knowledge. Nondetected results for analytes not expected to be present were assigned one-half the SQL. Nondetected results for analytes expected to be present were assigned the full SQL. The analytes assigned the full SQL were common plant-wide contaminants at PGDP: TCE and its degradation products [i.e., *cis*-1,2-DCE; *trans*-1,2-DCE); 1,2-dichloroethane (1,2-DCA); and VC], polychlorinated biphenyls (PCBs), uranium radioisotopes, metallic uranium, ^{99}Tc, and fluoride. After assigning surrogate values to all nondetect results, the assigned values were compared to the maximum detected value. If the surrogate value assigned to a sample was found to be greater than the maximum detected concentration across all samples, then the assigned surrogate value was reduced to the maximum detected concentration.

- *Analyze duplicate samples.* Duplicate samples were available for some sample analyses. In cases where the value from the original sample and its duplicate were both detected values, the greater of the results from the original sample and its duplicate was retained in the data set. In cases where one value was a detected value and the other was a nondetect, the detected value was retained in the data set. Finally, when both values were listed as nondetects, the lesser of the two values was retained in the data set.

- *Compare maximum detected concentrations to human health screening values.* The maximum detected result for each analyte within an area's groundwater data set (i.e., SWMU 1, C-720 Building area, storm sewer, and over all groundwater data from the Southwest Plume) was compared to no action screening values for water use as part of the toxicity screen. Analytes with a maximum detected value less than the analyte's no action screening value were not retained as COPCs. The

Deleted: SWMU 4,

Deleted: 06-064(E)/041406

values used for this screen were the direct contact residential use no-action values taken from Appendix A of the Risk Methods Document. Consistent with the Risk Methods Document, this screen was not applied to those analytes known to accumulate significantly in biota [i.e., this screen was not used for analytes with a bioaccumulation factor (BAF) for fish greater than 100].

Analytes removed from the Southwest Plume data set based on the toxicity screen are presented in Table G.16. As shown in that table several analytes were removed from each groundwater data set based on this screen. Results for individual areas are in Attachment 1 of this appendix.

Deleted: 7

- *Remove essential nutrients from the data sets.* Results for the seven essential nutrients listed earlier were removed from the data sets.

- *Remove protactinium-234m (^{234m}Pa), potassium-40 (^{40}K), and thorium-234 (^{234}Th) from the data sets.* All results for ^{234m}Pa were removed to prevent double-counting its contribution to cancer risk through use of a toxicity value for ^{238}U that includes its short-lived progeny. All ^{40}K and ^{234}Th results were removed to be consistent with the Risk Methods Document and earlier BHHRAs prepared for the PGDP.

- Analytes retained as COPCs under current conditions are presented in Tables G.17 through G.20. These tables include a listing of all detected analytes in groundwater samples by location. In addition to the analyte's name, this table also contains the analyte's frequency of detection, range of nondetected values, range of detected values, arithmetic mean of detected values, background value, human health risk-based screening value, and units of measure. The last column of this table indicates whether or not the analyte is a COPC and, if the analyte is selected as a COPC, the basis for its selection.

Deleted: 8

Deleted: 2

G2.3.2 Evaluation of Modeled Concentrations for Groundwater

As reported in Section 5 of the SI report, models were used to simulate fate and transport of selected contaminants in soil to RGA groundwater. The methods and results of the modeling are summarized in Appendix F of the SI report.

Table G.21 presents the maximum modeled concentrations of the contaminants at the PGDP fence boundary, PGDP property boundary, and near the Ohio River and the times that these maximum concentrations are estimated to be attained. In addition, the maximum modeled concentrations are compared to ELCR- and HI- based residential use no action risk-based values concentrations taken from the Risk Methods Document in order to select COPCs.

Deleted: 3

As shown in Table G.21, the primary COPC for contaminant migration for SWMU 1 and the C-720 Building area is TCE. Because the storm sewer was determined not to be a source of contamination to RGA groundwater in the SI Report, COPCs for contaminant migration are not presented for this area.

Deleted: 3

Deleted: s

Deleted: and 4

G2.4 EVALUATION OF DATA FROM OTHER SOURCES

This subsection describes results of the Phase I groundwater user survey (CH2M Hill 1991a) and the impact of response actions upon groundwater use. This information was used to develop the exposure assessment in Section 3.

Deleted: 06-064(E)/041406

Table G.16. Comparison of maximum detected concentrations in the Southwest Plume groundwater data set to residential use no action screening values for water[a]

Analyte	Frequency of Detection[b]	Maximum Detected Value	HI-based No Action Screening Value[c]	ELCR-based No Action Screening Value[c]	HI Screening Value Exceeded?	ELCR Screening Value Exceeded?	Units
Inorganic Chemicals (Metals)							
Aluminum	15/102	3.04E+01	1.49E+00		Yes		mg/L
Arsenic	9/244	1.75E-02	4.52E-04	3.50E-05	Yes	Yes	mg/L
Barium	114/114	6.43E-01	1.04E-01		Yes		mg/L
Beryllium	1/114	7.80E-04	2.64E-03		No		mg/L
Boron	2/2	1.00E-02	1.36E-01		No		mg/L
Calcium	118/118	3.52E+01					mg/L
Chromium	37/246	2.03E+00	1.76E+00		Yes		mg/L
Cobalt	27/42	2.11E-01	9.06E-02		Yes		mg/L
Copper	8/118	1.29E-01	5.57E-02		Yes		mg/L
Iron	32/46	3.12E+01	4.49E-01		Yes		mg/L
Lead	1/248	5.56E-03	1.50E-02		No		mg/L
Magnesium	118/118	1.38E+01					mg/L
Manganese	114/114	4.25E+00	3.50E-02		Yes		mg/L
Molybdenum	5/18	5.98E-02	7.53E-03		Yes		mg/L
Nickel	66/118	1.42E+00	3.01E-02		Yes		mg/L
Potassium	89/118	9.20E+00					mg/L
Selenium	13/244	5.00E-02	7.54E-03		Yes		mg/L
Silicon	74/74	6.28E+01					mg/L
Sodium	102/102	6.27E+01					mg/L
Uranium	9/339	3.50E-01	9.06E-04		Yes		mg/L
Vanadium	3/98	1.28E-01	9.25E-03		Yes		mg/L
Zinc	9/118	6.95E-01	4.50E-01		Yes		mg/L
Organic Compounds							
1,1-Dichloroethane	4/398	1.70E-02	3.63E-02		No		mg/L
1,1-Dichloroethene	123/688	3.40E-01	2.46E-03	4.70E-05	Yes	Yes	mg/L
1,2-Dichloroethane	1/398	2.00E-01	4.65E-04	1.47E-04	Yes	Yes	mg/L
2-Butanone	4/231	3.50E-02	8.68E-02		No		mg/L
2-Propanol	1/29	5.40E-01					mg/L
Acetone	17/231	4.90E-02	2.75E-02		Yes		mg/L
Benzene	1/398	1.60E-02	5.04E-04	3.85E-04	Yes	Yes	mg/L
Bromodichloromethane	1/398	1.00E-03	5.49E-03	2.16E-04	No	Yes	mg/L
Bromomethane	1/217	4.10E-03	3.91E-04		Yes		mg/L
Carbon tetrachloride	22/398	1.20E-01	1.90E-04	1.81E-04	Yes	Yes	mg/L
Chloroform	37/398	1.30E-01	2.87E-05	2.18E-04	Yes	Yes	mg/L
Chloromethane	1/231	1.00E-02	8.64E-03	1.67E-03	Yes	Yes	mg/L
Dibromochloromethane	1/231	2.00E-03	5.49E-03	1.59E-04	No	Yes	mg/L
Methylene chloride	4/231	5.90E-01	6.86E-02	4.26E-03	Yes	Yes	mg/L
Tetrachloroethene	14/398	4.00E-03	8.42E-03	5.82E-04	No	Yes	mg/L
Trichloroethene	752/881	6.70E+01	1.60E-03	1.73E-03	Yes	Yes	mg/L
Vinyl chloride	43/688	4.00E-01	3.06E-03	3.50E-05	Yes	Yes	mg/L
cis-1,2-Dichloroethene	148/688	1.20E+01	2.73E-03		Yes		mg/L
trans-1,2-Dichloroethene	136/688	1.10E-01	5.48E-03		Yes		mg/L
Radionuclides							
Neptunium-237	1/50	3.85E+00		5.73E-01		Yes	pCi/L
Technetium-99	151/359	1.67E+03		1.40E+01		Yes	pCi/L
Thorium-230	1/39	4.96E-01		4.24E-01		Yes	pCi/L
Thorium-232	1/39	1.57E-01		3.82E-01		No	pCi/L
Uranium-234	1/26	5.66E+02		5.46E-01		Yes	pCi/L
Uranium-238	3/31	7.58E+02		4.43E-01		Yes	pCi/L

[a] Results shown are over all RGA water samples collected from borings or wells within the boundary of the Southwest Plume.
[b] Number of detected results over total number of samples used in the BHHRA.
[c] Risk-based screening values are taken from Appendix A of the Risk Methods Document Table 18. Groundwater No Action Levels (NAL) for the PGDP. The HI-based NAL value is that for the child resident. The ELCR-based NAL value is that for the adult resident lifetime exposure. HI and ELCR target values used for the screening values are 0.1 and 1×10^{-6}, respectively.

Deleted: 7

Deleted: .

Deleted: [c] Risk-based screening values are taken from Appendix A of the Risk Methods Document. The HI-based value is that for the child resident. The ELCR-based value is that for lifetime exposure. HI and ELCR target values used for the screening values are 0.1 and 1×10^{-6}, respectively.

Deleted: 06-064(E)/041406

051706

Deleted: 8

Deleted: 06-064(E)/041406

Table G.17. Summary of COPC screening for detected analytes – Southwest Plume[a]

Analyte	Frequency of Detection[b]	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected Value	Maximum Detected Value	Mean of Detected Values	Background[c] Concentration	HI-based No Action Screening Value[d]	ELCR-based No Action Screening Value[d]	Essential Nutrient	Units	COPC?[e]
Inorganic Chemicals (Metals)												
Aluminum	15/102	2.00E-01	3.04E+01	2.04E-01	3.04E+01	1.05E+01	2.19E+00	1.49E+00			mg/L	Yes - P
Arsenic	9/244	1.00E-03	1.00E-03	1.00E-03	1.75E-02	4.18E-03	5.00E-03	4.52E-04	3.50E-05		mg/L	Yes - P
Barium	114/114			6.00E-02	6.43E-01	1.63E-01	2.35E-01	1.04E-01			mg/L	Yes - P
Beryllium	1/114	1.00E-03	5.00E-03	7.80E-04	7.80E-04	7.80E-04	4.00E-03	2.64E-03			mg/L	No
Boron	2/2			1.00E-02	1.00E-02	1.00E-02		1.36E-01			mg/L	No
Calcium	118/118			1.18E+01	3.52E+01	2.13E+01	4.12E+01			X	mg/L	No-E
Chromium	37/246	2.00E-02	1.25E-01	2.00E-03	2.03E+00	3.29E-01	1.44E-01	1.76E+00			mg/L	Yes - P
Cobalt	27/42	1.00E-03	5.00E-02	1.03E-03	2.11E-01	1.54E-02	4.50E-02	9.06E-02			mg/L	Yes - P
Copper	8/118	2.00E-02	4.00E-01	9.90E-03	1.29E-01	5.46E-02	3.60E-02	5.57E-02			mg/L	Yes - P
Iron	32/46	1.00E-01	2.00E-01	1.39E-01	3.12E+01	5.26E+00	5.03E+00	4.49E-01			mg/L	Yes - P
Lead	1/248	3.00E-03	2.00E-01	5.56E-03	5.56E-03	5.56E-03	1.29E-01	1.50E-02			mg/L	No
Magnesium	118/118			5.00E+00	1.38E+01	8.85E+00	1.63E+01			X	mg/L	No-E
Manganese	114/114			8.58E-03	4.25E+00	1.18E+00	1.19E-01	3.50E-02			mg/L	Yes - P
Molybdenum	5/18	1.00E-03	4.00E-02	4.98E-03	5.98E-02	2.69E-02	5.00E-02	7.53E-03			mg/L	Yes - P
Nickel	66/118	5.00E-03	8.60E-02	5.22E-03	1.42E+00	2.04E-01	6.82E-01	3.01E-02			mg/L	Yes - P
Potassium	89/118	2.00E+00	6.12E+00	3.42E-01	9.20E+00	2.53E+00	5.20E+00			X	mg/L	No-E
Selenium	13/244	5.00E-03	5.00E-02	5.33E-03	5.00E-02	1.08E-02	5.00E-03	7.54E-03			mg/L	Yes - P
Silicon	74/74			6.78E+00	6.28E+01	1.56E+01					mg/L	Yes - Qual
Sodium	102/102			1.18E+01	6.27E+01	2.09E+01	5.95E+01			X	mg/L	No-E
Uranium	9/339	1.00E-03	4.00E+01	1.00E-03	3.50E-01	4.73E-02	2.00E-03	9.06E-04			mg/L	Yes - P
Vanadium	3/98	2.00E-02	1.28E-01	9.30E-02	1.28E-01	1.16E-01	1.34E-01	9.25E-03			mg/L	Yes - P
Zinc	9/118	2.00E-02	1.15E+00	1.00E-02	6.95E-01	2.25E-01	5.40E-02	4.50E-01			mg/L	Yes - P
Organic Compounds												
1,1-Dichloroethane	4/398	1.00E-03	5.00E+00	1.30E-03	1.70E-02	5.88E-03		3.63E-02			mg/L	No
1,1-Dichloroethene	123/688	1.00E-03	5.00E+00	4.00E-05	3.40E-01	1.06E-02		2.46E-03	4.70E-05		mg/L	Yes - P
1,2-Dichloroethane	1/398	1.00E-03	5.00E+00	2.00E-01	2.00E-01	2.00E-01		4.65E-04	1.47E-04		mg/L	Yes - P
2-Butanone	4/231	5.00E-03	1.00E+01	6.00E-03	3.50E-02	2.45E-02		8.68E-02			mg/L	No
2-Propanol	1/29	5.00E-02	5.00E-02	5.40E-01	5.40E-01	5.40E-01					mg/L	Yes - Qual
Acetone	17/231	5.00E-03	1.00E+01	5.00E-03	4.90E-02	1.35E-02		2.75E-02			mg/L	Yes - P
Benzene	1/398	1.00E-03	5.00E+00	1.60E-02	1.60E-02	1.60E-02		5.04E-04	3.85E-04		mg/L	Yes - P

051706

Table G.17. Summary of COPC screening for detected analytes[a] (continued)

Analyte	Frequency of Detection[b]	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected Value	Maximum Detected Value	Mean of Detected Values	Background[c] Concentration	HI-based No Action Screening Value[d]	ELCR-based No Action Screening Value[d]	Essential Nutrient	Units	COPC?[e]
						Organic Compounds (continued)						
Bromodichloromethane	1/398	1.00E-03	5.00E+00	1.00E-03	1.00E-03	1.00E-03		5.49E-03	2.16E-04		mg/L	Yes - P
Bromomethane	1/217	2.00E-03	2.00E-01	4.10E-03	4.10E-03	4.10E-03		3.91E-04			mg/L	Yes - P
Carbon tetrachloride	22/398	1.00E-03	5.00E+00	2.00E-03	1.20E-01	2.39E-02		1.90E-04	1.81E-04		mg/L	Yes - P
Chloroform	37/398	1.00E-03	5.00E+00	1.00E-03	1.30E-01	2.58E-02		2.87E-05	2.18E-04		mg/L	Yes - P
Chloromethane	1/231	2.00E-03	5.00E+00	1.00E-02	1.00E-02	1.00E-02		8.64E-03	1.67E-03		mg/L	Yes - P
Dibromochloromethane	1/231	1.00E-03	5.00E+00	2.00E-03	2.00E-03	2.00E-03		5.49E-03	1.59E-04		mg/L	Yes - P
Methylene chloride	4/231	1.00E-03	1.00E+01	1.00E-03	5.90E-01	1.51E-01		6.86E-02	4.26E-03		mg/L	Yes - P
Tetrachloroethene	14/398	1.00E-03	5.00E+00	1.00E-03	4.00E-03	2.36E-03		8.42E-03	5.82E-04		mg/L	Yes - P
Trichloroethene	752/881	5.00E-04	2.00E-01	5.00E-05	6.70E+01	4.60E-01		1.60E-03	1.73E-03		mg/L	Yes - P
Vinyl chloride	43/688	1.00E-03	1.00E+01	6.00E-05	4.00E-01	1.07E-02		3.06E-03	3.50E-05		mg/L	Yes - P
cis-1,2-Dichloroethene	148/688	5.00E-04	1.00E+00	6.00E-05	1.20E+01	1.78E-01		2.73E-03			mg/L	Yes - P
trans-1,2-Dichloroethene	136/688	5.00E-04	5.00E+00	5.00E-05	1.10E-01	4.57E-03		5.48E-03			mg/L	Yes - P
						Radionuclides						
Neptunium-237	1/50	-9.56E-01	4.00E-01	3.85E+00	3.85E+00	3.85E+00	8.00E-01		5.73E-01		pCi/L	Yes - P
Technetium-99	151/359	-2.06E+01	1.01E+02	1.66E+01	1.67E+03	1.79E+02	2.23E+01		1.40E+01		pCi/L	Yes - P
Thorium-230	1/39	-5.56E-01	1.66E-01	4.96E-01	4.96E-01	4.96E-01	1.10E+00		4.24E-01		pCi/L	Yes - P
Thorium-232	1/39	-7.63E-02	6.27E-02	1.57E-01	1.57E-01	1.57E-01			3.82E-01		pCi/L	No
Uranium-234	1/26	-1.18E-01	3.09E+02	5.66E+02	5.66E+02	5.66E+02	7.00E-01		5.46E-01		pCi/L	Yes - P
Uranium-238	3/31	0.00E+00	4.39E-01	1.02E+00	7.58E+02	4.10E+02	7.00E-01		4.43E-01		pCi/L	Yes - P

[a] Results shown are over all RGA water samples collected from borings or wells within the boundary of the Southwest Plume. Only results for analytes detected one or more times are presented.
[b] Number of detected results over total number of samples used in the BHHRA.
[c] Provisional background concentrations are taken from Appendix A of the Risk Methods Document. Blank cells indicate that a background concentration for the analyte does not exist.
[d] Risk-based screening values are taken from Appendix A of the Risk Methods Document Table 18. Groundwater No Action Levels (NAL) for the PGDP. The HI-based NAL value is that for the child resident. The ELCR-based NAL value is that for the adult resident lifetime exposure. HI and ELCR target values used for the screening values are 0.1 and 1×10^{-6}, respectively.
[e] "Yes" indicates that the analyte is a COPC for RGA groundwater within the Southwest Plume.
P = Analyte maximum detected value exceeds a no action screening value.
Qual = Analyte does not have a no action value to screen against.
"No" indicates that the analyte is not a COPC for RGA groundwater.
E = Analyte is an essential nutrient.

Deleted: 8

Deleted: 06-064(E)/041406

Deleted: [d] Risk-based screening values are taken from Appendix A of the Risk Methods Document. The HI-based value is that for the child resident. The ELCR-based value is that for lifetime exposure. HI and ELCR target values used for the screening values are 0.1 and 1×10^{-6}, respectively. ¶

051706

Table G.18. Summary of COPC screening for detected analytes – SWMU 1[a]

Deleted: 9

Deleted: 06-064(E)/041406

Analyte	Frequency of Detection[b]	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected Value	Maximum Detected Value	Mean of Detected Values	Background[c] Concentration	HI-based No Action Screening Value[d]	ELCR-based No Action Screening Value[d]	Essential Nutrient	Units	COPC?[e]
Inorganic Chemicals (Metals)												
Arsenic	1/3	1.00E-02	1.00E-01	4.36E-03	4.36E-03	4.36E-03	5.00E-03	4.52E-04	3.50E-05		mg/L	Yes - P
Barium	3/3			8.72E-02	4.62E-01	3.14E-01	2.35E-01	1.04E-01			mg/L	Yes - P
Calcium	3/3			1.59E+01	2.59E+01	2.13E+01	4.12E+01			X	mg/L	No-E
Chromium	1/3	2.00E-02	2.00E-02	2.97E-02	2.97E-02	2.97E-02	1.44E-01	1.76E+00			mg/L	Yes-BTF
Cobalt	2/3	1.00E-03	1.00E-03	2.90E-02	2.11E-01	1.20E-01	4.50E-02	9.06E-02			mg/L	Yes - P
Iron	3/3			2.93E-01	5.57E+00	3.10E+00	5.03E+00	4.49E-01			mg/L	Yes - P
Magnesium	3/3			8.16E+00	1.14E+01	9.67E+00	1.63E+01			X	mg/L	No-E
Manganese	3/3			9.15E-03	3.97E+00	1.72E+00	1.19E-01	3.50E-02			mg/L	Yes - P
Nickel	3/3			2.63E-02	1.47E-01	6.93E-02	6.82E-01	3.01E-02			mg/L	Yes - P
Potassium	3/3			1.04E+00	1.31E+00	1.21E+00	5.20E+00			X	mg/L	No-E
Selenium	1/3	5.00E-03	5.00E-02	7.45E-03	7.45E-03	7.45E-03	5.00E-03	7.54E-03			mg/L	No
Sodium	1/1			1.59E+01	1.59E+01	1.59E+01	5.95E+01			X	mg/L	No-E
Zinc	1/3	2.00E-02	2.00E-01	3.15E-02	3.15E-02	3.15E-02	5.40E-02	4.50E-01			mg/L	Yes-BTF
Organic Compounds												
1,1-Dichloroethene	2/27	2.86E-03	1.00E+00	5.00E-04	7.00E-04	6.00E-04		2.46E-03	4.70E-05		mg/L	Yes - P
Chloroform	1/19	5.00E-03	1.00E+00	3.20E-03	3.20E-03	3.20E-03		2.87E-05	2.18E-04		mg/L	Yes - P
Trichloroethene	25/28	1.87E-03	2.00E-01	1.00E-04	7.80E-01	1.82E-01		1.60E-03	1.73E-03		mg/L	Yes - P
cis-1,2-Dichloroethene	2/27	4.00E-03	1.00E+00	3.00E-02	6.70E-02	4.85E-02		2.73E-03			mg/L	Yes - P
Radionuclides												
Technetium-99	2/17	-8.65E+00	1.03E+01	2.48E+01	2.49E+01	2.49E+01	2.23E+01		1.40E+01		pCi/L	Yes - P

[a] Results shown are for RGA water samples collected from borings or wells at SWMU 1. Only results for analytes detected one or more times are presented.
[b] Number of detected results over total number of samples used in the BHHRA.
[c] Provisional background concentrations are taken from Appendix A of the Risk Methods Document. Blank cells indicate that a background concentration for the analyte does not exist.
[d] Risk-based screening values are taken from Appendix A of the Risk Methods Document Table 18. Groundwater No Action Levels (NAL) for the PGDP. The HI-based NAL value is that for the child resident. The ELCR-based NAL value is that for the adult resident lifetime exposure. HI and ELCR target values used for the screening values are 0.1 and 1×10^{-6}, respectively.
[e] "Yes" indicates that the analyte is a COPC for RGA groundwater within the Southwest Plume.
P = Analyte maximum detected value exceeds a no action screening value.
BTF = Analyte has a fish BTF greater than 100 and is retained as a COPC.
"No" indicates that the analyte is not a COPC for RGA groundwater.
E = Analyte is an essential nutrient.

051706

Table G.19. Summary of COPC screening for detected analytes – C-720 area[a]

Analyte	Frequency of Detection[b]	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected Value	Maximum Detected Value	Mean of Detected Values	Background[c] Concentration	HI-based No Action Screening Value[d]	ELCR-based No Action Screening Value[d]	Essential Nutrient	Units	COPC?[e]
Inorganic Chemicals (Metals)												
Arsenic	1/1			4.26E-03	4.26E-03	4.26E-03	5.00E-03	4.52E-04	3.50E-05		mg/L	Yes - P
Barium	1/1			4.22E-01	4.22E-01	4.22E-01	2.35E-01	1.04E-01			mg/L	Yes - P
Calcium	1/1			3.52E+01	3.52E+01	3.52E+01	4.12E+01			1.60E+02	mg/L	No-E
Chromium	3/3			3.08E-02	3.80E-01	2.03E-01	1.44E-01	1.76E+00			mg/L	Yes-BTF
Cobalt	1/1			2.86E-02	2.86E-02	2.86E-02	4.50E-02	9.06E-02			mg/L	Yes-BTF
Copper	2/3	2.00E-02	2.00E-02	3.70E-02	5.50E-02	4.60E-02	3.60E-02	5.57E-02		2.00E-01	mg/L	Yes-BTF
Iron	3/3			9.13E-01	3.12E+01	1.13E+01	5.03E+00	4.49E-01		2.00E+00	mg/L	Yes - P
Magnesium	1/1			1.38E+01	1.38E+01	1.38E+01	1.63E+01			3.40E+01	mg/L	No-E
Manganese	1/1			4.25E+00	4.25E+00	4.25E+00	1.19E-01	3.50E-02			mg/L	Yes - P
Nickel	3/3			1.13E-01	7.01E-01	3.99E-01	6.82E-01	3.01E-02			mg/L	Yes - P
Potassium	1/1			1.93E+00	1.93E+00	1.93E+00	5.20E+00			3.20E+02	mg/L	No-E
Sodium	1/1			5.78E+01	5.78E+01	5.78E+01	5.95E+01			8.00E+01	mg/L	No-E
Organic Compounds												
1,1-Dichloroethene	8/31	1.00E-03	1.00E+00	7.00E-04	5.40E-02	2.41E-02		2.46E-03	4.70E-05		mg/L	Yes - P
Trichloroethene	31/31			3.80E-03	1.26E+00	2.52E-01		1.60E-03	1.73E-03		mg/L	Yes - P
Vinyl chloride	1/31	1.00E-03	1.00E+00	2.10E-03	2.10E-03	2.10E-03		3.06E-03	3.50E-05		mg/L	Yes - P
cis-1,2-Dichloroethene	9/31	1.00E-03	1.00E+00	3.00E-04	3.10E-02	6.98E-03		2.73E-03			mg/L	Yes - P
trans-1,2-Dichloroethene	8/31	1.00E-03	1.00E+00	1.00E-04	1.40E-02	4.43E-03		5.48E-03			mg/L	Yes - P
Radionuclides												
Technetium-99	10/10			3.55E+01	1.29E+02	6.77E+01	2.23E+01		1.40E+01		pCi/L	Yes - P

[a] Results shown are for RGA water samples collected from borings or wells at the C-720 area. Only results for analytes detected one or more times are presented.
[b] Number of detected results over total number of samples used in the BHHRA.
[c] Provisional background concentrations are taken from Appendix A of the Risk Methods Document. Blank cells indicate that a background concentration for the analyte does not exist.
[d] Risk-based screening values are taken from Appendix A of the Risk Methods Document Table 18. Groundwater No Action Levels (NAL) for the PGDP. The HI-based NAL value is that for the child resident. The ELCR-based NAL value is that for the adult resident lifetime exposure. HI and ELCR target values used for the screening values are 0.1 and 1 × 10^{-6}, respectively.
[e] "Yes" indicates that the analyte is a COPC for RGA groundwater within the Southwest Plume.
P = Analyte maximum detected value exceeds a no action screening value.
BTF = Analyte has a fish BTF greater than 100 and is retained as a COPC.
"No" indicates that the analyte is not a COPC for RGA groundwater.
E = Analyte is an essential nutrient.

Deleted: 20

Deleted: 06-064(E)/041406

Deleted: [d] Risk-based screening values are taken from Appendix A of the Risk Methods Document. The HI-based value is that for the child resident. The ELCR-based value is that for lifetime exposure. HI and ELCR target

Deleted: values used for the screening values are 0.1 and 1 × 10^{-6}, respectively.

Deleted: Page Break

Deleted: Table G.21. Summary of COPC screening for detected analytes – SWMU 4[a]¶ Analyte ... [2]

Table G.20. Summary of COPC screening for detected analytes – storm sewer[a]

Analyte	Frequency of Detection[b]	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected Value	Maximum Detected Value	Mean of Detected Values	Background[c] Concentration	HI-based No Action Screening Value[d]	ELCR-based No Action Screening Value[d]	Essential Nutrient	Units	COPC?[e]
Organic Compounds												
1,1-Dichloroethene	2/8	4.00E-03	5.00E-03	1.00E-04	1.00E-04	1.00E-04		2.46E-03	4.70E-05		mg/L	Yes - P
Trichloroethene	8/8			9.00E-05	1.00E-02	4.41E-03		1.60E-03	1.73E-03		mg/L	Yes - P
trans-1,2-Dichloroethene	3/8	4.00E-03	5.00E-03	8.00E-04	4.00E-03	1.90E-03		5.48E-03			mg/L	No

[a] Results shown are for RGA water samples collected from borings or wells at the storm sewer. Only results for analyte detected one or more times are presented.
[b] Number of detected results over total number of samples in the BHHRA.
[c] Provisional background concentrations are taken from Appendix A of the Risk Methods Document. Blank cells indicate that a background concentration for the analyte does not exist.
[d] Risk-based screening values are taken from Appendix A of the Risk Methods Document Table 18. Groundwater No Action Levels (NAL) for the PGDP. The HI-based NAL value is that for the child resident. The ELCR-based NAL value is that for the adult resident lifetime exposure. HI and ELCR target values used for the screening values are 0.1 and 1 × 10^{-6}, respectively.
[e] "Yes" indicates that the analyte is a COPC for RGA groundwater within the Southwest Plume.
P = Analyte maximum detected value exceeds a no action screening value.
"No" indicates that the analyte is not a COPC for RGA groundwater.

Deleted: 2

Deleted: 06-064(E)/041406

Deleted: [d] Risk-based screening values are taken from Appendix A of the Risk Methods Document. The HI-based value is that for the child resident. The ELCR-based value is that for lifetime exposure. HI and ELCR target values used for the screening values are 0.1 and 1 × 10^{-6}, respectively.

Table G.21. Modeled concentrations of the contaminants at the PGDP fence boundary, PGDP property boundary, and near the Ohio River[a]

Analyte	Plant Boundary: Predicted Time of Maximum Concentration (years)	Plant Boundary: Maximum Mean Concentration (µg/L)	Property Boundary: Predicted Time of Maximum Concentration (years)	Property Boundary: Maximum Mean Concentration (µg/L)	Near Ohio River: Predicted Time of Maximum Concentration (years)	Near Ohio River: Maximum Mean Concentration (µg/L)	No Action Screening Values: HI-based[b] (µg/L)	No Action Screening Values: ELCR-based[b] (µg/L)	MCL (µg/L)	COPC?[c]
C-720 Building Area –Variable Degradation Scenario										
Trichloroethene	45	3.1	50	0.74	NA	0	1.6	1.73	5	Yes-P
cis-1,2-Dichloroethene	25	3.2	25	2.1	NR	NR	2.73		70	No
trans-1,2-Dichloroethene	30	0.15	35	0.07	NR	NR	5.48		100	No
Vinyl chloride	35	0.08	40	0.04	NR	NR	3.06	0.035	2	No
C-720 Building Area – Fixed Degradation Scenario										
Trichloroethene	30	15.7	45	7.97	NA	0	1.6	1.73	5	Yes-P
cis-1,2-Dichloroethene	25	3.2	25	2.1	NR	NR	2.73		70	No
trans-1,2-Dichloroethene	30	0.15	35	0.07	NR	NR	5.48		100	No
Vinyl chloride	35	0.08	40	0.04	NR	NR	3.06	0.035	2	No
SWMU 1 Source Area - Variable Degradation Scenario										
Trichloroethene	15	71.9	40	5.05	NA	0	1.6	1.73	5	Yes-P
cis-1,2-Dichloroethene	15	16.1	20	3.1	NR	NR	2.73		70	No
trans-1,2-Dichloroethene	15	21.1	20	3.6	NR	NR	5.48		100	No
Vinyl chloride	15	0.16	20	0.03	NR	NR	3.06	0.035	2	No
SWMU 1 Source Area - Fixed Degradation Scenario										
Trichloroethene	15	112.0	25	18.1	80	1.8	1.6	1.73	5	Yes-P
cis-1,2-Dichloroethene	15	16.1	20	3.1	NR	NR	2.73		70	No
trans-1,2-Dichloroethene	15	21.1	20	3.6	NR	NR	5.48		100	No
Vinyl chloride	15	0.16	20	0.03	NR	NR	3.06	0.035	2	No

[a] Results taken from Appendix F of the SI report. TCE results are the largest within time step median values generated by the probabilistic modeling over the period modeled. Results for other VOCs are the maximum values estimated as part of preliminary SESOIL and AT123D modeling. "NR" indicates that the model was not run for this location because results at the property boundary yielded concentrations below *de minimis* risk levels.

[b] Risk-based screening values are taken from Appendix A of the Risk Methods Document Table 18. Groundwater No Action Levels (NAL) for the PGDP. The HI-based NAL value is that for the child resident. The ELCR-based NAL value is that for the adult resident lifetime exposure. HI and ELCR target values used for the screening values are 0.1 and 1 × 10^{-6}, respectively.

[c] "Yes-P" indicates that the analyte is a COPC because a maximum contaminant concentration exceeds the residential use no action screening value for water use at one or more POEs. "No" indicates that the analyte is not a COPC.

051706

Deleted: 3
Deleted: 06-064(E)/041406
Deleted: *e*
Deleted: *e*
Deleted: *Degradation…Scenrio* ... [3]
Deleted: *Degradation…Scenrio* ... [4]
Deleted: *SWMU 4 Source Area*
Deleted: Trichloroethene ... [5]
Deleted: *cis*-1,2-Dichloroethene ... [6]
Deleted: *trans*-1,2-Dichloroethe ... [7]
Deleted: Vinyl chloride ... [8]
Deleted: [b] Risk-based screening values are taken from Appendix A of the Risk Methods Document. The HI-based value is that for the child resident. The ELCR-based value is that for lifetime exposure. HI and ELCR target values used for the screening values are 0.1 and 1 × 10^{-6}, respectively.
Deleted: NA = *trans*-1,2-DCE not modeled for SWMU 4.¶
Deleted: [d]Maximum concentration is based on arithmetic mean¶
Deleted: UPON ACCEPTING COMMENTS NEED TO ACTUALLY DELETE ROWS OF TABLE
Formatted: Left
Formatted: Highlight

In response to the discovery of groundwater contamination in residential wells near PGDP, a survey of users of groundwater and surface water in the vicinity of PGDP was conducted in February and March of 1990. The two objectives of the survey were to (1) estimate the number of residents using water wells that may be affected by groundwater contamination originating at PGDP and (2) determine the number of surface water intakes on the Ohio River within 15 miles downstream of PGDP. The groundwater users' survey included residences and businesses with wells within a 4-mile radius of the plant; therefore, this survey included parts of McCracken and Ballard counties in Kentucky and part of Massac County in Illinois. A questionnaire was mailed to local residents to identify well water users. State agencies and major industrial facilities were contacted to identify surface water users. The information provided by respondents was developed into a database, which is summarized in the following text.

A total of 1988 surveys were delivered; 44% (872) of these were returned. Of the respondents, 58% used well water for some purpose. Eighty-four percent used well water as their sole water supply. Eighty-five percent used well water for drinking; 47% used well water for irrigation; 29% used well water for watering livestock; and 80% used well water for domestic uses such as laundry, washing cars, etc. The total depth of wells in the study area (i.e., the area investigated by this survey) was reported to range from 15 ft to 245 ft; however, 21% of residents did not report total depth. The most frequently reported total depth was 40 ft (26 respondents), followed by 30 ft (21 respondents) and 100 ft (20 respondents). Fifty-four percent of wells were reported to be 20 ft to 60 ft deep. Plastic and tile were the predominant construction materials; however, steel, brick, and concrete also were reported.

Deleted: as

Unfortunately, the questionnaire used in this survey did not determine frequency of groundwater use. (See Section 1 of Appendix 5 in the Risk Methods Document for a reproduction of the questionnaire.) However, as indicated earlier, these data were used qualitatively in the exposure assessment to develop the site conceptual model and reduce the level of uncertainty of the exposure assessment in the BHHRA.

The DOE has undertaken several actions subsequent to the identification of the contaminant plumes to protect the neighboring population and to reduce the off-site migration of the portions of the groundwater plumes that contain the highest concentration of contamination. These actions include providing an alternate drinking water source to certain, nearby residences immediately after off-site groundwater contamination was discovered in August 1988; extending water lines as a permanent source of drinking water to such residences (*Engineering Evaluation/Cost Analysis for the Water Policy at the Paducah Gaseous Diffusion Plant* [DOE 1993a]); and constructing and implementing groundwater treatment systems for both the Northwest and Northeast Plumes to reduce contaminant migration (*Record of Decision for Interim Remedial Action of the Northwest Plume at the Paducah Gaseous Diffusion Plant* [DOE 1993b] and *Record of Decision for Interim Remedial Action at the Northeast Plume* [DOE 1995a]). Each of these actions limits or prevents the exposure of off-site receptors to contaminated groundwater under current conditions.

G2.5 SUMMARY OF COPCS

A summary of the groundwater COPCs at each SWMU and over the Southwest Plume are presented in Tables G.22 to G.25. This information was compiled from Tables G.17 through G.20 and G.21 and earlier transport modeling results. COPCs in Table G.22 through G.25 lacking toxicity information and which, therefore, cannot be quantitatively assessed, are indicated with "Yes-Qual." In total, there are 15 metal COPCs, 17 organic compound COPCs, and 5 radionuclide COPCs for the Southwest Plume; 8 metal COPCs, 4 organic compound COPCs, and 1 radionuclide COPC for SWMU 1; 8 metal COPCs, 5 organic compound COPCs, and 1 radionuclide COPC for the C-720 area; and 2 organic compound COPCs for the storm sewer. Generally, the groundwater COPCs listed in Table G.22 through G.25 are similar to the RGA groundwater COCs identified in earlier BHHRAs.

Deleted: 4

Deleted: 8

Deleted: 8

Deleted: 2

Deleted: 3

Deleted: 4

Deleted: 8

Deleted: 9 metal COPCs, 15 organic compound COPCs, and 4 radionuclide COPC for SWMU 4;

Deleted: 4

Deleted: 8

Deleted: 06-064(E)/041406

Deleted: 4

Table G.22. Summary of COPC screening for detected analytes – Southwest Plume[a]

Analyte	Frequency of Detection[b]	COPCs for RGA Groundwater?[c]
	Inorganic Chemicals (Metals)	
Aluminum	15/102	Yes - P
Arsenic	9/244	Yes - P
Barium	114/114	Yes - P
Chromium	37/246	Yes - P
Cobalt	27/42	Yes - P
Copper	8/118	Yes - P
Iron	32/46	Yes - P
Manganese	114/114	Yes - P
Molybdenum	5/18	Yes - P
Nickel	66/118	Yes - P
Selenium	13/244	Yes - P
Silicon	74/74	Yes - Qual
Uranium	9/339	Yes - P
Vanadium	3/98	Yes - P
Zinc	9/118	Yes - P
	Organic Compounds	
1,1-Dichloroethene	123/688	Yes - P
1,2-Dichloroethane	1/398	Yes - P
2-Propanol	1/29	Yes - Qual
Acetone	17/231	Yes - P
Benzene	1/398	Yes - P
Bromodichloromethane	1/398	Yes - P
Bromomethane	1/217	Yes - P
Carbon tetrachloride	22/398	Yes - P
Chloroform	37/398	Yes - P
Chloromethane	1/231	Yes - P
Dibromochloromethane	1/231	Yes - P
Methylene chloride	4/231	Yes - P
Tetrachloroethene	14/398	Yes - P
Trichloroethene	752/881	Yes - P
Vinyl chloride	43/688	Yes - P
cis-1,2-Dichloroethene	148/688	Yes - P
trans-1,2-Dichloroethene	136/688	Yes - P
	Radionuclides	
Neptunium-237	1/50	Yes - P
Technetium-99	151/359	Yes - P
Thorium-230	1/39	Yes - P
Uranium-234	1/26	Yes - P
Uranium-238	3/31	Yes - P

[a] Results shown are over all RGA water samples collected from borings or wells within the boundary of the Southwest Plume.
[b] Number of detected results over total number of samples used in the BHHRA.
[c] "Yes" indicates that the analyte is a COPC for RGA groundwater within the Southwest Plume.
P = Analyte maximum detected value exceeds a no action screening value.
Qual = Analyte does not have a no action value to screen against.
"No" indicates that the analyte is not a COPC for RGA groundwater.

Deleted: 06-064(E)/041406

Table G.23, Summary of COPC screening for detected analytes – SWMU 1[a]

Deleted: 5

Analyte	Frequency of Detection[b]	COPCs for RGA Groundwater?[c]	COPCs for Migration from Source Units?[c]
	Inorganic Chemicals (Metals)		
Arsenic	1/3	Yes - P	No
Barium	3/3	Yes - P	No
Chromium	1/3	Yes - BTF	No
Cobalt	2/3	Yes - P	No
Iron	3/3	Yes - P	No
Manganese	3/3	Yes - P	No
Nickel	3/3	Yes - P	No
Zinc	1/3	Yes – BTF	No
	Organic Compounds		
1,1-Dichloroethene	2/27	Yes - P	No
Chloroform	1/19	Yes - P	No
Trichloroethene	25/28	Yes - P	Yes – P
cis-1,2-Dichloroethene	2/27	Yes - P	No
	Radionuclides		
Technetium-99	2/17	Yes - P	No

[a] Results shown are for RGA water samples collected from borings or wells at SWMU 1.
[b] Number of detected results over total number of samples used in the BHHRA.
[c] "Yes" indicates that the analyte is a COPC for RGA groundwater within the Southwest Plume.
P = Analyte maximum detected value exceeds a no action screening value.
BTF = Analyte is a COPC because its fish BTF exceeds 100.
"No" indicates that the analyte is not a COPC for RGA groundwater.

Table G.24, Summary of COPC screening for detected analytes – C-720 area[a]

Deleted: 6

Analyte	Frequency of Detection[b]	COPCs for RGA Groundwater?[c]	COPCs for Migration from Source Units?[c]
	Inorganic Chemicals (Metals)		
Arsenic	1/1	Yes - P	No
Barium	1/1	Yes - P	No
Chromium	3/3	Yes – BTF	No
Cobalt	1/1	Yes – BTF	No
Copper	2/3	Yes - BTF	No
Iron	3/3	Yes - P	No
Manganese	1/1	Yes - P	No
Nickel	3/3	Yes - P	No
	Organic Compounds		
1,1-Dichloroethene	8/31	Yes - P	No
Trichloroethene	31/31	Yes - P	Yes - P
Vinyl chloride	1/31	Yes - P	No
cis-1,2-Dichloroethene	9/31	Yes - P	No
trans-1,2-Dichloroethene	8/31	Yes - P	No
	Radionuclides		
Technetium-99	10/10	Yes - P	No

[a] Results shown are for RGA water samples collected from borings or wells at the C-720 area.
[b] Number of detected results over total number of samples used in the BHHRA.
[c] "Yes" indicates that the analyte is a COPC for RGA groundwater within the Southwest Plume.
P = Analyte maximum detected value exceeds a no action screening value.
BTF = Analyte is a COPC because its fish BTF exceeds 100.
"No" indicates that the analyte is not a COPC for RGA groundwater.

Deleted: 06-064(E)/041406

Table G.25. Summary of COPC screening for detected analytes – storm sewer[a]

Analyte	Frequency of Detection[b]	COPCs for RGA Groundwater?[c]	COPCs for Migration from Source Units? [d]
Organic Compounds			
1,1-Dichloroethene	2/8	Yes - P	No
Trichloroethene	8/8	Yes - P	No

[a] Results shown are for RGA water samples collected from borings or wells at the storm sewer.
[b] Number of detected results over total number of samples used in the BHHRA.
[c] "Yes" indicates that the analyte is a COPC for RGA groundwater within the Southwest Plume.
P = Analyte maximum detected value exceeds a no action screening value.
"No" indicates that the analyte is not a COPC for RGA groundwater.
[d] Samplings results collected as part of the SI indicates that a source of contamination is not associated with the storm sewer.

Deleted: 8

Deleted: Table G.27. Summary of COPC screening for detected analytes – SWMU 4[a]¶
Analyte ... [9]

G.3 EXPOSURE ASSESSMENT

This section describes the exposure assessment used to determine the pathways of exposure that were considered in the assessment of the groundwater and subsurface soil data collected at the source units as part of the Southwest Plume SI. Specifically, the exposure assessment process is delineated, the exposure setting of the Southwest Plume and its sources are described, the routes of exposure to groundwater are outlined, and the daily intakes and doses are derived. The ultimate products presented in this section are the conceptual site model for the Southwest Plume and its sources and the CDIs used when calculating ELCR and HI in Section 5.

G3.1 DESCRIPTION OF THE EXPOSURE ASSESSMENT PROCESS

Exposure is the contact of an organism with a chemical or physical agent. The magnitude of exposure (i.e., dose) is determined by measuring or estimating the amount of an agent available at exchange boundaries (e.g., gut, skin, etc.) during a specified period. Exposure assessment is a process that uses information about the exposure setting and human activities to develop conceptual site models under current and potential future conditions.

The first step in the exposure assessment is to characterize the exposure setting. This includes describing the activities of the human population (on or near a site) that may affect the extent of exposure and the physical characteristics of the site. During this process, sensitive subpopulations that may be present at the site or that may be exposed to contamination migrating from the site also are considered when determining if the BHHRA should address these populations. Generally, site characterization results in a qualitative evaluation of the site and the surrounding population.

The second step in the exposure assessment is to identify exposure pathways. Exposure pathways describe the path a contaminant travels from its source to an individual. A complete exposure pathway includes all links between the source and the exposed population; therefore, a complete pathway consists of a source of release, a mechanism of release, a transport medium, a point of potential human contact, and an exposure route.

The third step in the exposure assessment is to calculate dose by quantifying the magnitude, frequency, and duration of exposure for the populations for the exposure pathways selected for quantitative evaluation. This step involves estimating exposure or EPCs for COPCs and quantifying pathway-specific intakes.

Deleted: 06-064(E)/041406

G3.2 CHARACTERIZATION OF THE EXPOSURE SETTING

The first step in evaluating exposure is to characterize surface features, meteorology, geology, demography and land use, ecology, hydrology, and hydrogeology of the area inhabited by potential receptors. These aspects are discussed in Chapter 2 of the SI report and in the WAG 27 RI report, and much of that information does not bear repeating here. Physical descriptions of SWMU 1, the C-720 area, and the storm sewer are included within this exposure assessment to support later discussions of the conceptual model and its uncertainties.

Deleted: and 3

Deleted: s

Deleted: SWMU 4,

G3.2.1 Physical Description of SWMU 1

SWMU 1, the C-747-C Landfarm, is located in the western portion of the PGDP. The landfarm consisted of two plots of about 1,125 ft^2 each that were plowed to a depth of 1 to 2 ft. The area was slightly depressed, causing superficial depressions to fill with water at times of heavy precipitation. At some point, a layer of gravel was placed below the soil in the landfarm to improve drainage. No cap or cover was placed over the plots following closure in 1979. The precise locations of the two 1,125 ft^2 plots have not been defined, but based on review of historical aerial photographs, they are believed to be located in the northern portion of the SWMU. (See Chap. 2 of the SI Report for detailed diagrams.) The total area of SWMU 1 is estimated to be about 96,300 ft^2 (2.2 acres) with the TCE source area estimated to be 8,712 ft^2 (0.2 acres). Currently, SWMU 1 is 100% grass covered.

G3.2.2 Physical Description of the C-720 Area

The C-720 area is located in the southwest portion of the PGDP. The C-720 area includes the Compressor Shop Pit, the backfill areas surrounding the drainage system where the drains exit the building, and SWMU 167, the white room sump. The total size of the C-720 area is estimated to be 893,000 ft^2 (20.5 acres); however, the TCE source areas cover 15,000 ft^2 (0.3 acres) and are located at the northeast and southeast corners of the C-720 Building area. (See Chapter 2 of the SI Report for detailed diagrams.) Currently, the C-720 Building area is 100% covered by concrete or asphalt.

Deleted: <#>**Physical Description of SWMU 4¶**
SWMU 4, the C-747 Contaminated Burial Yard is located in the west-central section of PGDP. The burial yard consisted of two main cells that covered an area of approximately 8,200 ft^2. The horizontal extent of one cell measured about 50 by 15 ft and the other measured about 50 by 150 ft. The estimated total waste volume at SWMU 4 is estimated to be 123,000 ft^3. Both cells were reported to have been excavated to a depth of approximately 15 ft.¶
The burial cells were used for disposal of radiologically contaminated and uncontaminated trash and excess equipment [consisting of steel, Monel (a nickel alloy), and other metals]. Some of the trash was burned before burial. The majority of contaminated metal was buried in the northern part of the yard. When the yard was closed, a smaller cell was reported to have been excavated for the disposal of radiologically contaminated scrap metal. The burial yard also may have received uranium contaminated with ^{99}Tc. Sludges originally designated to be disposed of in the C-404 burial ground also may have been placed in SWMU 4. The sludges may have consisted of uranium-contaminated solid waste and magnesium fluoride contaminated with ^{99}Tc. The entire burial yard was covered with 2–3 ft of soil, and a 6-in. clay cap was placed over the area in 1982. (See Chapter 2 of the SI Report for detailed diagrams.) SWMU 4 is approximately 265,716 ft^2 (6.1 acres) in size and 100% grass covered. The TCE source areas were estimated to cover 177,500 ft^2 (1.8 acres).

G3.2.3 Physical Description of the Storm Sewer

The C-400 to Outfall 008 storm sewer is part of SWMU 102 at the PGDP. This storm sewer drains the central-west portion of the plant. Major areas and buildings that contribute storm water runoff to the system include all of the following:

- C-631 Cooling Towers,
- C-331 Process Building – roof drains for northwest quadrant,
- C-310 Building – roof drains for north half,
- C-410/C-420 Complex,
- C-400 Building,
- C-409 Building,
- C-600 Steam Plant area,
- C-720 Building – roof drains for north and west sides and associated shops on north side,
- C-746-H3 Storage Pad, and
- C-740 Storage Yard.

Construction drawings show that the Outfall 008 storm sewer begins to the east of the C-400 Building as a 15-in. diameter pipe. The video survey of the Outfall 008 storm sewer that was part of the

Deleted: 06-064(E)/041406

Southwest Plume SI revealed that the main storm sewer south of C-400 is a 36-in. diameter, reinforced concrete pipe that enlarges to a 48-in. diameter pipe and then a 54-in. diameter pipe between 10th and 8th Streets. West of 8th Street, the Outfall 008 storm sewer continues as a 72-in. diameter pipe. The video survey confirmed that the bottom of the storm sewer is between 13 and 15 ft bgs. Additionally, the survey determined that the structural integrity of the storm sewer was good. Construction drawings indicate that the feeder lines into the main storm sewer range from 8-inch diameter vitreous clay pipe to 24-in. diameter concrete pipe.

G3.2.4 Demography and land use

As shown in the physical descriptions presented above, current land use of all sources investigated during the Southwest Plume SI is industrial. Under current use, because of security arrangements, only plant workers and authorized visitors are allowed access to the source areas. As discussed in the PGDP Site Management Plan (DOE 2004a), foreseeable future land use of the area is expected to be industrial as well.

At present, both recreational and residential land uses occur in areas surrounding PGDP. Recreational use occurs in the Western Kentucky Wildlife Management Area (WKWMA). The WKWMA is used primarily for hunting and fishing, but other activities include horseback riding, field trials, hiking, and bird watching. An estimated 5,000 fishermen visit the area annually, according to the Kentucky Department of Fish and Wildlife Resources manager of the WKWMA. Residential use near the plant and in areas to which the Southwest Plume may migrate is rural residential and includes agricultural activities. However, current response actions have eliminated exposure to contaminated groundwater by these rural residents. More urban residential use occurs in the villages of Heath, Grahamville, and Kevil, which are within 3 miles of DOE property boundaries, but outside of the area projected to be potentially impacted by the Southwest Plume. The closest major urban area is the municipality of Paducah, Kentucky, which has a population of approximately 28,000 and is approximately 10 miles from PGDP. Other municipalities in the region near PGDP are Cape Girardeau, Missouri, which is approximately 40 miles west of the plant; and the cities of Metropolis and Joppa, Illinois, which are across the Ohio River from PGDP. Total population within a 40-mile radius of the plant is approximately 500,000 people, with about 50,000 people living within 10 miles. The population of McCracken County, in which PGDP lies, is estimated at 63,000 people.

In the area near PGDP and in western Kentucky, in general, the economy has historically been agriculturally based; however, industry has increased in recent years. The PGDP is a major employer with approximately 1,800 workers. Another major employer near the PGDP is the Tennessee Valley Authority (TVA) Shawnee Steam Plant, which employs approximately 500 individuals.

G3.3 IDENTIFICATION OF EXPOSURE PATHWAYS

Exposure pathways describe how a contaminant travels from its source to an individual. A complete exposure pathway includes all links between the source and the exposed population. That is, a complete pathway consists of the source of release, a mechanism of release, a transport medium, a point of potential human contact, and an exposure route. Sources of release, mechanisms of release, and transport media are discussed in Chap. 5 and Appendix F of the SI report; therefore, the following discussions focus on points of potential human contact, types of receptors, and exposure routes that are relevant to exposure to contaminated groundwater.

Deleted: ,

Deleted: ,

Deleted: .

Deleted: 06-064(E)/041406

G3.3.1 Points of Human Contact – Land Use Considerations

As discussed earlier, at present, the potential sources to the Southwest Plume are in an industrial area located within a large industrial facility; therefore, the current land use is industrial. Per KDEP and EPA agreement (Risk Methods Document), this land use limits the current exposure medium for a receptor to the first foot of surface soil and precludes any current use of groundwater drawn from the RGA at the sources.

Also as discussed earlier, the current land use can be expected to continue in the foreseeable future. That is, the most plausible future land use of the area containing the sources of the Southwest Plume is also industrial. In the future, the expected exposure medium for all but an excavation worker, who may be exposed to deeper soils, is limited to the first foot of surface soil. Additionally, use of groundwater drawn from the RGA at the sources is not expected. However, uses of areas surrounding PGDP indicate that it would be prudent to examine a range of land uses to provide managers with estimates of the risk that may be posed to humans under alternate uses, however unlikely. In addition, consideration of a range of land uses is consistent with requirements outlined in the Risk Methods Document. Alternate land uses considered in earlier BHHRAs of the source areas, in order of their plausibility, were excavation, recreational, and rural residential. Baseline risks under each of these uses are presented for SWMU 1 and the C-720 Building area in Section 1 of this BHHRA. (A previous BHHRA is not available for the storm sewer.)

Deleted: , SWMU 4,

To be consistent with the earlier BHHRAs, this assessment assumes that future use of groundwater drawn from the RGA below the source units is possible even though current response actions eliminate the possibility that a rural resident may be exposed to contaminated groundwater. It also assumes that water supply wells will be placed at downgradient POEs where the maximum contaminant concentration within the Southwest Plume will occur in the future.

G3.3.2 Potential Receptor Populations

As noted above, the potential receptor population under current conditions at the source units is industrial workers, and the potential receptor populations under future conditions are industrial workers, excavation workers, recreational users, and rural residents. The potential receptor populations under current and future conditions in areas to which the Southwest Plume may migrate are recreational and residential. Within these broad categories, the recreational users and rural residents contain age cohorts. For the recreational users, the cohorts include the child (aged 1 to 7), teen (aged 8 to 20), and the adult (older than 21). For rural residents, the cohorts include children (aged 1 to 7) and older individuals (termed adults in this and previous BHHRAs). The recreational user and the rural resident population may also contain sensitive subpopulations such as pregnant women, young children (aged 0 to 1), the elderly, and the infirm. In this and earlier BHHRAs, exposure by these subpopulations is not quantified because much of the information that is needed is not available; however, these subpopulations are considered qualitatively in the uncertainty discussions. Finally, this and earlier assessments assume that the recreational user is a rural resident who has repeated access to the study area. Recreational users not residing in the study area are not considered separately because nearby residents were determined to be the individuals most likely to take part in recreational activities at PGDP on a continual basis. In addition, the exposure assessment determined that little information useful in remedy selection would be obtained by including a separate visiting recreational user in the assessment.

G3.3.3 Delineation of exposure point/exposure routes

As discussed, human health risks are assessed by determining POEs and exposure routes. POEs are locations where human receptors can contact contaminated media. Exposure routes are the processes by which human receptors contact contaminated media. The exposure routes considered during the exposure

Deleted: 06-064(E)/041406

assessment for all BHHRAs per the Risk Methods Document are listed in the following paragraphs. This material also presents reasons for selecting or not selecting each exposure route for each of the potentially exposed populations in this BHHRA. Although most of these exposure routes were quantitatively assessed in earlier BHHRAs, consistent with the new data collected in the SI, the only exposure routes quantitatively assessment in this BHHRA are those that include groundwater use.

- Ingestion of water while using groundwater as a drinking water source. Residential and industrial use of groundwater is common in western Kentucky. Potential receptors for this pathway are rural residents. This exposure route is assessed quantitatively in this BHHRA.

- Inhalation of volatile constituents emitted while using groundwater. As noted previously, residential and industrial use of groundwater is common in western Kentucky. Rural residents are potential receptors for this exposure route. This exposure route is assessed quantitatively in this BHHRA.

- Dermal contact with groundwater while showering. As noted earlier, residential and industrial use of groundwater is common in western Kentucky. Rural residents are potential receptors for this exposure route. This exposure route is assessed quantitatively in this BHHRA.

- Inhalation of vapor released from the groundwater into home basements. This exposure route was modeled quantitatively in this BHHRA for rural residents based on measured TCE, *cis*-1,2-DCE, *trans*-1,2-DCE, and vinyl chloride concentration at SMWU-001 and C-720, as well as modeled TCE concentrations at the plant and property Boundaries.

- External exposure to ionizing radiation emitted by contaminants in groundwater while showering. As noted previously, residential and industrial use of groundwater is common in western Kentucky. Rural residents are potential receptors for this exposure route. This exposure route is not assessed quantitatively in this BHHRA because previous BHHRAs have concluded that shielding by water prevents a significant dose from occurring through this route of exposure.

- Inhalation of VOCs during irrigation with contaminated groundwater. In the Midwest, irrigation of farmland with groundwater using center pivot irrigation is common. Rural residents are potential receptors for this exposure route. Because only modeled groundwater data are available for this BHHRA in areas where migration may occur in the future, and because earlier assessments have shown that risk from this exposure route is minimal, this exposure route is not assessed quantitatively in this BHHRA.

- Incidental ingestion of contaminated soil (soil and waste). Industrial processes at source units have contaminated the soil. Recreational users may ingest soil while recreating, and residents may ingest soil while gardening. Industrial workers may ingest soil while working outdoors, and excavation workers may ingest soil while digging. Recreational users, rural residents, industrial workers, and excavation workers are potential receptors for this exposure route. This exposure route was considered in earlier BHHRAs, but is not reassessed in this BHHRA because new data are not available.

- Dermal contact with contaminated soil (soil and waste). Industrial processes at source units have contaminated the soil. Recreational users may get soil on their skin while recreating, and residents may get soil on their skin while gardening. Industrial workers may get soil on their skin while working outdoors, while excavation workers may get soil on their skin while digging. Recreational users, rural residents, industrial workers, and excavation workers are potential receptors for this exposure route. This exposure route was considered in earlier BHHRAs, but is not reassessed in this BHHRA because new data are not available.

Deleted:
Deleted: for
Deleted: ichloroethene
Deleted: ichloroethene
Deleted: V
Deleted: P
Deleted: P
Deleted: B

Deleted: 06-064(E)/041406

- Inhalation of particulates emitted from contaminated soil (soil and waste). Industrial processes at source units have contaminated the soil, and this soil may release particulates to the air when the soil is dry and disturbed. Recreational users may inhale these particulates while recreating, and residents may inhale these particulates while gardening. Industrial workers may inhale these particulates while working outdoors, and excavation workers may inhale these particulates while digging. Recreational users, rural residents, industrial workers, and excavation workers are potential receptors for this exposure route. This exposure route was considered in earlier BHHRAs, but is not reassessed in this BHHRA because new data are not available.

- Inhalation of volatile constituents emitted from contaminated soil (soil and waste). Industrial processes at source units have contaminated the soil. Some of these contaminants may be volatile and released to the air as vapors. Recreational users may inhale these vapors while recreating, and residents may inhale these vapors while gardening. Industrial workers may inhale these vapors while working outdoors, and excavation workers may inhale these vapors while digging. Recreational users, rural residents, industrial workers, and excavation workers are potential receptors for this exposure route. This exposure route was considered in earlier BHHRAs, but is not reassessed in this BHHRA because new data are not available.

- External exposure to ionizing radiation emitted from contaminated soil (soil and waste). Industrial processes at source units have contaminated the soil. Radionuclides present in contaminated soil will, in turn, undergo decay and emit ionizing radiation. Recreational users may be exposed to this ionizing radiation while recreating, and residents may be exposed to it while gardening. Industrial workers may be exposed to the ionizing radiation while working outdoors, and excavation workers may be exposed to it while digging. Recreational users, rural residents, industrial workers, and excavation workers are potential receptors for this exposure route. This exposure route was considered in earlier BHHRAs, but is not reassessed in this BHHRA because new data are not available.

- Incidental ingestion of water while swimming in privately owned fish ponds filled with groundwater. Construction of fish ponds was determined to be a viable future agriculture land use after the Agriculture Extension Agents for Ballard and McCracken counties noted that "pay-to-fish" lakes filled with groundwater exist in Ballard County and that the Agriculture Extension office has actively promoted the construction of commercial ponds. (See Section 2 of Appendix 5 of the Risk Methods Document.) Although the agents disagreed on how profitable this form of farming could be in western Kentucky, the presence of "pay-to-fish" lakes filled with groundwater in Ballard County indicates that aquaculture is a viable alternative rural residential land use in the study area. Because open bodies of water are often attractive for recreation, swimming and wading in these ponds by residents is reasonable. Incidental ingestion of water could occur during swimming. Rural residents are potential receptors for this exposure route. Because only modeled groundwater data are available for this BHHRA in areas where this activity may occur in the future, this exposure route is not assessed quantitatively in this BHHRA.

- Dermal contact with water while swimming or wading in privately owned fish ponds filled with groundwater. The rationale for considering ponds is presented in the previous paragraph. In addition, recreational use of these ponds by residents may reasonably be expected to occur. During recreational use (e.g., swimming or wading), dermal contact with water could occur. Rural residents are potential receptors for this exposure route. Because only modeled groundwater data are available for this BHHRA in areas where this activity may occur in the future, this exposure route is not assessed quantitatively in this BHHRA.

- Incidental ingestion of sediment while swimming or wading in privately owned fishponds filled with groundwater. The rationale for considering ponds is presented previously. In addition, recreational

Deleted: 06-064(E)/041406

use of these ponds by residents may reasonably be expected to occur. During recreational activities, incidental ingestion of sediment contaminated by constituents in groundwater is possible. Rural residents are potential receptors for this exposure route. Because only modeled groundwater data are available for this BHHRA in areas where this activity may occur in the future, this exposure route is not assessed quantitatively in this BHHRA.

- External exposure to ionizing radiation emitted by contaminants in groundwater while swimming or wading in privately owned fish ponds filled with groundwater. The rationale for considering ponds is presented previously. During use of these ponds by residents, exposure to ionizing radiation emitted by radionuclides in water could occur. Rural residents are potential receptors for this exposure route. Because only modeled groundwater data are available for this BHHRA in areas where this activity may occur in the future, this exposure route is not assessed quantitatively in this BHHRA.

- External exposure to ionizing radiation emitted by contaminants in sediment while swimming or wading in privately owned fish ponds filled with groundwater. The rationale for considering ponds is presented previously. During use of these ponds by residents, exposure to ionizing radiation emitted by radionuclides in groundwater and sediment could occur. Rural residents are potential receptors for this exposure route. Because only modeled groundwater data are available for this BHHRA in areas where this activity may occur in the future, this exposure route is not assessed quantitatively in this BHHRA.

- Consumption of fish raised in privately owned fish ponds filled with groundwater. The fish raised in ponds would be exposed to contaminants in groundwater and may accumulate some contaminants in their edible tissues. These fish, caught in either a "pay-to-fish" or a commercial pond by residents, could reasonably be expected to be consumed. Recreational users (i.e., visitors) and rural residents are potential receptors for this exposure route. Because only modeled groundwater data are available for this BHHRA in areas where this activity may occur in the future, this exposure route is not assessed quantitatively in this BHHRA.

- Incidental ingestion of surface water in creeks or ponds. Open bodies of water, such as Bayou Creek or settling ponds, are attractive for recreation (e.g., swimming and wading) and must be maintained. Although such bodies of water are not included in the assessment of the source areas, contaminants may migrate from the sources to these creeks or ponds. Recreational users and industrial workers are potential receptors for this exposure route. This exposure route is not assessed quantitatively in this BHHRA because earlier BHHRAs have concluded that mixing with surface water results in risks that are insignificant. Additionally, only modeled groundwater data are available in this BHHRA in areas where this activity may occur in the future.

- Dermal contact with surface water while swimming or wading in creeks or ponds. Open bodies of water, such as Bayou Creek or settling ponds, are attractive for recreation (e.g., swimming and wading) and must be maintained. Although such bodies of water are not included in this assessment of the source areas, contaminants may migrate from sources to these bodies of water. Recreational users and industrial workers are potential receptors for this exposure route. This exposure route is not assessed quantitatively in this BHHRA because earlier BHHRAs have concluded that mixing with surface water results in risks that are insignificant. Additionally, only modeled groundwater data are available in this BHHRA in areas where this activity may occur in the future.

- Incidental ingestion of sediment while swimming or wading in creeks or ponds. Open bodies of water, such as Bayou Creek or settling ponds, are attractive for recreation (e.g., swimming and wading) and must be maintained. Although such bodies of water are not included in this assessment of the source areas, contaminants may migrate from sources to these bodies of water. Recreational users and industrial workers are potential receptors for this exposure route. This exposure route is not

Deleted: 06-064(E)/041406

assessed quantitatively in this BHHRA because earlier BHHRAs have concluded that mixing with surface water results in risks that are insignificant. Additionally, only modeled groundwater data are available in this BHHRA in areas where this activity may occur in the future.

- External exposure to ionizing radiation emitted by contaminants in surface water while swimming or wading in creeks or ponds. Open bodies of water, such as Bayou Creek or settling ponds, are attractive for recreation (e.g., swimming and wading) and must be maintained. Although such bodies of water are not included in this assessment of the source areas, contaminants may migrate from sources to these bodies of water. Recreational users and industrial workers are potential receptors for this exposure route. This exposure route is not assessed quantitatively in this BHHRA because earlier BHHRAs have concluded that mixing with surface water results in risks that are insignificant. Additionally, only modeled groundwater data are available in this BHHRA in areas where this activity may occur in the future.

- External exposure to ionizing radiation emitted by contaminants in sediment while swimming or wading in creeks or ponds. Open bodies of water, such as Bayou Creek or settling ponds, are attractive for recreation (e.g., swimming and wading) and must be maintained. Although such bodies of water are not included in this assessment of the source areas, contaminants may migrate from sources to these bodies of water. Recreational users and industrial workers are potential receptors for this exposure route. This exposure route is not assessed quantitatively in this BHHRA because earlier BHHRAs have concluded that mixing with surface water results in risks that are insignificant. Additionally, only modeled groundwater data are available in this BHHRA in areas where this activity may occur in the future.

- Consumption of fish taken from creeks and ponds containing contaminated surface water. Fish living in Bayou Creek or settling ponds may accumulate contaminants in surface water in their edible tissues. Although such bodies of water are not included in this assessment of the source areas, contaminants may migrate from sources to these bodies of water. Recreational users and residents may catch and consume fish from the potentially impacted surface water bodies. Potential receptors for this route of exposure are recreational users. This exposure route is not assessed quantitatively in this BHHRA because earlier BHHRAs have concluded that mixing with surface water results in risks that are insignificant. Additionally, only modeled groundwater data are available in this BHHRA in areas where this activity may occur in the future.

- Consumption of vegetables and produce raised in contaminated soil (soil and waste). As noted in Section 2 of Appendix 5 of the Risk Methods Document, crop farming and gardening are common activities near the PGDP, and this land use pattern could be expanded to the source areas in the future after the industrial infrastructure is removed. Because industrial use of the source areas has contaminated soil, plants raised in this soil may, in turn, accumulate these contaminants. Finally, humans may consume this contaminated produce. Potential receptors for this route of exposure are rural residents. This exposure route was considered in earlier BHHRAs, but is not reassessed in this BHHRA because new data are not available.

- Consumption of beef from cattle contaminated by consuming vegetation (pasture and concentrates) irrigated with groundwater, consuming soil (soil and waste) contaminated through irrigation or industrial use while on pasture, and drinking groundwater. During interviews, Agriculture Extension Agents for Ballard and McCracken counties indicated that small scale cow-calf operations are common in western Kentucky. (See Section 2 of Appendix 5 of the Risk Methods Document.) They further noted that slaughtering feeder cattle for home consumption is common. In the study area, such beef may be contaminated by incidental ingestion of soil while on pasture, by consumption of contaminated vegetation (pasture and concentrate), and by ingestion of contaminated groundwater.

Deleted: 06-064(E)/041406

Residents may eat this beef; therefore, potential receptors for this route of exposure are rural residents. This exposure route was considered in earlier BHHRAs, but is not reassessed in this BHHRA because new soil data are not available, and only modeled groundwater data are available in this BHHRA in areas where this activity may occur in the future.

- Consumption of dairy products (i.e., milk) from cows contaminated by consuming vegetation (pasture or concentrates) irrigated with groundwater, consuming soil (soil and waste) contaminated through industrial use while on pasture, and drinking groundwater. During interviews, Agriculture Extension Agents for Ballard and McCracken counties noted that dairy farming still occurs in their counties. (See Section 2 of Appendix 5 of the Risk Methods Document.) Furthermore, the agents stated that these cattle are fed stored feed and are allowed to graze on pasture. As noted previously, the soil at source units is contaminated, and the vegetation may become contaminated. Therefore, dairy cattle raised at the sources after the industrial infrastructure is removed may become contaminated through incidental ingestion of soil while on pasture, consumption of contaminated vegetation, and ingestion of contaminated groundwater. Products made from milk from these cows could, in turn, be consumed by residents; therefore, potential receptors for this route of exposure are rural residents. This exposure route was considered in earlier BHHRAs, but is not reassessed in this BHHRA because new soil data are not available, and only modeled groundwater data are available in this BHHRA in areas where this activity may occur in the future.

- Consumption of poultry given groundwater to drink. During interviews, Agriculture Extension Agents for Ballard and McCracken counties noted that commercial broiler production did occur in their counties, but not near PGDP. (See Section 2 of Appendix 5 of the Risk Methods Document.) (Home flocks for both meat and eggs were noted as being uncommon.) Furthermore, they stated that broilers were fed bought (not locally raised) feed, that normal resident time in poultry houses was 2 months, and that commercial distribution of the product occurs. However, the agents did note that the birds are most likely watered with groundwater; therefore, broilers may become contaminated through ingestion of contaminated groundwater. For this exposure assessment, the receptor assumed to consume the contaminated poultry is the rural resident. Because only modeled groundwater data are available for this BHHRA in areas where this activity may occur in the future, this exposure route is not assessed quantitatively in this BHHRA.

- Consumption of pork from swine fed contaminated feed and water with groundwater. During interviews, Agriculture Extension Agents for Ballard and McCracken counties noted that both large commercial and small hog farms exist in their counties. (See Section 2 of Appendix 5 of the Risk Methods Document.) Furthermore, they indicated that swine on both types of farms were fed locally raised feed and, on the smaller farms, that farm-raised pork was consumed by farmers. Any swine raised may be contaminated through consumption of contaminated feed and groundwater, and this pork may be eaten by rural residents; therefore, rural residents are potential receptors for this pathway. Because only modeled groundwater data are available for this BHHRA in areas where this activity may occur in the future, this exposure route is not assessed quantitatively in this BHHRA.

- Consumption of game contaminated by consumption of vegetation grown in contaminated soil (soil and waste) and ingestion of groundwater. As indicated in the Risk Methods Document and discussed earlier, the taking of game is common around the study area. Potential game species include deer, rabbits, ducks, geese, quail, and wild turkey. Each of these species may be contaminated by consumption of contaminated vegetation, soil, or groundwater. Potential receptors for this route of exposure are recreational users. Because no new soil data were available for this BHHRA and modeled contaminant concentrations in groundwater at the Ohio River were very low, this exposure route is not assessed quantitatively in this BHHRA.

Deleted: 06-064(E)/041406

As demonstrated above, a total of 28 routes of exposure, including those that consider biota, is possible for the Southwest Plume and its sources; however, only four of these routes have new data suitable for additional assessment in this BHHRA. The routes that are quantified and the number of the table in which the equation used to quantify each route are listed below.

Deleted: are

- Ingestion of water while using groundwater as a drinking water source – Table G.26
- Dermal contact with groundwater while showering – Table G.27
- Inhalation of volatiles in groundwater while showering – Table G.28
- Inhalation of volatiles in groundwater during household use – Table G.29
- Inhalation of volatiles as a result of vapor intrusion into home basements – Table G.29 and Appendix F

Deleted: 9

Deleted: 30

Deleted: 31

Deleted: 32

Deleted: volitiles

G3.3.4 Development of Conceptual Site Models

Using the information presented in the previous subsections, a conceptual site model was developed for the Southwest Plume and its sources. This conceptual site model (Fig. G.7) illustrates the sources, pathways of migration, and routes of exposure relevant to this BHHRA.

Table G.26. Reasonable maximum exposure assumptions and human intake factors for ingestion of water by a rural resident

Deleted: 9

Equations:

$$Chemical\ Intake\ [mg/(kg \times day)] = \frac{C_w \times IR \times EF \times ED}{BW \times AT}$$

$$Radionuclide\ Intake\,(pCi) = A_w \times IR \times EF \times ED$$

Parameter	Units	Value used[a]
Chemical concentration in water = $\mathbf{C_w}$	mg/L	Chemical-specific
Radiological activity = $\mathbf{A_w}$	pCi/L	Chemical-specific
Ingestion Rate = **IR**	L/d	2 (adult)
		1 (child)
Exposure frequency = **EF**	d/year	350
Exposure duration = **ED**	years	34 (adult)
		6 (child)
Body weight = **BW**	kg	70 (adult)
		14.5 (child)
Averaging time = **AT**	yr ×	70 × 365 (carcinogen)
	day/yr.	ED × 365 (noncarcinogen)

[a] All values are from the Risk Methods Document.

Deleted: 06-064(E)/041406

Table G.27. Reasonable maximum exposure assumptions and human intake factors for dermal contact with water while showering by a rural resident

Deleted: 30

Equation:

$$Absorbed\ Dose\ \ [mg/(kg \times day)] = \frac{C_w \times SA \times P_c \times CF \times ED \times EF \times ET}{BW \times AT}$$

Parameter	Units	Value used[a]
Concentration in water = **C_w**	mg/L	Chemical-specific
Skin surface area exposed[b] = **SA**	m^2	1.815 (adult) 0.72 (child)
Skin permeability constant = **P_c**	cm/hr	Chemical-specific
Conversion Factor = **CF**	(L-m)/(cm-m^3)	10
Exposure duration = **ED**	years	34 (adult) 6 (child)
Exposure frequency = **EF**	baths/yr	350
Exposure time = **ET**	hrs/bath	0.2
Body weight = **BW**	kg	70 (adult) 14.5 (child)
Averaging time = **AT**	yr × day/yr	70 × 365 (carcinogen) ED × 365 (noncarcinogen)

[a] All values are from the Risk Methods Document.
[b] Entire surface area of body for both adult and child.

Deleted: 06-064(E)/041406

Table G.28. Reasonable maximum exposure assumptions and human intake factors for inhalation of volatile organic compounds in water while showering by a rural resident

Deleted: 31

Equations:

$$Chemical\ Intake\ [mg/(kg \times day)] = \frac{C_{shower} \times IR_{air} \times EF \times ED \times ET}{BW \times AT}$$

$$Radionuclide\ Intake\ (pCi) = A_{gw} \times IR_{air} \times EF \times ED \times IEF$$

$$C_{shower}\ (mg/m^3) = \frac{[(C_{a\,max}/2) \times t_1] + [C_{a\,max} \times t_2]}{t_1 + t_2} \qquad C_{a\,max}\ (mg/m^3) = \frac{C_{gw} \times f \times F_w \times t_1}{V_a}$$

Parameter	Units	Value used[a]
Time-adjusted concentration in shower = $\mathbf{C_{shower}}$	mg/m^3	Chemical-specific
Indoor inhalation rate = $\mathbf{IR_{air}}$	m^3/hour	0.6
Exposure frequency = **EF**	day/year	350
Exposure duration = **ED**	years	34 (adult) 6 (child)
Exposure Time = **ET**	hours/day	0.2
Body weight = **BW**	kg	70 (adult) 14.5 (child)
Averaging time = **AT**	yr × day/yr	70 × 365 (carcinogen) ED × 365 (noncarcinogen)
Activity in groundwater = $\mathbf{A_{gw}}$	pCi/L	Chemical-specific
Inhalation exposure factor = **IEF**	(L-hr)/ (m^3-day)	Chemical-specific Default value is 0. Values for tritium and radon are 0.2064 and 5.6, respectively.
Maximum air concentration = $\mathbf{C_{amax}}$	mg/m^3	Chemical-specific
Time of shower = $\mathbf{t_1}$	hour	0.1
Time after shower = $\mathbf{t_2}$	hour	0.1
Concentration in groundwater = $\mathbf{C_{gw}}$	mg/L	Chemical-specific
Fraction volatilized = **f**	unitless	0.75
Water flow rate = $\mathbf{F_w}$	L/h	890
Bathroom volume = $\mathbf{V_a}$	m^3	11

[a] All values are from the Risk Methods Document.

Deleted: 06-064(E)/041406

Table G.29. Reasonable maximum exposure assumptions and human intake factors for inhalation of volatile organic compounds in water during household use by a rural resident

Deleted: 32

Equations:

$$Chemical\ Intake\ [mg/(kg \times day)] = \frac{C_{house} \times IR_{air} \times EF \times ED \times ET}{BW \times AT}$$

$$Radionuclide\ Intake\ (pCi) = A_{gw} \times IR_{air} \times EF \times ED \times IEF$$

$$C_{house}\ (mg/m^3) = \frac{C_{gw} \times WHF \times f}{HV \times ER \times MC}$$

Deleted: $C_{house\ (vapor\ intrusion)}(mg/m^3) =$ value from vapor intrusion modeling¶

Formatted: Highlight

Parameter	Units	Value used[a]
Concentration in household air = $\mathbf{C_{house}}$	mg/m^3	Chemical-specific based pm vapor intrusion modeling
Indoor inhalation rate = $\mathbf{IR_{air}}$	m^3/hour	0.833
Exposure frequency = **EF**	day/year	350
Exposure duration = **ED**	years	34 (adult) 6 (child)
Exposure time = **ET**	hours/day	16
Body weight = **BW**	kg	70 (adult) 14.5 (child)
Averaging time = **AT**	yr × day/yr	70 × 365 (carcinogen) ED × 365 (noncarcinogen)
Activity in groundwater = $\mathbf{A_{gw}}$	pCi/L	Chemical-specific
Inhalation exposure factor = **IEF**	(L-hr)(m^3-day)	Chemical-specific Default value is 0. Values for tritium and radon are 0.2064 and 5.6, respectively.
Concentration in groundwater = $\mathbf{C_{gw}}$	mg/L	Chemical-specific
Water flow rate = **WHF**	L/day	890
Fraction volatilized = **f**	unitless	0.75
House volume = **HV**	m^3/change	450
Exchange rate = **ER**	changes/day	10
Mixing coefficient = **MC**	unitless	0.5

[a] All values are from the Risk Methods Document.

Deleted: 06-064(E)/041406

051706

Deleted: 06-064(E)/041406

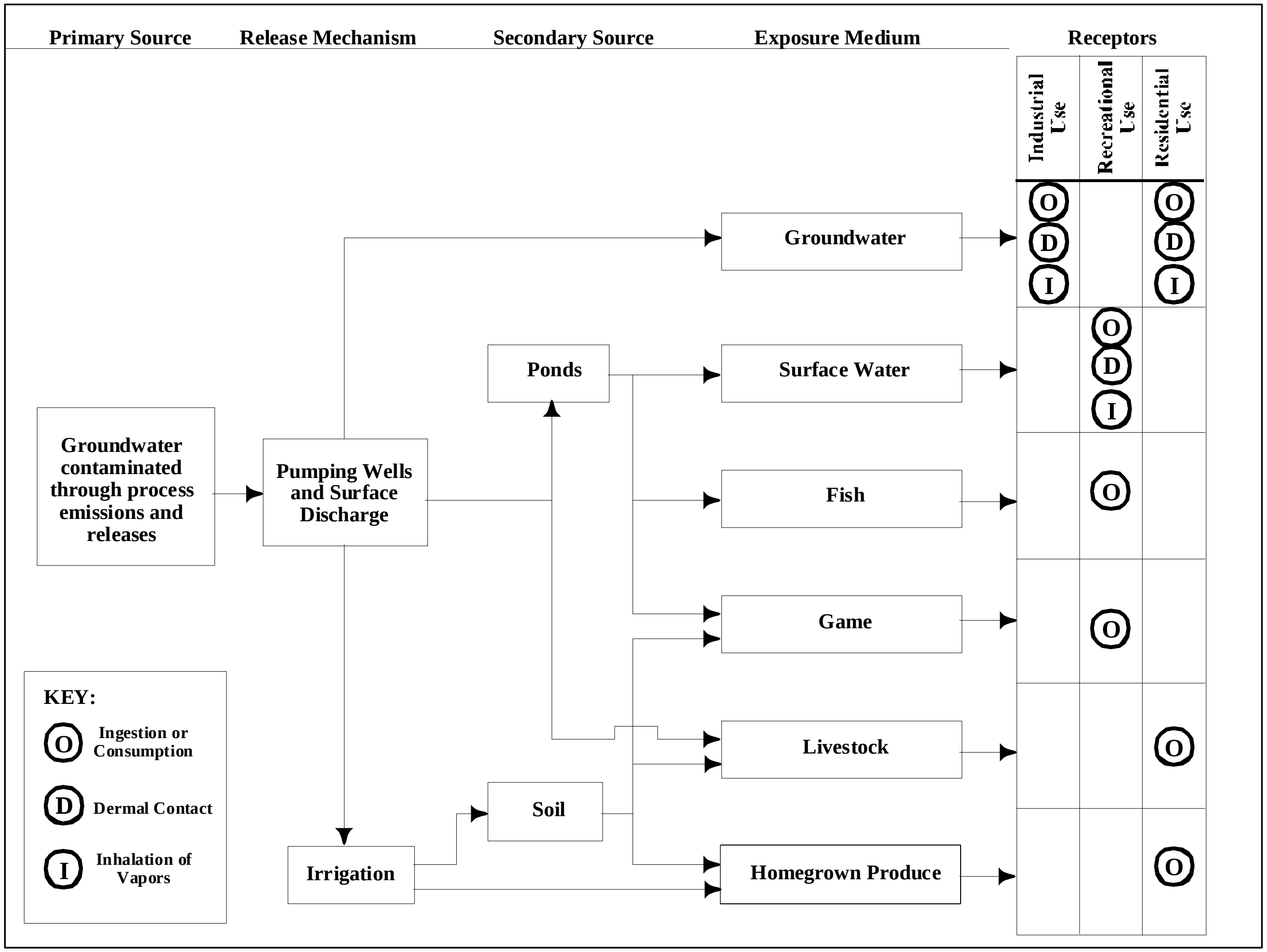


Fig. G.7. Conceptual site model for RGA groundwater in the Southwest Plume and at its sources.

G3.4 QUANTIFICATION OF EXPOSURE

G3.4.1 Calculation of EPCs of COPCs

The EPCs for COPCs in groundwater under current conditions were determined before the intake models presented in Subsection 3.3.3 were used to calculate the chronic daily intakes used in the risk calculations. EPCs derived from sampling data and were used to determine current and potential future risks at the four source locations and for the SW plume in general. The calculation of these EPCs did not account for potential decreases or increases in COPC concentrations over time. The EPCs for COPCs in groundwater based on sampling data are presented in Tables G.30 through G.31. EPCs used to determine potential future risks at three points of exposure (i.e., plant boundary, property boundary, and Ohio River) were developed from modeling and are not repeated in this section (see Section 2).

Deleted: 3

Deleted: 7

Deleted: 3

Table G.30. Exposure point concentrations for all Southwest Plume RGA groundwater COPCs

COPC	Distribution Flag[a]	UCL95[b]	Maximum Detected Value	Exposure Point Concentration[c]	Units
Inorganic Chemicals (Metals)					
Aluminum	L	2.40E+00	3.04E+01	2.40E+00	mg/L
Arsenic	N	3.46E-03	1.75E-02	3.46E-03	mg/L
Barium	L	1.75E-01	6.43E-01	1.75E-01	mg/L
Chromium	N	8.49E-02	2.03E+00	8.49E-02	mg/L
Cobalt	L	2.30E-02	2.11E-01	2.30E-02	mg/L
Copper	N	1.98E-02	1.29E-01	1.98E-02	mg/L
Iron	L	2.63E+01	3.12E+01	2.63E+01	mg/L
Manganese	N	1.34E+00	4.25E+00	1.34E+00	mg/L
Molybdenum	L	1.09E-01	5.98E-02	5.98E-02	mg/L
Nickel	L	1.67E-01	1.42E+00	1.67E-01	mg/L
Selenium	N	3.94E-03	5.00E-02	3.94E-03	mg/L
Silicon	L	1.73E+01	6.28E+01	1.73E+01	mg/L
Uranium	N	4.16E-01	3.50E-01	3.50E-01	mg/L
Vanadium	L	1.91E-02	1.28E-01	1.91E-02	mg/L
Zinc	L	1.38E-01	6.95E-01	1.38E-01	mg/L
Organic Compounds					
1,1-Dichloroethene	N	1.86E-02	3.40E-01	1.86E-02	mg/L
1,2-Dichloroethane	N	9.17E-02	2.00E-01	9.17E-02	mg/L
2-Propanol	N	7.30E-02	5.40E-01	7.30E-02	mg/L
Acetone	N	7.50E-02	4.90E-02	4.90E-02	mg/L
Benzene	N	2.29E-02	1.60E-02	1.60E-02	mg/L
Bromodichloromethane	N	2.30E-02	1.00E-03	1.00E-03	mg/L
Bromomethane	L	3.87E-03	4.10E-03	3.87E-03	mg/L
Carbon tetrachloride	N	2.45E-02	1.20E-01	2.45E-02	mg/L
Chloroform	N	2.73E-02	1.30E-01	2.73E-02	mg/L
Chloromethane	N	3.53E-02	1.00E-02	1.00E-02	mg/L
Dibromochloromethane	N	3.37E-02	2.00E-03	2.00E-03	mg/L
Methylene chloride	N	6.63E-02	5.90E-01	6.63E-02	mg/L
Tetrachloroethene	N	2.31E-02	4.00E-03	4.00E-03	mg/L
Trichloroethene	L	5.01E-01	6.70E+01	5.01E-01	mg/L
Vinyl chloride	N	3.16E-02	4.00E-01	3.16E-02	mg/L
cis-1,2-Dichloroethene	L	4.53E-02	1.20E+01	4.53E-02	mg/L
trans-1,2-Dichloroethene	N	4.10E-02	1.10E-01	4.10E-02	mg/L
Radionuclides					
Neptunium-237	L	1.59E+00	3.85E+00	1.59E+00	pCi/L
Technetium-99	L	1.70E+02	1.67E+03	1.70E+02	pCi/L
Thorium-230	L	2.07E-01	4.96E-01	2.07E-01	pCi/L
Uranium-234	L	4.08E+01	5.66E+02	4.08E+01	pCi/L
Uranium-238	L	4.21E+01	7.58E+02	4.21E+01	pCi/L

[a] "L" = data were determined to be log normally distributed. "N" = data were determined to be normally distributed.
[b] 95% UCL on the mean concentration calculated using the appropriate distribution.
[c] The lesser of the 95 UCL and maximum detected concentration.

Deleted: % upper confidence limit

Deleted: 95

Deleted: 06-064(E)/041406

Deleted: 4

Table G.31. Exposure point concentrations for RGA groundwater COPCs at SWMU 1

COPC	Distribution Flag[a]	UCL95[b]	Maximum Detected Value	Exposure Point Concentration[c]	Units
		Inorganic Chemicals (Metals)			
Arsenic	<	NC	4.36E-03	4.36E-03	mg/L
Barium	<	NC	4.62E-01	4.62E-01	mg/L
Chromium	<	NC	2.97E-02	2.97E-02	mg/L
Cobalt	<	NC	2.11E-01	2.11E-01	mg/L
Iron	<	NC	5.57E+00	5.57E+00	mg/L
Manganese	<	NC	3.97E+00	3.97E+00	mg/L
Nickel	<	NC	1.47E-01	1.47E-01	mg/L
Zinc	<	NC	3.15E-02	3.15E-02	mg/L
		Organic Compounds			
1,1-Dichloroethene	L	4.30E-02	7.00E-04	7.00E-04	mg/L
Chloroform	L	7.45E-02	3.20E-03	3.20E-03	mg/L
Trichloroethene	L	2.50E+01	7.80E-01	7.80E-01	mg/L
cis-1,2-Dichloroethene	L	8.28E-02	6.70E-02	6.70E-02	mg/L
		Radionuclides			
Technetium-99	L	2.39E+01	2.49E+01	2.39E+01	pCi/L

[a] "<" = 5 or fewer results were available; therefore, distribution was not determined. "L" = data were determined to be log normally distributed. "N" = data were determined to be normally distributed.
[b] 95% UCL on the mean concentration calculated using the appropriate distribution. NC = UCL95 not calculated because 5 or fewer results were available.
[c] The lesser of the UCL95 and maximum detected concentration.

Deleted: upper confidence limit

Deleted: 5

Table G.32. Exposure point concentrations for RGA groundwater COPCs at the C-720 Building area

COPC	Distribution Flag[a]	UCL95[b]	Maximum Detected Value	Exposure Point Concentration[c]	Units
		Inorganic Chemicals (Metals)			
Arsenic	<	NC	4.26E-03	4.26E-03	mg/L
Barium	<	NC	4.22E-01	4.22E-01	mg/L
Chromium	<	NC	3.80E-01	3.80E-01	mg/L
Cobalt	<	NC	2.86E-02	2.86E-02	mg/L
Copper	<	NC	5.50E-02	5.50E-02	mg/L
Iron	<	NC	3.12E+01	3.12E+01	mg/L
Manganese	<	NC	4.25E+00	4.25E+00	mg/L
Nickel	<	NC	7.01E-01	7.01E-01	mg/L
		Organic Compounds			
1,1-Dichloroethene	L	6.09E-02	5.40E-02	5.40E-02	mg/L
Trichloroethene	L	7.38E-01	1.26E+00	7.38E-01	mg/L
Vinyl chloride	L	5.78E-01	2.10E-03	2.10E-03	mg/L
cis-1,2-Dichloroethene	L	1.32E+00	3.10E-02	3.10E-02	mg/L
trans-1,2-Dichloroethene	L	4.33E+00	1.40E-02	1.40E-02	mg/L
		Radionuclides			
Technetium-99	L	9.34E+01	1.29E+02	9.34E+01	pCi/L

[a] "<" = 5 or fewer results were available; therefore, a distribution was not determined. "L" = data were determined to be log normally distributed. "N" = data were determined to be normally distributed.
[b] 95% UCL on the mean concentration calculated using the appropriate distribution. NC = UCL95 not calculated because 5 or fewer results were available.
[c] The lesser of the UCL95 and maximum detected concentration.

Deleted: upper confidence limit

Deleted: 06-064(E)/041406

Deleted: ¶

Deleted: 7

Deleted: Table G.36. Exposure point concentrations for RGA groundwater COPCs at SWMU 4¶
COPC ... [10]

Table G.33. Exposure point concentrations for RGA groundwater COPCs at the storm sewer

COPC	Distribution Flag[a]	UCL95[b]	Maximum Detected Value	Exposure Point Concentration[c]	Units
		Organic Compounds			
1,1-Dichloroethene	L	4.11E-02	1.00E-04	1.00E-04	mg/L
Trichloroethene	L	3.03E-01	1.00E-02	1.00E-02	mg/L

[a] "L" = data were determined to be log normally distributed. "N" = data were determined to be normally distributed.
[b] 95% UCL on the mean concentration calculated using the appropriate distribution.
[c] The lesser of the UCL95 and maximum detected concentration.

Deleted: upper confidence limit

Deleted: Page Break

Deleted: 3

Deleted: 7

The EPCs presented in Tables G.30 to G.33 were determined following the rules presented in the Risk Methods Document. These rules are as follows:

1. If results from fewer than five samples are available, then the EPC is the maximum detected concentration.

2. If results from more than five but fewer than ten samples are available, then the data was assumed to be log normally distributed, and the EPC was the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean of the log normal distribution.

3. If results from more than 10 samples are available, then a distribution check was performed, and the EPC was the lesser of the maximum detected concentration and the 95% UCL on the mean of the appropriate distribution. Data found to be not normally distributed were assumed to be log normally distributed. The distribution check was performed using the Wilkes-Shapiro test in the Univariate Procedure in the Statistical Analysis System (SAS 1990).

The equations used to calculate the 95% UCL values are presented below. The equations were taken from Risk Methods Document. Equation 1 is used for normally distributed data, and Equation 2 is used for log normally distributed data.

Deleted: .

$$95\%\ \text{UCL} = \overline{X} + t(s/\sqrt{n}) \qquad \textbf{Eq. 1}$$

where: 95% UCL = upper confidence limit (95%) of the normal distribution
$\bar{x}$ = mean of all values, including nondetects
t = Student-t statistic (e.g., from standard statistical tables)
s = standard deviation of all values, including nondetects
n = number of observations

$$95\%\ \text{UCL} = e^{(\bar{x}+0.5s^2+sH\sqrt{n-1})} \qquad \textbf{Eq. 2}$$

where: 95% UCL = upper confidence limit (95%) of the log normal distribution
$\bar{x}$ = mean of transformed values, including nondetects
s = standard deviation of transformed values, including nondetects
H = H-statistic (e.g., from standard statistical tables)
n = number of observations

Deleted: 06-064(E)/041406

G3.4.2 Chronic Daily Intakes

All exposure estimates in this BHHRA represent normalized exposure rates that are evaluated for sources of uncertainty such as variability in data, modeling results, and/or parameter assumptions. Specifically, in this BHHRA, the exposure estimates are an estimation of the reasonable maximum exposure (RME) that can be expected to occur under current or future site conditions. An RME estimate is a conservative estimate of exposure that falls within the upper bound of the range of all possible exposure estimates. In situations where populations are exposed through multiple pathways, RME estimates are calculated for both individual and multiple pathways.

Consistent with the Risk Methods Document, the focus of the exposure assessment for this BHHRA is to determine chronic intake or dose. The chronic exposure estimate is used because it allows for estimation of health consequences that result from long-term or unrestricted exposure to contaminants.

Deleted: Page Break

Using the human exposure models, conceptual site model, and the EPCs, the CDIs of each of the COPCs were determined. These CDIs are presented in Tables G.34 through G.45. In this presentation, the chronic daily intakes used to estimate HI (i.e., noncarcinogenic effects) are presented first, and the values used to estimate ELCR follow. Within each of these broader classifications, CDIs are presented by receptor and exposure route.

Deleted: 8

Deleted: 2

As indicated in Section G.3.4.1, the EPCs for COPCs in groundwater under current conditions were determined before the intake models were used to calculate the chronic daily intakes used in the risk calculations. EPCs derived from sampling data were used to determine current and potential future risks at the four source locations and for the SW plume in general. The calculation of these EPCs did not account for potential decreases or increases in COPC concentrations over time. EPCs used to determine potential future risks at three points of exposure (i.e., plant boundary, property boundary, and Ohio River) were developed from modeling (see Section 2).

G3.5 SUMMARY OF EXPOSURE ASSESSMENT

Consistent with the data collected during the SI, the receptor selected for assessment is the residential groundwater user. Exposure routes for this receptor, which include both a child and adult cohort, are ingestion of groundwater as a drinking water source, dermal contact with groundwater while showering, inhalation of volatiles in groundwater while showering, and inhalation of volatiles in groundwater during household use.

Deleted: 06-064(E)/041406

Table G.34. Chronic daily intakes (carcinogenic) for all Southwest Plume RGA groundwater COPCs

Deleted: 8

COPC	Exposure Point Concentration[a]	Exposure Route-Chronic Daily Intake[b] Ingestion Intake - Cancer	Dermal Intake - Cancer	Shower Inhalation Intake - Cancer	Household Inhalation Intake - Cancer
Inorganic Chemicals (Metals)					
Aluminum	2.40E+00	4.56E-02	7.77E-05		
Arsenic	3.46E-03	6.57E-05	1.12E-07		
Barium	1.75E-01	3.33E-03	5.67E-06		
Chromium	8.49E-02	1.61E-03	2.74E-06		
Cobalt	2.30E-02	4.36E-04	7.42E-07		
Copper	1.98E-02	3.76E-04	6.41E-07		
Iron	2.63E+01	4.99E-01	8.49E-04		
Manganese	1.34E+00	2.54E-02	4.33E-05		
Molybdenum	5.98E-02	1.13E-03	1.93E-06		
Nickel	1.67E-01	3.17E-03	5.41E-06		
Selenium	3.94E-03	7.47E-05	1.27E-07		
Silicon	1.73E+01	3.28E-01			
Uranium	3.50E-01	6.64E-03	1.13E-05		
Vanadium	1.91E-02	3.62E-04	6.16E-07		
Zinc	1.38E-01	2.61E-03	4.45E-06		
Organic Compounds					
Acetone	4.90E-02	9.30E-04	9.03E-07	3.30E-04	2.39E-03
Benzene	1.60E-02	3.04E-04	1.09E-05	1.08E-04	7.80E-04
Bromodichloromethane	1.00E-03	1.90E-05	1.87E-07	6.73E-06	4.87E-05
Bromomethane	3.87E-03	7.35E-05	4.38E-07	2.61E-05	1.89E-04
Carbon Tetrachloride	2.45E-02	4.65E-04	1.74E-05	1.65E-04	1.19E-03
Chloroform	2.73E-02	5.17E-04	7.84E-06	1.83E-04	1.33E-03
Chloromethane	1.00E-02	1.90E-04	1.36E-06	6.73E-05	4.87E-04
Dibromochloromethane	2.00E-03	3.80E-05	2.52E-07	1.35E-05	9.75E-05
Dichloroethane, 1,2-	9.17E-02	1.74E-03	1.57E-05	6.17E-04	4.47E-03
Dichloroethylene, 1,1-	1.86E-02	3.54E-04	5.36E-06	1.25E-04	9.09E-04
Dichloroethylene, 1,2-*cis*-	4.53E-02	8.61E-04	1.47E-05	3.05E-04	2.21E-03
Dichloroethylene, 1,2-*trans*-	4.10E-02	7.78E-04	1.46E-06	2.76E-04	2.00E-03
Methylene Chloride	6.63E-02	1.26E-03	9.64E-06	4.46E-04	3.23E-03
Propanol, 2-	7.30E-02	1.38E-03	2.10E-06	4.91E-04	3.56E-03
Tetrachloroethylene	4.00E-03	7.59E-05	4.78E-05	2.69E-05	1.95E-04
Trichloroethylene	5.01E-01	9.51E-03	2.59E-04	3.37E-03	2.44E-02
Vinyl Chloride	3.16E-02	5.99E-04	7.45E-06	2.12E-04	1.54E-03
Radionuclides					
Neptunium-237	1.59E+00	4.12E+04			
Technetium-99	1.70E+02	4.39E+06			
Thorium-230	2.07E-01	5.35E+03			
Uranium-234	4.08E+01	1.06E+06			
Uranium-238	4.21E+01	1.09E+06			

Blank cells indicate that the exposure route is not appropriate to the COPC.
[a] Units for metals and organic compounds are mg/L. Units for radionuclides are pCi/L.
[b] Units for intakes for metals and organic compounds are mg/(kg-day). Units for intakes for radionuclides are pCi.

Deleted: 06-064(E)/041406

Table G.35. Chronic daily intakes (noncarcinogenic-child) for all Southwest Plume RGA groundwater COPCs

Deleted: 9

COPC	Exposure Point Concentration[a]	Exposure Route-Chronic Daily Intake[b] Ingestion Intake - Hazard	Dermal Intake - Hazard	Shower Inhalation Intake - Hazard	Household Inhalation Intake - Hazard
Inorganic Chemicals (Metals)					
Aluminum	2.40E+00	1.59E-01	2.29E-04		
Arsenic	3.46E-03	2.29E-04	3.30E-07		
Barium	1.75E-01	1.16E-02	1.67E-05		
Chromium	8.49E-02	5.61E-03	8.08E-06		
Cobalt	2.30E-02	1.52E-03	2.19E-06		
Copper	1.98E-02	1.31E-03	1.89E-06		
Iron	2.63E+01	1.74E+00	2.50E-03		
Manganese	1.34E+00	8.86E-02	1.28E-04		
Molybdenum	5.98E-02	3.95E-03	5.69E-06		
Nickel	1.67E-01	1.11E-02	1.59E-05		
Selenium	3.94E-03	2.60E-04	3.75E-07		
Silicon	1.73E+01	1.14E+00			
Uranium	3.50E-01	2.31E-02	3.33E-05		
Vanadium	1.91E-02	1.26E-03	1.82E-06		
Zinc	1.38E-01	9.10E-03	1.31E-05		
Organic Compounds					
Acetone	4.90E-02	3.24E-03	2.66E-06	1.77E-03	1.28E-02
Benzene	1.60E-02	1.06E-03	3.20E-05	5.78E-04	4.19E-03
Bromodichloromethane	1.00E-03	6.61E-05	5.52E-07	3.61E-05	2.62E-04
Bromomethane	3.87E-03	2.56E-04	1.29E-06	1.40E-04	1.01E-03
Carbon Tetrachloride	2.45E-02	1.62E-03	5.13E-05	8.85E-04	6.41E-03
Chloroform	2.73E-02	1.80E-03	2.31E-05	9.85E-04	7.13E-03
Chloromethane	1.00E-02	6.61E-04	4.00E-06	3.61E-04	2.62E-03
Dibromochloromethane	2.00E-03	1.32E-04	7.43E-07	7.22E-05	5.23E-04
Dichloroethane, 1,2-	9.17E-02	6.07E-03	4.63E-05	3.31E-03	2.40E-02
Dichloroethylene, 1,1-	1.86E-02	1.23E-03	1.58E-05	6.73E-04	4.88E-03
Dichloroethylene, 1,2-*cis*-	4.53E-02	3.00E-03	4.32E-05	1.64E-03	1.19E-02
Dichloroethylene, 1,2-*trans*-	4.10E-02	2.71E-03	4.30E-06	1.48E-03	1.07E-02
Methylene Chloride	6.63E-02	4.38E-03	2.84E-05	2.39E-03	1.73E-02
Propanol. 2-	7.30E-02	4.83E-03	6.18E-06	2.64E-03	1.91E-02
Tetrachloroethylene	4.00E-03	2.65E-04	1.41E-04	1.44E-04	1.05E-03
Trichloroethylene	5.01E-01	3.31E-02	7.64E-04	1.81E-02	1.31E-01
Vinyl Chloride	3.16E-02	2.09E-03	2.19E-05	1.14E-03	8.26E-03

Blank cells indicate that the exposure route is not appropriate to the COPC.
CDIs for radionuclides are not presented because they are not pertinent to the hazard endpoint.
[a] Units for metals and organic compounds are mg/L.
[b] Units for intakes for metals and organic compounds are mg/(kg-day).

Deleted: 06-064(E)/041406

Table G.36. Chronic daily intakes (noncarcinogenic-adult) for all Southwest Plume RGA groundwater COPCs

Deleted: 40

COPC	Exposure Point Concentration[a]	Exposure Route-Chronic Daily Intake[b]			
		Ingestion Intake - Hazard	Dermal Intake - Hazard	Shower Inhalation Intake - Hazard	Household Inhalation Intake - Hazard
Inorganic Chemicals (Metals)					
Aluminum	2.40E+00	6.58E-02	1.20E-04		
Arsenic	3.46E-03	9.49E-05	1.72E-07		
Barium	1.75E-01	4.80E-03	8.72E-06		
Chromium	8.49E-02	2.33E-03	4.22E-06		
Cobalt	2.30E-02	6.29E-04	1.14E-06		
Copper	1.98E-02	5.43E-04	9.86E-07		
Iron	2.63E+01	7.20E-01	1.31E-03		
Manganese	1.34E+00	3.67E-02	6.66E-05		
Molybdenum	5.98E-02	1.64E-03	2.97E-06		
Nickel	1.67E-01	4.58E-03	8.32E-06		
Selenium	3.94E-03	1.08E-04	1.96E-07		
Silicon	1.73E+01	4.73E-01			
Uranium	3.50E-01	9.59E-03	1.74E-05		
Vanadium	1.91E-02	5.22E-04	9.48E-07		
Zinc	1.38E-01	3.77E-03	6.84E-06		
Organic Compounds					
Acetone	4.90E-02	1.34E-03	1.39E-06	3.67E-04	2.66E-03
Benzene	1.60E-02	4.38E-04	1.67E-05	1.20E-04	8.67E-04
Bromodichloromethane	1.00E-03	2.74E-05	2.88E-07	7.48E-06	5.42E-05
Bromomethane	3.87E-03	1.06E-04	6.74E-07	2.90E-05	2.10E-04
Carbon Tetrachloride	2.45E-02	6.71E-04	2.68E-05	1.83E-04	1.33E-03
Chloroform	2.73E-02	7.47E-04	1.21E-05	2.04E-04	1.48E-03
Chloromethane	1.00E-02	2.74E-04	2.09E-06	7.48E-05	5.42E-04
Dibromochloromethane	2.00E-03	5.48E-05	3.88E-07	1.50E-05	1.08E-04
Dichloroethane, 1,2-	9.17E-02	2.51E-03	2.42E-05	6.86E-04	4.97E-03
Dichloroethylene, 1,1-	1.86E-02	5.11E-04	8.25E-06	1.39E-04	1.01E-03
Dichloroethylene, 1,2-*cis*-	4.53E-02	1.24E-03	2.25E-05	3.39E-04	2.46E-03
Dichloroethylene, 1,2-*trans*-	4.10E-02	1.12E-03	2.24E-06	3.07E-04	2.22E-03
Methylene Chloride	6.63E-02	1.82E-03	1.48E-05	4.96E-04	3.59E-03
Propanol, 2-	7.30E-02	2.00E-03	3.23E-06	5.46E-04	3.95E-03
Tetrachloroethylene	4.00E-03	1.10E-04	7.36E-05	2.99E-05	2.17E-04
Trichloroethylene	5.01E-01	1.37E-02	3.99E-04	3.75E-03	2.72E-02
Vinyl Chloride	3.16E-02	8.65E-04	1.15E-05	2.36E-04	1.71E-03

Blank cells indicate that the exposure route is not appropriate to the COPC.
CDIs for radionuclides are not presented because they are not pertinent to the hazard endpoint.
[a] Units for metals and organic compounds are mg/L.
[b] Units for intakes for metals and organic compounds are mg/(kg-day).

Deleted: 06-064(E)/041406

Table G.37. Chronic daily intakes (carcinogenic) for RGA groundwater COPCs at SWMU 1

COPC	Exposure Point Concentration[a]	Exposure Route-Chronic Daily Intake[b]: Ingestion Intake - Cancer	Dermal Intake - Cancer	Shower Inhalation Intake - Cancer	Household Inhalation Intake - Cancer	Household Inhalation Intake – Intake - Cancer from Vapor Intrusion
		Inorganic Chemicals (Metals)				
Arsenic	4.36E-03	8.27E-05	1.41E-07			
Barium	4.62E-01	8.77E-03	1.49E-05			
Chromium	2.97E-02	5.64E-04	9.60E-07			
Cobalt	2.11E-01	4.00E-03	6.82E-06			
Iron	5.57E+00	1.06E-01	1.80E-04			
Manganese	3.97E+00	7.53E-02	1.28E-04			
Nickel	1.47E-01	2.79E-03	4.75E-06			
Zinc	3.15E-02	5.98E-04	1.02E-06			
		Organic Compounds				
1,1-Dichloroethene	7.00E-04	1.33E-05	2.01E-07	4.71E-06	3.41E-05	
Chloroform	3.20E-03	6.07E-05	9.20E-07	2.15E-05	1.56E-04	1.30E-02
Trichloroethene	7.80E-01	1.48E-02	4.03E-04	5.25E-03	3.80E-02	
cis-1,2-Dichloroethene	6.70E-02	1.27E-03	2.17E-05	4.51E-04	3.27E-03	1.33E-03
		Radionuclides				
Technetium-99	2.39E+01	6.18E+05				

Blank cells indicate that the exposure route is not appropriate to the COPC.
[a] Units for metals and organic compounds are mg/L. Units for radionuclides are pCi/L.
[b] Units for intakes for metals and organic compounds are mg/(kg-day). Units for intakes for radionuclides are pCi.

Margin comments (Table G.37)

Deleted: 41
Deleted: Dermal Intake - Car… [11]
Deleted: 1.41E-07
Deleted: 1.49E-05
Deleted: 9.60E-07
Deleted: 6.82E-06
Deleted: 1.80E-04
Deleted: 1.28E-04
Deleted: 4.75E-06
Deleted: 1.02E-06
Deleted: 2.01E-07 ... [12]
Deleted: 9.20E-07 ... [13]
Deleted: 4.03E-04 ... [14]
Deleted: 2.17E-05 ... [15]

Table G.38. Chronic daily intakes (noncarcinogenic-child) for RGA groundwater COPCs at SWMU 1

COPC	Exposure Point Concentration	Exposure Route-Chronic Daily Intake: Ingestion Intake - Hazard	Dermal Intake - Hazard	Shower Inhalation Intake - Hazard	Household Inhalation Intake - Hazard	Household Inhalation Intake – Hazard from Vapor Intrusion
		Inorganic Chemicals (Metals)				
Arsenic	4.36E-03	2.88E-04	4.15E-07			
Barium	4.62E-01	3.06E-02	4.40E-05			
Chromium	2.97E-02	1.96E-03	2.83E-06			
Cobalt	2.11E-01	1.40E-02	2.01E-05			
Iron	5.57E+00	3.68E-01	5.30E-04			
Manganese	3.97E+00	2.63E-01	3.78E-04			
Nickel	1.47E-01	9.72E-03	1.40E-05			
Zinc	3.15E-02	2.08E-03	3.00E-06			
		Organic Compounds				
1,1-Dichloroethene	7.00E-04	4.63E-05	5.93E-07	2.53E-05	1.83E-04	
Chloroform	3.20E-03	2.12E-04	2.71E-06	1.16E-04	8.37E-04	

Margin comments (Table G.38)

Deleted: 42
Formatted Table
Deleted: Dermal Intake - Ha… [16]
Formatted: Highlight
Formatted Table
Deleted: 4.15E-07
Deleted: 4.40E-05
Deleted: 2.83E-06
Deleted: 2.01E-05
Deleted: 5.30E-04
Deleted: 3.78E-04
Deleted: 1.40E-05
Deleted: 3.00E-06
Formatted Table
Deleted: 5.93E-07 ... [17]
Deleted: 2.71E-06 ... [18]
Deleted: 06-064(E)/041406

Trichloroethene	7.80E-01	5.16E-02	1.19E-03	2.82E-02	2.04E-01	1.30E-01
cis-1,2-Dichloroethene	6.70E-02	4.43E-03	6.38E-05	2.42E-03	1.75E-02	1.32E-02

Blank cells indicate that the exposure route is not appropriate to the COPC.
CDIs for radionuclides are not presented because they are not pertinent to the hazard endpoint.
[a] Units for metals and organic compounds are mg/L.
[b] Units for intakes for metals and organic compounds are mg/(kg-day).

Table G.39. Chronic daily intakes (noncarcinogenic-adult) for RGA groundwater COPCs at SWMU 1

COPC	Exposure Point Concentration[a]	Exposure Route-Chronic Daily Intake[b]: Ingestion Intake - Hazard	Dermal Intake - Hazard	Shower Inhalation Intake - Hazard	Household Inhalation Intake - Hazard	Household Inhalation Intake – Hazard from Vapor Intrusion
		Inorganic Chemicals (Metals)				
Arsenic	4.36E-03	1.19E-04	2.17E-07			
Barium	4.62E-01	1.27E-02	2.30E-05			
Chromium	2.97E-02	8.14E-04	1.48E-06			
Cobalt	2.11E-01	5.78E-03	1.05E-05			
Iron	5.57E+00	1.53E-01	2.77E-04			
Manganese	3.97E+00	1.09E-01	1.97E-04			
Nickel	1.47E-01	4.03E-03	7.31E-06			
Zinc	3.15E-02	8.63E-04	1.57E-06			
		Organic Compounds				
1,1-Dichloroethene	7.00E-04	1.92E-05	3.10E-07	5.24E-06	3.79E-05	
Chloroform	3.20E-03	8.77E-05	1.42E-06	2.39E-05	1.73E-04	
Trichloroethene	7.80E-01	2.14E-02	6.21E-04	5.84E-03	4.23E-02	2.68E-02
cis-1,2-Dichloroethene	6.70E-02	1.84E-03	3.33E-05	5.01E-04	3.63E-03	2.74E-03

Blank cells indicate that the exposure route is not appropriate to the COPC.
CDIs for radionuclides are not presented because they are not pertinent to the hazard endpoint.
[a] Units for metals and organic compounds are mg/L.
[b] Units for intakes for metals and organic compounds are mg/(kg-day).

- **Deleted:** 1.19E-03
- **Deleted:** 2.82E-02
- **Deleted:** 2.04E-01
- **Deleted:** 6.38E-05
- **Deleted:** 2.42E-03
- **Deleted:** 1.75E-02
- **Deleted:** 43
- **Deleted:** Dermal Intake - Hazard
- **Deleted:** Shower Inhalation Intake - Hazard
- **Deleted:** Household Inhalation Intake - Hazard
- **Formatted:** Highlight
- **Deleted:** 2.17E-07
- **Deleted:** 2.30E-05
- **Deleted:** 1.48E-06
- **Deleted:** 1.05E-05
- **Deleted:** 2.77E-04
- **Deleted:** 1.97E-04
- **Deleted:** 7.31E-06
- **Deleted:** 1.57E-06
- **Deleted:** 3.10E-07
- **Deleted:** 5.24E-06
- **Deleted:** 3.79E-05
- **Deleted:** 4.23E-02
- **Deleted:** 1.42E-06
- **Deleted:** 2.39E-05
- **Deleted:** 1.73E-04
- **Deleted:** 6.21E-04
- **Deleted:** 5.84E-03
- **Deleted:** 3.33E-05
- **Deleted:** 5.01E-04
- **Deleted:** 3.63E-03
- **Deleted:** 06-064(E)/041406

Table G.40. Chronic daily intakes (carcinogenic) for RGA groundwater COPCs at the C-720 Building area

COPC	Exposure Point Concentration[a]	Ingestion Intake - Cancer	Dermal Intake - Cancer	Shower Inhalation Intake - Cancer	Household Inhalation Intake - Cancer	Household Inhalation Intake – Cancer from Vapor Intrusion
		Exposure Route-Chronic Daily Intake[b]				
		Inorganic Chemicals (Metals)				
Arsenic	4.26E-03	8.08E-05	1.38E-07			
Barium	4.22E-01	8.01E-03	1.36E-05			
Chromium	3.80E-01	7.21E-03	1.23E-05			
Cobalt	2.86E-02	5.43E-04	9.24E-07			
Copper	5.50E-02	1.04E-03	1.78E-06			
Iron	3.12E+01	5.92E-01	1.01E-03			
Manganese	4.25E+00	8.06E-02	1.37E-04			
Nickel	7.01E-01	1.33E-02	2.27E-05			
		Organic Compounds				
1,1-Dichloroethene	5.40E-02	1.02E-03	1.55E-05	3.63E-04	2.63E-03	
Trichloroethene	7.38E-01	1.40E-02	3.82E-04	4.97E-03	3.60E-02	1.68E-03
Vinyl chloride	2.10E-03	3.98E-05	4.95E-07	1.41E-05	1.02E-04	9.75E-04
cis-1,2-Dichloroethene	3.10E-02	5.88E-04	1.00E-05	2.09E-04	1.51E-03	3.55E-04
trans-1,2-Dichloroethene	1.40E-02	2.66E-04	4.98E-07	9.42E-05	6.82E-04	8.81E-05
		Radionuclides				
Technetium-99	9.34E+01	2.42E+06				

Blank cells indicate that the exposure route is not appropriate to the COPC.
[a] Units for metals and organic compounds are mg/L. Units for radionuclides are pCi/L.
[b] Units for intakes for metals and organic compounds are mg/(kg-day). Units for intakes for radionuclides are pCi.

Table G.41. Chronic daily intakes (noncarcinogenic-child) for RGA groundwater COPCs at the C-720 Building area

COPC	Exposure Point Concentration[a]	Ingestion Intake - Hazard	Dermal Intake - Hazard	Shower Inhalation Intake - Hazard	Household Inhalation Intake - Hazard	Household Inhalation Intake – Hazard from Vapor Intrusion
		Exposure Route-Chronic Daily Intake[b]				
		Inorganic Chemicals (Metals)				
Arsenic	4.26E-03	2.82E-04	4.06E-07			
Barium	4.22E-01	2.79E-02	4.02E-05			
Chromium	3.80E-01	2.51E-02	3.62E-05			
Cobalt	2.86E-02	1.89E-03	2.72E-06			
Copper	5.50E-02	3.64E-03	5.24E-06			
Iron	3.12E+01	2.06E+00	2.97E-03			
Manganese	4.25E+00	2.81E-01	4.05E-04			
Nickel	7.01E-01	4.64E-02	6.68E-05			
		Organic Compounds				
1,1-Dichloroethene	5.40E-02	3.57E-03	4.58E-05	1.95E-03	1.41E-02	
Trichloroethene	7.38E-01	4.88E-02	1.12E-03	2.67E-02	1.93E-01	1.67E-02
Vinyl chloride	2.10E-03	1.39E-04	1.46E-06	7.58E-05	5.49E-04	9.70E-03

Deleted: ¶
Deleted: 4
Deleted: Dermal Intake - Car ... [19]
Formatted: Highlight
Formatted Table
Deleted: 1.38E-07
Deleted: 1.36E-05
Deleted: 1.23E-05
Deleted: 9.24E-07
Deleted: 1.78E-06
Deleted: 1.01E-03
Deleted: 1.37E-04
Deleted: 2.27E-05
Deleted: 1.55E-05 ... [20]
Formatted Table
Deleted: 3.82E-04 ... [21]
Deleted: 4.95E-07 ... [22]
Deleted: 1.00E-05 ... [23]
Deleted: 4.98E-07 ... [24]
Formatted Table
Deleted: 5
Deleted: Dermal Intake - Haz ... [25]
Formatted: Highlight
Deleted: 4.06E-07
Deleted: 4.02E-05
Deleted: 3.62E-05
Deleted: 2.72E-06
Deleted: 5.24E-06
Deleted: 2.97E-03
Deleted: 4.05E-04
Deleted: 6.68E-05
Deleted: 4.58E-05 ... [26]
Deleted: 1.12E-03 ... [27]
Deleted: 1.46E-06 ... [28]
Deleted: 06-064(E)/041406

cis-1,2-Dichloroethene	3.10E-02	2.05E-03	2.95E-05	1.12E-03	8.11E-03	3.53E-03
trans-1,2-Dichloroethene	1.40E-02	9.26E-04	1.47E-06	5.06E-04	3.66E-03	8.81E-04

Blank cells indicate that the exposure route is not appropriate to the COPC.
CDIs for radionuclides are not presented because they are not pertinent to the hazard endpoint.
[a] Units for metals and organic compounds are mg/L.
[b] Units for intakes for metals and organic compounds are mg/(kg-day).

Table G.42. Chronic daily intakes (noncarcinogenic-adult) for RGA groundwater COPCs at the C-720 Building area

		Exposure Route-Chronic Daily Intake[b]				
COPC	Exposure Point Concentration[a]	Ingestion Intake - Hazard	Dermal Intake - Hazard	Shower Inhalation Intake - Hazard	Household Inhalation Intake - Hazard	Household Inhalation Intake – Hazard from Vapor Intrusion
		Inorganic Chemicals (Metals)				
Arsenic	4.26E-03	1.17E-04	2.12E-07			
Barium	4.22E-01	1.16E-02	2.10E-05			
Chromium	3.80E-01	1.04E-02	1.89E-05			
Cobalt	2.86E-02	7.84E-04	1.42E-06			
Copper	5.50E-02	1.51E-03	2.73E-06			
Iron	3.12E+01	8.55E-01	1.55E-03			
Manganese	4.25E+00	1.16E-01	2.11E-04			
Nickel	7.01E-01	1.92E-02	3.49E-05			
		Organic Compounds				
1,1-Dichloroethene	5.40E-02	1.48E-03	2.39E-05	4.04E-04	2.93E-03	
Trichloroethene	7.38E-01	2.02E-02	5.87E-04	5.52E-03	4.00E-02	3.47E-03
Vinyl chloride	2.10E-03	5.75E-05	7.62E-07	1.57E-05	1.14E-04	2.01E-03
cis-1,2-Dichloroethene	3.10E-02	8.49E-04	1.54E-05	2.32E-04	1.68E-03	7.30E-04
trans-1,2-Dichloroethene	1.40E-02	3.84E-04	7.66E-07	1.05E-04	7.59E-04	1.83E-04

Blank cells indicate that the exposure route is not appropriate to the COPC.
CDIs for radionuclides are not presented because they are not pertinent to the hazard endpoint.
[a] Units for metals and organic compounds are mg/L.
[b] Units for intakes for metals and organic compounds are mg/(kg-day).

Table G.43. Chronic daily intakes (carcinogenic) for RGA groundwater COPCs at the storm sewer

		Exposure Route-Chronic Daily Intake[b]			
COPC	Exposure Point Concentration[a]	Ingestion Intake - Cancer	Dermal Intake - Cancer	Shower Inhalation Intake - Cancer	Household Inhalation Intake - Cancer
		Organic Compounds			
1,1-Dichloroethene	1.00E-04	1.90E-06	2.88E-08	6.73E-07	4.87E-06
Trichloroethene	1.00E-02	1.90E-04	5.17E-06	6.73E-05	4.87E-04

Blank cells indicate that the exposure route is not appropriate to the COPC.
[a] Units for organic compounds are mg/L.
[b] Units for intakes for organic compounds are mg/(kg-day).

Deleted: 2.95E-05 ... [29]
Deleted: 1.47E-06 ... [30]
Deleted: 6
Deleted: Dermal Intake - Haz ... [31]
Formatted: Highlight
Deleted: 2.12E-07
Deleted: 2.10E-05
Deleted: 1.89E-05
Deleted: 1.42E-06
Deleted: 2.73E-06
Deleted: 1.55E-03
Deleted: 2.11E-04
Deleted: 3.49E-05
Deleted: 2.39E-05 ... [32]
Deleted: 5.87E-04 ... [33]
Deleted: 7.62E-07 ... [34]
Deleted: 1.54E-05 ... [35]
Deleted: 7.66E-07 ... [36]
Formatted: Highlight
Formatted: Highlight
Deleted: Table G.47. Chronic daily intakes (carcinogenic) for RGA groundwater COPCs at SWMU 4¶ COPC ... [37]
Formatted ... [38]
Deleted: 50
Deleted: 06-064(E)/041406

Table G.44. Chronic daily intakes (noncarcinogenic-child) for RGA groundwater COPCs at the storm sewer

Deleted: Page Break

Deleted: 51

COPC	Exposure Point Concentration[a]	Exposure Route-Chronic Daily Intake[b]			
		Ingestion Intake - Hazard	Dermal Intake - Hazard	Shower Inhalation Intake - Hazard	Household Inhalation Intake - Hazard
Organic Compounds					
1,1-Dichloroethene	1.00E-04	6.61E-06	8.48E-08	3.61E-06	2.62E-05
Trichloroethene	1.00E-02	6.61E-04	1.52E-05	3.61E-04	2.62E-03

Blank cells indicate that the exposure route is not appropriate to the COPC.
CDIs for radionuclides are not presented because they are not pertinent to the hazard endpoint.
[a] Units for organic compounds are mg/L.
[b] Units for intakes for organic compounds are mg/(kg-day).

Table G.45. Chronic daily intakes (noncarcinogenic-adult) for RGA groundwater COPCs at the storm sewer

Deleted: 2

COPC	Exposure Point Concentration[a]	Exposure Route-Chronic Daily Intake[b]			
		Ingestion Intake - Hazard	Dermal Intake - Hazard	Shower Inhalation Intake - Hazard	Household Inhalation Intake - Hazard
Organic Compounds					
1,1-Dichloroethene	1.00E-04	2.74E-06	4.43E-08	7.48E-07	5.42E-06
Trichloroethene	1.00E-02	2.74E-04	7.96E-06	7.48E-05	5.42E-04

Blank cells indicate that the exposure route is not appropriate to the COPC.
CDIs for radionuclides are not presented because they are not pertinent to the hazard endpoint.
[a] Units for organic compounds are mg/L.
[b] Units for intakes for organic compounds are mg/(kg-day).

G.4 TOXICITY ASSESSMENT

This section summarizes the potential toxicological effects of the COPCs on exposed populations. Many of the toxicological summaries were obtained from information drawn from the *Risk Assessment Information System* (RAIS) prepared by the Toxicology and Risk Analysis Section of Oak Ridge National Laboratory for DOE (DOE 2004b). This site also lists toxicity values taken from the EPA's Integrated Risk Information System (IRIS) database (EPA 2004a), National Center for Environmental Assessment (NCEA), and Health Effects Assessment Summary Tables (HEAST) database (EPA 2000). This list formed the basis of the toxicity values reported in this section. For those chemicals not profiled in RAIS, a brief summary of information drawn from Agency for Toxic Substances and Disease Registry (ATSDR) or other library research sources is included in this section. The last paragraph of each profile contains the toxicity values used in this BHHRA.

The toxicity information considered in the assessment of potential carcinogenic risks includes (1) a weight-of-evidence classification and (2) a slope factor. The weight-of-evidence classification qualitatively describes the likelihood that an agent is a human carcinogen, based on the available data from animal and human studies. A chemical may be placed in one of three groups to indicate its potential for carcinogenic effects: Group A, a known human carcinogen; Group B, a probable human carcinogen;

Deleted: 06-064(E)/041406

and Group C, a possible human carcinogen. Group B is divided into Subgroups B1 and B2. Assignment of a chemical to Subgroup B1 indicates that the judgment that the chemical is a probable human carcinogen is based on limited human data, and assignment of a chemical to Subgroup B2 indicates that the judgment that the chemical is a probable human carcinogen is based on animal data because human data are lacking or inadequate. Chemicals that cannot be classified as human carcinogens because of a lack of data are categorized in Group D, and those for which there is evidence of noncarcinogenicity in humans are categorized in Group E.

The slope factor for chemicals is defined as a plausible upperbound estimate of the probability of a response (i.e., development of cancer) per unit intake of a chemical over a lifetime (EPA 1989a). Slope factors are specific for each chemical and route of exposure. Slope factors currently are available for ingestion and inhalation pathways. The slope factors used for oral and inhalation routes of exposure for the COPCs considered in this report are shown in Table G.46.

Toxicity values used in risk calculations also include the chronic RfD, which is used to estimate the potential for systemic toxicity or noncarcinogenic risk. The chronic RfD is defined as an estimate of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime. (EPA 1989a). RfD values are specific to the route of exposure. The RfDs used for oral and inhalation routes of exposure for the COPCs considered in this report are presented in Table G.47.

For the dermal routes of exposure (i.e., dermal exposure to contaminated water during swimming or bathing or dermal contact with contaminated soil), it is necessary to consider the absorbed dose received by a receptor. This is reflected by the addition of an absorption coefficient in the equations used to calculate the CDI for these pathways. Because the CDI is expressed as an absorbed dose, it is necessary to use RfDs and slope factors that also are expressed in terms of absorbed dose. Currently, EPA has not produced lists of RfDs and slope factors based on absorbed dose. EPA, however, has produced guidance concerning the estimation of absorbed dose RfDs and slope factors from administered dose RfDs and slope factors. This guidance is found in *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)* (EPA 2004b) and states that to convert an administered dose slope factor to an absorbed dose slope factor, the administered dose slope factor is divided by the GI absorption efficiency of the contaminant. Alternatively, to convert an administered dose RfD to an absorbed dose RfD, the administered dose RfD is multiplied by the GI absorption efficiency of the contaminant. The absorbed dose slope factors and RfDs and the information used in their derivation are presented in Tables G.48 and G.49, respectively.

Deleted: 53

Deleted: 54

Deleted: 55

Deleted: 56

Deleted: 06-064(E)/041406

Table G.46. Toxicity values for chronic exposure to carcinogens via the ingestion and inhalation exposure routes

Deleted: 53

COPC[a]	Class (J)	Oral Slope Factor[b]	Oral Slope Factor Source[c]	Oral Unit Risk[d]	Inhalation Slope Factor[e]	Inhalation Slope Factor Source[c]	Inhalation Unit Risk[f]	Types of Cancers
			Inorganic Chemicals (Metals)					
Aluminum	D							
Arsenic	A	1.50E+00	a	5.00E-05	1.50E+01	a	4.30E-03	Respiratory system tumors
Barium	D							
Chromium	D,A				4.20E+01	a,u	1.20E-02	Lung tumors
Cobalt	NA							
Copper	D							
Iron	NA							
Manganese	D							
Molybdenum	NA							
Nickel	NA							
Selenium	D							
Silicon								
Uranium	NA							
Vanadium	NA							
Zinc	D							
			Organic Compounds					
1,1-Dichloroethene	C	6.00E-01	a	1.70E-05	1.75E-01	a,u	5.00E-05	Kidney, adenocarcinoma
1,2-Dichloroethane	B2	9.10E-02	a	2.60E-06	9.10E-02	w	2.6-E-05	Adenocarcinoma, sarcomas of spleen, liver, pancreas, and mammary gland
1,2-Dichloroethene, *cis-*	D							
1,2-Dichloroethene, *trans-*	D							
2-Propanol	NA							
Acetone	D							
Benzene	A	5.50E-02	a	1.60E-06	2.73E-02	a,u	7.80E-06	Leukemia, tumors of skin, lung, ovaries, and mammary gland
Bromodichloromethane	B2	6.20E-02	a	1.80E-06	6.20E-02	ex		Liver, kidney, and intestinal cancer
Bromomethane	D							
Carbon Tetrachloride	B2	1.30E-01	a	3.70E-06	5.25E-02	a.u	1.50E-05	Liver tumors
Chloroform	B2	6.10E-03	a	1.70E-07	8.05E-02	a,u	2.30E-05	Colon, bladder, rectum, and liver carcinoma

Deleted: 53

Table G.46. Toxicity values for chronic exposure to carcinogens via the ingestion and inhalation exposure routes (continued)

COPC[a]	Class (J)	Oral Slope Factor[b]	Oral Slope Factor Source[c]	Oral Unit Risk[d]	Inhalation Slope Factor[e]	Inhalation Slope Factor Source[c]	Inhalation Unit Risk[f]	Types of Cancers
Chloromethane	C	1.30E-02	b	3.70E-07	6.30E-03	b	1.80E-06	Kidney tumors
Dibromochloromethane	C	8.40E-02	a	2.40E-06	8.40E-02	ex		Kidney tumors
Methylene Chloride	B2	7.50E-03	a	2.10E-07	1.65E-03	a,u	4.70E-07	Liver hepatocellular carcinoma and neoplastic nodule
Tetrachloroethene	NA	5.20E-02	v	1.50E-06	2.00E-03	v	5.80E-07	Leukemia and liver cancer
Trichloroethene	NA	1.10E-02	x	3.20E-07	6.00E-03	x	1.70E-06	Liver and lung cancer
Vinyl Chloride	A	1.40E+00	a	4.20E-05	3.08E-02	a,u	8.80E-05	Liver, lung, digestive, track, and brain tumors
				Radionuclides				
	ICRP[g] Lung Class (I)							
Neptunium-237	W	6.74E-11	b		1.77E-08	b		Various
Technetium-99	W	2.75E-12	b		1.41E-11	b		Various
Thorium-230	Y	9.10E-11	b		2.85E-08	b		Various
Uranium-234	Y	7.07E-11	b		1.14E-08	b		Various
Uranium-238	Y	8.71E-11	b		9.35E-09	b		Various

Note: Blank cells indicate that data are not available or are not appropriate.
[a] All COPCs are listed.
[b] The units for the oral slope factors are $(\text{mg/kg} \times \text{day})^{-1}$ for nonradionuclides and Risk/pCi for radionuclides.
[c] Source codes are defined as follows:
a Source: *Integrated Risk Information System* (IRIS)
b Source: *Health Effects Assessment Summary Tables* (HEAST)
ex Value is extrapolated from the oral slope factor.
u The inhalation slope factor was calculated from inhalation unit risk as described in *RAGS: Region 4 Bulletins, Human Health Risk Assessment (Interim Guidance)* (November 1995).
v A provisional value provided to DOE's Oak Ridge Operations by EPA's Superfund Health Risk Technical Support Center.
w This value was withdrawn from IRIS or HEAST but is used in the assessment per guidance in the Risk Methods Document.
x A provision value from EPA National Center for Environmental Assessment (NCEA).
[d] The units for the oral unit risks are (L/µg).
[e] The units for the inhalation slope factors are $\text{mg/kg} \times \text{day})^{-1}$ for nonradionuclides and Risk/pCi for radionuclides.
[f] The units for inhalation unit risks are m^3/µg.
[g] International Commission on Radiological Protection

Deleted: *and Environmental Affects*

Table G.47. Toxicity values for chronic exposure to noncarcinogens via the ingestion and inhalation exposure routes

Deleted: 54

COPC[a]	Oral Reference Dose[b]	Oral Reference Dose Source[c]	Inhalation Reference Dose[d]	Inhalation Reference Concentration[e]	Inhalation Reference Concentration Source[c]	RfD basis (vehicle)[f]	Target Organ Critical Effect[g]	Confidence Level[h]	Uncertainty Factor/Modifying Factor[i]
Inorganic Chemicals (Metals)									
Aluminum	1.00E+00	x	1.40E-03	5.00E-03	x	(I)LOAEL (O)LOAEL	Nervous system	(I)Low (O)Low	(I)UF=300 (I)MF=1 (O)UF=100 (O)MF=1
Arsenic	3.00E-04	a				(O)NOAEL/ LOAEL	Skin	Medium	(O)UF=3 (O)MF=1
Barium	7.00E-02	a	1.43E-04	5.00E-04	b	(I)NOEL (O)NOAEL	Fetus, baritosis	(I)NA) (O)Medium	(I)UF=1000 (I)MF=1 (O)UF=3 (O)MF=1
Chromium	1.50E+00	a				NOAEL	GI, lungs	Low	(O)UF=100 (O)MF=10
Cobalt	6.00E-02	x				LOAEL	Blood	Low	(O)UF=10 (O)MF=1
Copper	3.70E-02	b				NA	GI, liver, kidney	NA	NA
Iron	3.00E-01	x				NA	NA	NA	NA
Manganese	2.4 E-02	a	1.43E-05	5.00E-05	a	(I)LOAEL (O)NOAEL	CNS	(I)Medium (O)Medium	(I)UF=1000 (I)MF=1 (O)UF=1 (O)MF=1
Molybdenum	5.00E-03	a				LOAEL	Uric acid levels	Medium	(O)UF=30 (O)MF=1
Nickel	2.00E-02	a				NOAEL/ LOAEL	Decreased organ and body weight	Medium	(O)UF=300 (O)MF=1
Selenium	5.00E-03	a				NOAEL/ LOAEL	Lungs (selenosis)	High	(O)UF=3 (O)MF=1
Silicon						NA	NA	NA	NA
Uranium	6.00E-04	a,e				LOAEL	Kidney	NA	(O)UF=100 (O)MF=1
Vanadium	7.00E-03	b				NOAEL	Kidney, liver	NA	(O)UF=100 (O)MF=1
Zinc	3.00E-01	a				LOAEL	Lung, GI	Medium	(O)UF=3 (O)MF=1
Organic Compounds									
1,1-Dichloroethene	9.00E-03	a	9.00E-03	3.15E-02	ex	LOAEL	Liver	Medium	(O)UF=1000 (O)MF=1

Deleted: 54

Table G.47. Toxicity values for chronic exposure to noncarcinogens via the ingestion and inhalation exposure routes (continued)

COPC[a]	Oral Reference Dose[b]	Oral Reference Dose Source[c]	Inhalation Reference Dose[d]	Inhalation Reference Concentration[e]	Inhalation Reference Concentration Source[c]	RfD basis (vehicle)[f]	Target Organ Critical Effect[g]	Confidence Level[h]	Uncertainty Factor/Modifying Factor[i]
1,2-Dichloroethane	3.00E-02	x	1.40E-03	4.90E-03	x	NA	NA	NA	NA
1,2-Dichloroethene, *cis*-	1.00E-02	b	1.00E-02	3.49E-02	ex	NOAEL	Blood	Low	(O)UF=3000 (O)MF=1
1,2-Dichloroethene, *trans*-	2.00E-02	a	2.00E-02	6.98E-02	ex	NOAEL/ LOAEL	Blood	Low	(O)UF=1000 (O)MF=1
2-Propanol						NA	NA	NA	NA
Acetone	1.00E-01	a	1.00E-01	3.50E-01	ex	NOAEL	Kidney, liver	Medium	(O)UF=1000 (O)MF=1
Benzene	3.00E-03	x	1.69E-03	5.93E-03	x	(I)BMCL (O)BMDL	Blood	(I)Medium (O)Medium	(I)UF=300 (I)MF=1 (O)UF=300 (O)MF=1
Bromodichloromethane	2.00E-02	a	2.00E-02	6.98E-02	ex	LOAEL	Kidney	Medium	(O)UF=1000 (O)MF=1
Bromomethane	1.40E-03	a	1.40E-03	5.00E-03	a	(I)LOAEL (O)NOAEL/ LOAEL	Respiratory system, stomach	(I)High (O)Medium	(I)UF=100 (I)MF=1 (O)UF=1000 (O)MF=1
Carbon Tetrachloride	7.00E-04	a	7.00E-04	2.44E-03	ex	NOAEL/ LOAEL	Liver	Medium	(O)UF=1000 (O)MF=1
Chloroform	1.00E-02	a	8.75E-05	3.00E-04	x	LOAEL	Liver	Medium	(O)UF=1000 (O)MF=1
Chloromethane			2.57E-02	9.00E-02	a	NOAEL/ LOAEL	CNS	Medium	(I)UF=1000 (I)MF=1
Dibromochloromethane	2.00E-01	a	2.00E-01	7.00E-02	ex	(O)NOEL/ LOAEL	Liver	Medium	(O)UF=1000 (O)MF=1
Methylene Chloride	6.00E-02	a	8.57E-01	3.00E+00	b	(I)NOAEL (O)NOAEL/ LOAEL	Liver	(I)NA (O)Medium	(I)UF=100 (I)MF=1 (O)UF=100 (O)MF=1
Tetrachloroethene	1.00E-02	a	1.71E-01	6.00E-01	v	(I)BMC (O)NOAEL/ LOAEL	Kidney	(I)Medium (O)Medium	(I)UF=30 (I)MF=1 (O)UF=1000 (O)MF=1

Table G.47. Toxicity values for chronic exposure to noncarcinogens via the ingestion and inhalation exposure routes (continued)

Deleted: 54

COPC[a]	Oral Reference Dose[b]	Oral Reference Dose Source[c]	Inhalation Reference Dose[d]	Inhalation Reference Concentration[e]	Inhalation Reference Concentration Source[c]	RfD basis (vehicle)[f]	Target Organ Critical Effect[g]	Confidence Level[h]	Uncertainty Factor/Modifying Factor[i]
Trichloroethene	6.00E-03	v	6.00E-03	2.09E-02	ex	NA	Liver, kidney, CNS	NA	NA
Vinyl Chloride	3.00E-03	a	2.86E-02	1.00E-01	a	(I)NOAEL/ LOAEL (O)NOAEL/ LOAEL	Liver, kidney, CNS	Medium	(I)UF=30 (I)MF=1 (O)UF=3 (I)MF=1

Notes: Blank cells indicate that data are not available or are not appropriate. NA=information not readily available at this time; GI=gastrointestinal; CNS=central nervous system; UF=uncertainty factor; MF=modifying factor

[a] All COPCs are listed.

[b] The units for the oral reference doses are mg/(kg × day).

[c] Source codes are defined as follows:

a Source: *Integrated Risk Information System* (IRIS)

b Source: *Health Effects Assessment Summary Tables* (HEAST)

Deleted: *and*

Deleted: *Environmental Affects*

e Also see Soil Screening Guidance for Radionuclides: User's Guide.

ex Value is extrapolated from the oral reference dose.

u The inhalation slope factor was calculated from inhalation unit risk as described in *RAGS: Region 4 Bulletins, Human Health Risk Assessment (Interim Guidance)* (November 1995).

v A provisional value provided to DOE's Oak Ridge Operations by EPA's Superfund Health Risk Technical Support Center.

w This value was withdrawn from IRIS or HEAST but is used in the assessment per guidance in the Risk Methods Document.

x A provision value from EPA National Center for Environmental Assessment (NCEA).

[d] The units for the inhalation reference doses are mg/(kg × day).

[e] The units for the inhalation reference concentrations are mg/m^3.

[f] Or=oral; Inh=inhalation.

[g] GI=gastrointestinal tract; CNS=central nervous system.

[h] O=oral; I=inhalation; NA=not available.

[i] O=oral; I=inhalation; UF=uncertainty factor; MF=modifying factor; NA=not available.

Table G.48. Toxicity values for chronic exposure to carcinogens via the dermal and external exposure routes

Deleted: 55

COPC[a]	Oral Slope Factor[b]	GI Absorption Factor	Absorbed Slope Factor[c]
Inorganic Chemicals (Metals)			
Aluminum		0.10	
Arsenic	1.50E+00	0.41	3.66E+00
Barium		0.07	
Chromium		0.005	
Cobalt		0.80	
Copper		0.30	
Iron		0.15	
Manganese		0.04	
Molybdenum		0.38	
Nickel		0.27	
Selenium		0.44	
Silicon			
Uranium		0.85	
Vanadium		0.01	
Zinc		0.20	
Organic Compounds			
1,1-Dichloroethene	6.00E-01	1.00	6.00E-01
1,2-Dichloroethane	9.10E-02	1.00	9.10E-02
1,2-Dichloroethene, *cis-*		1.00	
1,2-Dichloroethene, *trans-*		1.00	
2-Propanol			
Acetone		0.83	
Benzene	5.50E-02	0.97	5.67E-02
Bromodichloromethane	6.20E-02	0.98	6.33E-02
Bromomethane		0.80	
Carbon Tetrachloride	1.30E-01	0.65	2.00E-01
Chloroform	6.10E-03	0.20	3.05E-02
Chloromethane	1.30E-02	0.80	1.63E-02
Dibromochloromethane	8.40E-02	0.60	1.40E-01
Methylene Chloride	7.50E-03	0.95	7.89E-03
Tetrachloroethene	5.20E-02	1.00	5.20E-02
Trichloroethene	1.10E-02	0.15	7.33E-02
Vinyl Chloride	1.40E+00	1.00	1.40E+00
Radionuclides			
			External Exposure Slope Factor[d]
Neptunium-237	6.74E-11	0.001	7.97E-07
Technetium-99	2.75E-12	0.80	8.14E-11
Thorium-230	9.10E-11	0.0002	8.19E-10
Uranium-234	7.07E-11	0.05	2.52E-10
Uranium-238	8.71E-11	0.05	1.14E-07

Note: Blank cells indicate that data are not available or are not appropriate.

[a] All COPCs are listed.

[b] The units for these oral slope factors are $(mg/kg \times d)^{-1}$ for nonradionuclides and (Risk/pCi) for radionuclides.

[c] The units for these absorbed dose slope factors are $(mg/kg \times d)^{-1}$ for nonradionuclides. Absorbed cancer slope factors are calculated by dividing the administered cancer slope factor by GI absorption factor; this value is used in the BHHRA to calculate contribution to cancer risk from dermal exposure.

[d] The units for these external exposure slope factors are ((Risk × g)/(pCi × yr)) for radionuclides. Each of these values is from HEAST.

Deleted: 06-064(E)/041406

Table G.49. Toxicity values for chronic exposure to noncarcinogens via the dermal contact exposure route

Deleted: 56

COPC[a]	Oral Reference Dose[b]	GI Absorption Factor	Absorbed Reference Dose[c]
Inorganic Chemicals (Metals)			
Aluminum	1.00E+00	0.10	1.00E-01
Arsenic	3.00E-04	0.41	1.23E-04
Barium	7.00E-02	0.07	4.90E-03
Chromium	1.50E+00	0.02	7.50E-03
Cobalt	6.00E-02	0.80	4.80E-02
Copper	3.70E-02	0.30	1.11E-02
Iron	3.00E-01	0.15	4.50E-02
Manganese	2.40E-02	0.04	9.60E-04
Molybdenum	5.00E-03	0.38	1.90E-03
Nickel	2.00E-02	0.27	5.40E-03
Selenium	5.00E-03	0.44	2.20E-03
Silicon			
Uranium	6.00E-04	0.85	5.10E-04
Vanadium	7.00E-03	0.01	7.00E-05
Zinc	3.00E-01	0.20	6.00E-02
Organic Compounds			
1,1-Dichloroethene	9.00E-03	1.00	9.00E-03
1,2-Dichloroethane	3.00E-02	1.00	3.00E-02
1,2-Dichloroethene, *cis-*	1.00E-02	1.00	1.00E-02
1,2-Dichloroethene, *trans-*	2.00E-02	1.00	2.00E-02
2-Propanol			
Acetone	1.00E-01	0.83	8.30E-02
Benzene	3.00E-03	0.97	2.91E-03
Bromodichloromethane	2.00E-02	0.98	1.96E-02
Bromomethane	1.40E-03	0.80	1.12E-03
Carbon Tetrachloride	7.00E-04	0.65	4.55E-04
Chloroform	1.00E-02	0.20	2.00E-03
Chloromethane		0.80	
Dibromochloromethane	2.00E-02	0.60	1.20E-02
Methylene Chloride	6.00E-02	0.95	5.70E-02
Tetrachloroethene	1.00E-02	1.00	1.00E-02
Trichloroethene	6.00E-03	0.15	9.00E-04
Vinyl Chloride	3.00E-03	1.00	3.00E-03

Note: Blank cells indicate that data are not available or are not appropriate

[a] All COPCs are listed.

[b] The units for the oral reference doses are mg/(kg × day).

[c] The units for the absorbed doses are mg/(kg × day). The absorbed reference doses are calculated by multiplying the administered reference dose by the GI absorption factor; this value is used in the BHHRA to calculate contribution to systemic toxicity from dermal exposure.

Deleted: 06-064(E)/041406

G4.1 INORGANIC COMPOUNDS

G4.1.1 Aluminum (CAS 000742-90-05) (RAIS)

Aluminum is a silver-white, flexible metal with a vast number of uses. It makes up about 8% of the earth's crust. The aluminum content of seawater ranges from 3 to 2400 µg/L. Aluminum metal is used as a structural material in the construction, automotive, and aircraft industries; in the production of metal alloys; and in the electrical industry in power lines, insulated cables and wiring. Other uses of aluminum metal include cooking utensils, decorations, fencing, highway signs, cans, food packaging, foil, and dental crowns and dentures. Aluminum powder is used in paints and fireworks, and natural aluminum minerals are used in water purification, sugar refining, and in the brewing and paper industries. Aluminum borate is used in the production of glass and ceramics, and aluminum chloride is used to make rubber, lubricants, wood preservatives, and cosmetics. Aluminum chlorohydrate is the active ingredient in antiperspirants and deodorants, while aluminum hydroxide is used as a pharmaceutical to lower plasma phosphorus levels of patients with kidney failure. Until recently, aluminum has existed in forms not available to humans and most other species. However, acid rain has increased the availability of aluminum to biological systems and has resulted in destructive effects to fish and plant species. It is unknown if humans are susceptible to this increased bioavailability. It is poorly absorbed and efficiently eliminated; however, when absorption does occur, aluminum is distributed mainly in bone, liver, testes, kidneys, and brain. Aluminum may be involved in Alzheimer's disease (dialysis dementia) and in Amyotrophic Lateral Sclerosis and Parkinsonism-Dementia Syndromes of Guam. Aluminum content of brain, muscle, and bone increases in Alzheimer's patients. Neurofibrillary tangles are found in patients suffering from aluminum encephalopathy and Alzheimer's disease. Symptoms of "dialysis dementia" include speech disorders, dementia, convulsions, and myoclonus. Neurological effects also have been observed in rats orally exposed to aluminum compounds.

The respiratory system appears to be the primary target following inhalation exposure to aluminum. Alveolar proteinosis has been observed in guinea pigs, rats, and hamsters exposed to aluminum powders. Rats and guinea pigs exposed to aluminum chlorohydrate exhibited an increase in alveolar macrophages, increased relative lung weight, and multifocal granulomatous pneumonia. Male rats exposed to aluminum (as aluminum chloride) via gavage for 6 months exhibited decreased spermatozoa counts and sperm motility, and testicular histological and histochemical changes. Male rats exposed to drinking water containing aluminum (as aluminum potassium sulfate) for a lifetime exhibited increases in unspecified malignant and nonmalignant tumors, and similarly exposed female mice exhibited an increased incidence of leukemia. Rats and guinea pigs exposed via inhalation to aluminum chlorohydrate developed lung granulomas, while granulomatous foci developed in similarly exposed male hamsters.

Aluminum has been placed in the EPA weight-of-evidence classification D, not classifiable as to human carcinogenicity. No slope factors, therefore, were used in this BHHRA.

Chronic RfDs have not been officially released by EPA in IRIS or HEAST. However, oral and inhalation RfDs of 1.00E+00 and 1.40E-03 mg/(kg × day), respectively, were used in the BHHRA based on a provisional value from NCEA. The GI absorption factor is 10 % and the corresponding absorbed dose reference dose is 1.00E-01 mg/(kg × day).

G4.1.2 Arsenic (CAS 007440-38-2) (RAIS)

Arsenic is a naturally occurring element widely distributed in the earth's crust. In the environment, arsenic is combined with oxygen, chlorine, and sulfur to form inorganic arsenic compounds. Arsenic in animals and plants combines with carbon and hydrogen to form organic arsenic compounds. Inorganic

Deleted: 06-064(E)/041406

arsenic compounds are mainly used to preserve wood. Organic arsenic compounds are used as pesticides, primarily on cotton plants. Arsenic cannot be destroyed in the environment. It can only change its form. Arsenic in air will settle to the ground or is washed out of the air by rain. Many arsenic compounds can dissolve in water. Fish and shellfish can accumulate arsenic, but the arsenic in fish is mostly in a form that is not harmful. The toxicity of inorganic arsenic depends on its valence state and also on the physical and chemical properties of the compound in which it occurs.

Water soluble inorganic arsenic compounds are absorbed through the GI tract and lungs; distributed primarily to the liver, kidney, lung, spleen, aorta, and skin; and excreted mainly in the urine at rates as high as 80%. Symptoms of acute inorganic arsenic poisoning in humans are nausea, anorexia, vomiting, epigastric and abdominal pain, and diarrhea. Dermatitis (exfoliative erythroderma), muscle cramps, cardiac abnormalities, hepatotoxicity, bone marrow suppression and hematologic abnormalities (anemia), vascular lesions, and peripheral neuropathy (motor dysfunction, paresthesia) also have been reported. Oral doses as low as 20-60 g/kg/day have been reported to cause toxic effects in some individuals. Severe exposures can result in acute encephalopathy, congestive heart failure, stupor, convulsions, paralysis, coma, and death. The acute lethal dose to humans has been estimated to be about 0.6 mg/kg/day.

General symptoms of chronic arsenic poisoning in humans are weakness, general debility and lassitude, loss of appetite and energy, loss of hair, hoarseness of voice, loss of weight, and mental disorders. Primary target organs are the skin (hyperpigmentation and hyperkeratosis), nervous system (peripheral neuropathy), and vascular system. Anemia, leukopenia, hepatomegaly, and portal hypertension also have been reported. In addition, possible reproductive effects include a high male to female birth ratio.

Epidemiological studies have revealed an association between arsenic concentrations in drinking water and increased incidences of skin cancers, as well as cancers of the liver, bladder, respiratory, and GI tracts. Occupational exposure studies have shown a clear correlation between exposure to arsenic and lung cancer mortality. Several studies have shown that inorganic arsenic can increase the risk of lung cancer, skin cancer, bladder cancer, liver cancer, kidney cancer, and prostate cancer. The World Health Organization (WHO), the Department of Health and Human Services (DHHS), and the EPA have determined that inorganic arsenic is a human carcinogen and is classified: A, human carcinogen.

Cancer slope factors for arsenic are available from EPA's IRIS. The values used in the BHHRA are 1.50E+00, 1.50E+01, and 3.66E+00 $[mg/(kg \times day)]^{-1}$ for the oral, inhalation, and dermal exposure routes, respectively. The slope factor for the dermal exposure route was calculated by assuming a GI absorption factor of 41%.

Chronic RfDs for arsenic also are available in EPA's IRIS. The values used in the BHHRA were 3.00E-04 and 1.23E-04 mg/(kg × day) for the oral and dermal routes, respectively. The dermal RfD was calculated by assuming a GI absorption factor of 41%.

G4.1.3 Barium (CAS 007440-39-3) (RAIS)

Barium is a divalent, alkaline-earth metal found only in combination with other elements in nature. The most important of these combinations are peroxide, chloride, sulfate, carbonate, nitrate, and chlorate. The pure metal oxidizes readily and reacts with water emitting hydrogen. The most likely source of barium in the atmosphere is from industrial emissions. Barium compounds are used by the oil and gas industries to make drilling muds. Drilling muds make it easier to drill through rock by keeping the drill bit lubricated. They also are used to make paint, bricks, tiles, glass, and rubber. A barium compound (barium sulfate) is sometimes used by doctors to perform medical tests and to take barium x-rays of the stomach. Since it is usually present as a particulate form, it can be removed from the atmosphere by wet

Deleted: 06-064(E)/041406

precipitation and deposition. Due to the element's tendency to form salts with limited solubility in soil and water, it is expected to have a residence time of hundreds of years and is not expected to be very mobile. Trace amounts of barium were found in more than 99% of the surface waters and finished drinking water samples across the United States.

The soluble salts of barium are toxic in mammalian systems. They are absorbed rapidly from the GI tract and are deposited in the muscles, lungs, and bone. Inhalation exposure of human populations to barium-containing dust can result in a benign pneumoconiosis called "baritosis." At low doses, barium acts as a muscle stimulant and at higher doses affects the nervous system eventually leading to paralysis. Acute and subchronic oral doses of barium cause vomiting and diarrhea, followed by decreased heart rate and elevated blood pressure. Higher doses result in cardiac irregularities, weakness, tremors, anxiety, and dyspnea. A drop in serum potassium may account for some of the symptoms. Death can occur from cardiac and respiratory failure. Acute doses around 0.8 grams can be fatal to humans.

The DHHS, the International Agency for Research (IARC) on Cancer, and the EPA have not classified barium as to its human carcinogenicity. No slope factors were used in this BHHRA for barium.

Chronic oral and inhalation RfDs for barium are available from EPA's IRIS and HEAST, respectively. The values used in the BHHRA are 7.00E-02, 1.43E-04, and 4.90E-03 mg/(kg × day) for the oral, inhalation, and dermal routes, respectively. The dermal RfD was calculated assuming a GI absorption factor of 7 %.

G4.1.4 Chromium III (CAS 16065-83-1) and Chromium VI (CAS 18540-29-9) (RAIS)

Elemental chromium does not occur in nature, but it is present in ores, primarily chromite. Chromium can be found in rocks, animals, plants, soil, and in volcanic dust and gases. Chromium is present in the environment in several different forms (oxidation states). The most common forms are chromium (0), chromium (III), and chromium (VI). No taste or odor is associated with chromium compounds. Chromium (III) occurs naturally in the environment and is an essential nutrient that helps the body use sugar, protein, and fat. Chromium (VI) and chromium (0) generally are produced by industrial processes. The metal chromium, chromium (0), is used for making steel. Chromium (VI) and chromium (III) are used for chrome plating, dyes and pigments, leather tanning, and wood preserving.

Chromium enters the body through the lungs, digestive tract and, to a lesser extent, the skin. Inhalation is the most important route for occupational exposure. Non-occupational exposure occurs via ingestion of chromium-containing food and water. Breathing high levels of chromium (VI) can cause irritation to the nose, such as runny nose, nosebleeds, and ulcers and holes in the nasal septum. Ingesting large amounts of chromium (VI) can cause stomach upsets and ulcers, convulsions, kidney and liver damage, and even death. Skin contact with certain chromium (VI) compounds can cause skin ulcers. Some people are extremely sensitive to chromium (VI) or chromium (III). Allergic reactions consisting of severe redness and swelling of the skin have been noted.

Several studies have shown that chromium (VI) compounds can increase the risk of lung cancer when inhaled. Animal studies also have shown an increased risk of cancer. There also is evidence for an increased risk of developing nasal, pharyngeal, and GI carcinomas. Based on sufficient evidence for humans and animals, Chromium (VI) has been placed in the EPA weight-of-evidence classification A: human carcinogen. Chromium (III) is most appropriately designated a Group D – Not classified as to its human carcinogenicity; however, the classification of chromium (VI) as a known human carcinogen raises a concern for the carcinogenic potential of trivalent chromium.

Deleted: 06-064(E)/041406

The cancer slope factor for Chromium (VI) from EPA's IRIS was used in the BHHRA. The value used was 4.20E+01 $[mg/(kg \times day)]^{-1}$ for the inhalation route of exposure. Slope factors for the oral and dermal routes of exposure are not available.

Consistent with the Risk Methods Document, the chronic RfDs from EPA's IRIS associated with Chromium (III) were used in the BHHRA. The values used were 1.50E+00 and 7.50E-03 mg/(kg × day) for the oral and dermal routes, respectively. The dermal RfD was calculated by assuming a GI absorption factor of 2 %.

G4.1.5 Cobalt (CAS 007440-48-4) (ATSDR)

Cobalt is a steel-gray, shiny, hard metal that occurs naturally in soil. Cobalt and cobalt-containing compounds are used widely in industry, and cobalt undergoes environmental redistribution through industrial processes, such as the burning of coal and oil and exhaust from cars. Cobalt is a component of Vitamin B_{12}.

Acute exposure to cobalt salts can lead to histological changes in the kidneys, lungs, liver, and adrenal glands. Cobalt is a sensitizer, and many occurrences of cobalt hypersensitivity have been documented in occupationally-exposed individuals. The effects observed among cobalt-exposed workers include allergic dermatitis, eczema, and changes in white blood cells. Chronic inhalation exposure has produced hard-metal pneumoconiosis and other lung diseases in humans, as well as lung damage in experimental animals. Some evidence in humans suggests an association between high levels of cobalt exposure and cardiomyopathy (ATSDR 1990).

When cobalt metal was tested in vitro, a weak mutagenic response was noted, probably due to cobalt complexes that formed. Cobalt has been reported to be genotoxic in other test systems, but antimutagenic in bacteria. Adverse teratogenic and reproductive effects have been observed experimentally in animals; however, teratogenic or reproductive effects have not been reported in humans following oral, dermal, or inhalation exposure to cobalt (Angerer et al. 1988: ATSDR 1990).

EPA has not classified cobalt as to its human carcinogenicity. No slope factors were used in this BHHRA for cobalt.

Chronic RfDs have not been officially released by EPA in IRIS or HEAST. However, oral and dermal reference doses of 6.00E-02 and 4.80E-02 mg/(kg × day), respectively, were used in the BHHRA based on a provisional oral RfD value from NCEA. The GI absorption factor used to calculate the dermal RfD was 80%.

G4.1.6 Copper (CAS 007440-50-8) (RAIS)

Copper is a reddish metal that occurs naturally in the environment in plants and animals. Copper is an essential element for all living things including humans. Copper is extensively mined in the United States and is used to make wire, sheet metal, pipes, and pennies. It also is used in farming to treat some plant diseases; in water treatment; and to preserve wood, leather, and fabrics. Also, because of its high electrical and thermal conductivity and other properties such as malleability, metallic copper is widely used in the manufacture of electrical equipment.

Copper is an essential trace element that is widely distributed in animal and plant tissues. Copper is necessary for good health and can be absorbed by the oral, inhalation, and dermal routes of exposure. Very large doses, however, can be harmful. In humans, ingestion of gram quantities of copper salts may cause GI, hepatic, and renal effects with symptoms such as severe abdominal pain, vomiting, diarrhea,

Deleted: 06-064(E)/041406

hemolysis, hepatic necrosis, hematuria, proteinuria, hypotension, tachycardia, convulsions, coma, and death. Acute inhalation exposure to copper dust or fumes at concentrations of 0.075-0.12 mg Cu/m3 may cause metal fume fever with symptoms such as cough, chills and muscle ache. Skin contact with copper can result in an allergic reaction, usually skin irritation or a skin rash.

No suitable bioassays or epidemiological studies are available to assess the carcinogenicity of copper. U.S. EPA, therefore, has placed copper in weight-of-evidence group D: not classifiable as to human carcinogenicity. No slope factors, therefore, were used in this BHHRA.

Chronic RfDs have not been officially released by EPA in IRIS; therefore, a value from HEAST was used in the BHHRA. The oral and dermal RfDs used were 3.70E-02 and 1.11E-02, respectively. The GI absorption factor used was 30%.

G4.1.7 Iron (CAS 007439-89-6)

Iron is one of the most abundant metals in the environment and is used in many industrial processes. It is an essential element in the human diet. More than 80% of the iron present in the body is involved in the support of red blood cell production. In addition, it is also an essential component of myoglobin and various enzymes. Iron deficiency is the most common cause of anemia (Goodman and Gilman 1985). Exposure to excessive levels of iron may cause GI damage and dysfunction and enlargement of the liver and pancreas (Goodman and Gilman 1985).

Iron has not been classified by EPA with regard to cancer weight-of-evidence. No slope factors were used in this BHHRA.

Chronic RfDs also have not been released by EPA in IRIS or HEAST. However, oral and dermal RfDs of 3.00E-01 and 4.50E-02 mg/(kg × day), respectively, were used in the BHHRA based on a provisional value from NCEA. The GI absorption factor used was 15%.

G4.1.8 Manganese (CAS 007439-96-5) (RAIS)

Manganese is a silver-colored, naturally occurring metal that is found in many types of rocks and makes up about 0.10% of the earth's crust. Manganese is not found alone, but combines with other substances such as oxygen, sulfur, or chlorine. Manganese also can be combined with carbon to make organic manganese compounds, including pesticides (e.g., maneb or mancozeb) and methylcyclopentadienyl manganese tricarbonyl (MMT), a fuel additive in some gasolines. Manganese is an essential trace element and is necessary for good health. Normal nutritional requirements of manganese are satisfied through the diet, which is the normal source of the element, with minor contributions from water and air. The National Research Council recommends a dietary allowance of 2-5 mg/day for a safe and adequate intake of manganese for an adult human. Manganese can be found in several food items, including grains, cereals, and tea.

Manganese can elicit a variety of serious toxic responses upon prolonged exposure to elevated concentrations, either orally or by inhalation. The central nervous system is the primary target. Initial symptoms are headache, insomnia, disorientation, anxiety, lethargy, and memory loss. These symptoms progress with continued exposure and eventually include motor disturbances, tremors, and difficulty in walking, symptoms similar to those seen with Parkinsonism. These motor difficulties are often irreversible. Some individuals exposed to very high levels of manganese for long periods of time at work developed mental and emotional disturbances and slow and clumsy body movements. This combination of symptoms is a disease called "manganism."

Deleted: 06-064(E)/041406

There are no human cancer data available for manganese. Manganese has been placed in the EPA weight-of-evidence classification D: not classifiable as to human carcinogenicity. No slope factors, therefore, were used in this BHHRA.

Chronic RfDs have been released by EPA in IRIS. The oral and inhalation RfDs used in the BHHRA were 2.40E-02 and 1.43E-05 mg/(kg × day), respectively. The GI absorption factor is 4% and the corresponding absorbed dose reference dose is 9.60E-04 mg/(kg × day).

G4.1.9 Molybdenum (CAS 007439-98-7) (RAIS)

Molybdenum occurs naturally in various ores, the most important being molybdenite, which is converted to molybdenum trioxide for use in iron and manganese alloys, chemicals, catalysts, ceramics, and pigments. Metallic molybdenum is used in electronic parts, induction heating elements, and electrodes, and molybdenum disulfide is used as a lubricant. Molybdenum is considered an essential trace element. It functions as an electron transport agent and a cofactor in biological processes. The provisional recommended dietary intake, based on average reported intake, is set at 75-250 g/day for adults and older children.

Water-soluble molybdenum compounds are readily taken up through the lungs and digestive tract, but insoluble compounds are not. Data documenting molybdenum toxicity in humans are limited. The physical and chemical state of molybdenum, the route of exposure, and compounding factors such as dietary copper and sulfur levels may all affect toxicity. In studies conducted in a region of Armenia where levels of molybdenum in the soil are high, some adults were found to have elevated concentrations of uric acid in the blood and urine, increased blood xanthine oxidase activity, and gout-like symptoms such as arthralgia, articular deformities, erythema, and edema. Excessive intake of molybdenum causes a physiological copper deficiency and, conversely, in cases of inadequate dietary intake of copper, molybdenum toxicity may occur at lower exposure levels. Studies of workers chronically exposed to molybdenum indicate a high incidence of weakness, fatigue, headache, irritability, lack of appetite, epigastric pain, joint and muscle pain, weight loss, red and moist skin, tremor of the hands, sweating, and dizziness.

Information on the oral or inhalation carcinogenicity of molybdenum compounds in humans was not available. Molybdenum has not been assigned a cancer weight-of-evidence classification by EPA, and no slope factors for molybdenum were used in this BHHRA.

A chronic RfD for the oral route of exposure from IRIS was used in the BHHRA. The oral RfD and its corresponding dermal RfD were 5.00E-03 and 1.90E-03 mg/(kg × day), respectively. The dermal route RfD is based on a GI absorption factor of 38%.

G4.1.10 Nickel (CAS 007440-02-0 for soluble nickel salts) (RAIS)

Nickel is a very abundant element in the environment. It is found primarily combined with oxygen (oxides) or sulfur (sulfides), found in all soils, and is emitted from volcanoes. Pure nickel is a hard, silvery-white metal that is combined with other metals to form mixtures called alloys. Some of the metals that nickel can be alloyed with are iron, copper, chromium, and zinc. These alloys are used to make metal coins and jewelry and in industry. Nickel compounds also are used for nickel plating, to color ceramics, to make some batteries, and as substances known as catalysts that increase the rate of chemical reactions. Nickel and its compounds have no characteristic odor or taste. Nickel forms included in this profile are nickel carbonyl, CAS number 13463-39-3; nickel refinery dust, no CAS number; nickel subsulfide, CAS number 12035-72-2; and nickel soluble salts, no CAS number.

Deleted: 06-064(E)/041406

Nickel is required to maintain health in animals. A small amount of nickel is probably essential for humans, although a lack of nickel has not been found to affect the health of humans. The absorption of nickel is dependent on its physicochemical form, with water-soluble forms being more readily absorbed. The most common adverse health effect of nickel in humans is an allergic reaction. Humans can become sensitive to nickel when jewelry or other nickel-containing items are in direct contact with the skin. Once a person is sensitized to nickel, further contact will produce a reaction; the most common reaction is a skin rash at the site of contact. Less frequently, some humans who are sensitive to nickel have asthma attacks or other reactions following exposure to nickel in food, water, or dust. Lung effects, including chronic bronchitis and reduced lung function, have been observed in workers who breathed large amounts of nickel. Current levels of nickel in workplace air are much lower than in the past, and today few workers show symptoms of nickel exposure. Humans who are not sensitive to it must eat very large amounts of nickel to show adverse health effects. In large doses (>0.5 g), some forms of nickel may be acutely toxic to humans when taken orally. Workers who accidentally drank water containing very high levels of nickel (100,000 times more than in normal drinking water) had stomachaches and effects on their blood and kidneys.

Epidemiologic studies have shown that occupational inhalation exposure to nickel dust (primarily nickel subsulfide) at refineries has resulted in increased incidences of pulmonary and nasal cancer. Inhalation studies using rats also have shown nickel subsulfide or nickel carbonyl to be carcinogenic. Based on these data, the EPA has classified nickel subsulfide and nickel refinery dust in weight-of-evidence group A; human carcinogen. Based on an increased incidence of pulmonary carcinomas and malignant tumors in animals exposed to nickel carbonyl by inhalation or by intravenous injection, this compound had been placed in weight-of-evidence group B2: probable human carcinogen. The U.S. EPA has not evaluated soluble salts of nickel as a class of compounds for potential human carcinogenicity. Because the form of nickel of concern to this BHHRA was soluble salts, no slope factors were used in this BHHRA.

Chronic RfDs from EPA's IRIS were available for nickel. The RfDs used in the BHHRA for the oral and dermal routes of exposure were 2.00E-02 and 5.40E-03 mg/(kg × day), respectively. The dermal route RfD was based on a GI absorption factor of 27%.

G4.1.11 Selenium (CAS 007782-49-2) (RAIS)

Selenium is a metal commonly found in rocks and soil; much of the selenium in rocks is combined with sulfide minerals or with silver, copper, lead, and nickel minerals. Selenium and oxygen combine to form several compounds. Selenium sulfide is a bright red-yellow powder used in anti-dandruff shampoo. Industrially produced hydrogen selenide is a colorless gas with a disagreeable odor. It is probably the only selenium compound that might pose a health concern in the workplace. Selenium dioxide is an industrially produced compound that dissolves in water to form selenious acid. Selenious acid can be found in gun bluing (a solution used to clean the metal parts of a gun). Selenium is an essential trace element important in many biochemical processes that take place in human cells. Recommended human dietary allowances for selenium for adults is about 40-70 µg.

In humans, acute oral exposures can result in excessive salivation, garlic odor to the breath, shallow breathing, diarrhea, pulmonary edema, and death. Other reported signs and symptoms of acute selenosis include tachycardia, nausea, vomiting, abdominal pain, abnormal liver function, muscle aches and pains, irritability, chills, and tremors. The exact levels at which these effects occur are not known. GI absorption in animals and humans of various selenium compounds ranges from about 44% to 95% of the ingested dose. If too much selenium is ingested over long periods of time, brittle hair and deformed nails can develop. Upon contact with skin, selenium compounds have caused rashes, swelling, and pain. Respiratory tract absorption rates of 97% and 94% for aerosols of selenious acid have been reported for

Deleted: 06-064(E)/041406

dogs and rats, respectively. In humans, inhalation of selenium or selenium compounds primarily affects the respiratory system. Dusts of elemental selenium and selenium dioxide can cause irritation of the skin and mucous membranes of the nose and throat, coughing, nosebleed, loss of sense of smell, dyspnea, bronchial spasms, bronchitis, and chemical pneumonia.

Studies of laboratory animals and humans show that most selenium compounds probably do not cause cancer. In fact, human studies suggest that lower-than-normal selenium levels in the diet might increase the risk of cancer. Other forms of selenium may, however, be carcinogenic according to the DHHS. Selenium sulfide produced a significant increase in the incidence of lung and liver tumors in rats and mice. EPA has placed selenium and selenious acid in Group D, not classifiable as to carcinogenicity in humans, while selenium sulfide is placed in Group B2, probable human carcinogen. Selenium sulfide is very different from the selenium compounds found in foods and in the environment. Selenium sulfide has not caused cancer in animals when it is placed on the skin, and the use of anti-dandruff shampoos containing selenium sulfide is considered safe.

Chronic RfDs from EPA's IRIS were available for selenium. The RfDs used in the BHHRA for the oral and dermal routes of exposure were 5.00E-03 and 2.20E-03 mg/(kg × day), respectively. The dermal route RfD was based on a GI absorption factor of 44%.

G4.1.12 Silicon (CAS 007440-21-3) (USGS)

Silicon is a light chemical element that combines with oxygen and other elements to form silicates. Silicon in the form of silicates constitutes more than 25% of the earth's crust. Silica as quartz or quartzite is used to produce silicon ferroalloys and silicon metal. Demand for silicon ferroalloys is driven principally by the production of cast iron and steel. Silicon metal, which generally is produced like ferrosilicon in submerged-arc electric furnaces, is used not as a ferroalloy, but rather for alloying with aluminum and for production of chemicals, especially silicones. Small quantities of silicon are processed into high-purity silicon for use in the semiconductor industry. Silicon is used in metallurgical and chemical applications for which different quality products are required.

Metallurgical grade silicon is used for producing alloys with other metals such as aluminum. It has the effect of strengthening and hardening aluminum to improve its suitability and resistance to heat for specific applications. Silicon is used in the production of both primary and secondary alloys where only the highest purity of metallurgical silicon is required to produce primary alloys.

Chemical grade silicon is used in the production of silicone. Silicone is the precursor used in the production of commonly used products such as polishes, lubricants, greases, hydraulic fluids, insulators, semiconductors, adhesives, medical implants, medical and surgical aids, cosmetics, paints, silicon chips, and photovoltaic or solar cells. The major users of chemical grade silicon require product qualities to meet their specific process needs.

Toxicity information for silicon was not available from EPA sources: therefore, neither slope factors nor RfDs were available for use in this BHHRA.

G4.1.13 Uranium (metal and soluble salts) (CAS 007440-61-1)

Uranium is a hard, silvery white amphoteric metal and is a radioactive element. In its natural state it consists of three isotopes: ^{234}U, ^{235}U, and ^{238}U. More than 100 uranium minerals exist; those of commercial importance are the oxides and oxygenous salts. The processing of uranium ore generally involves extraction then leaching either by an acid or a carbonate method. In addition, the metal may be obtained from its halides by fused salt electrolysis. The primary use of natural uranium is in nuclear

Deleted: 06-064(E)/041406

energy as a fuel for nuclear reactors, in plutonium production, and as feeds for gaseous diffusion plants; it is also a source of radium salts. Uranium compounds are used in staining glass, glazing ceramics, and enameling; in photographic processes; for alloying steels; and as a catalyst for chemical reactions, radiation shielding, and aircraft counterweights (Sittig 1981).

The primary route of exposure to uranium metals and salts is through dermal contact. Uranium soluble compounds act as a poison to cause kidney damage under acute exposure and pneumoconiosis or pronounced blood changes under chronic exposure conditions. Furthermore, it is difficult to separate the toxic chemical effects of uranium and its compounds from their radiation effects. The chronic radiation effects are similar to those produced by ionizing radiation. Reports now confirm that carcinogenicity is related to dose and exposure time. Cancer of the lung, osteosarcoma, and lymphoma have all been reported (Sittig 1985). An EPA weight-of-evidence classification for uranium metal was not located in the available literature. Slope factors for uranium metal also were not available for use in the BHHRA.

Chronic RfDs from EPA's IRIS were available for uranium metal. The oral and dermal RfD used in the BHHRA were 6.00E-04 and 5.10E-4 mg/(kg × day), respectively. A GI absorption factor of 85% was used to derive the dermal RfD.

G4.1.14 Vanadium (CAS 007440-62-2 for metal) (RAIS)

Vanadium is a compound that occurs in nature as a white-to-gray metal and is often found as crystals. Pure vanadium has no smell and usually combines with other elements such as oxygen, sodium, sulfur, or chloride, which greatly alter toxicity. Vanadium and vanadium compounds can be found in the earth's crust and in rocks, some iron ores, and crude petroleum deposits. Vanadium is mostly combined with other metals to make special metal mixtures called alloys. Most of the vanadium used in the United States, vanadium oxide, is used to make steel for automobile parts, springs, and ball bearings. Vanadium oxide is a yellow-orange powder, dark-gray flakes, or yellow crystals. Vanadium also is mixed with iron to make important parts for aircraft engines. Small amounts of vanadium are used in making rubber, plastics, ceramics, and other chemicals.

Exposure to high levels of vanadium can cause harmful health effects. Vanadium compounds are poorly absorbed through the digestive system (0.5-2% of dietary amount), but slightly more readily absorbed through the lungs (20-25%). The major effects from breathing high levels of vanadium are on the lungs, throat, and eyes. Workers who breathed it for short and long periods sometimes had lung irritation, coughing, wheezing, chest pain, runny nose, and a sore throat. These effects stopped soon when removed from the contaminated air. Similar effects have been observed in animal studies. No other significant health effects of vanadium have been found in humans. The health effects in humans of ingesting vanadium are not known. Animals that ingested very large doses have died. Lower, but still high, levels of vanadium in the water of pregnant animals resulted in minor birth defects. Some animals that breathed or ingested vanadium over a long term had minor kidney and liver changes.

There is no evidence that any vanadium compound is carcinogenic; however, very few adequate studies are available for evaluation. No increase in tumors was noted in a long-term animal study where the animals were exposed to vanadium in the drinking water. The DHHS, the IARC, and EPA have not classified vanadium as to its human carcinogenicity.

Chronic RfDs from EPA's HEAST were available for vanadium. The RfDs used in the BHHRA for the oral and dermal routes of exposure were 7.00E-03 and 7.00E-05 mg/(kg × day), respectively. The dermal route RfD was based on a GI absorption factor of 1%.

Deleted: 06-064(E)/041406

G4.1.15 Zinc (CAS 007440-66-6 for metal) (RAIS)

Pure zinc is a bluish-white, shiny metal. Zinc is one of the most common elements in the earth's crust and is found in air, soil, and water, and is present in all foods. Zinc has many commercial uses as coatings to prevent rust, in dry -cell batteries, and mixed with other metals to make alloys like brass and bronze. A zinc and copper alloy is used to make pennies in the United States. Zinc combines with other elements to form zinc compounds; common zinc compounds found at hazardous waste sites include zinc chloride, zinc oxide, zinc sulfate, zinc phosphide, zinc cyanide, and zinc sulfide. Zinc compounds are widely used in industry to make paint, rubber, dye, wood preservatives, and ointments.

Zinc is an essential element, with recommended daily allowances (RDAs) ranging from 5 mg for infants to 15 mg for adult males. Too little zinc can cause health problems, but too much zinc also is harmful.

The digestive tract absorbs 20% to 80 % of ingested zinc based on the chemical compound ingested. Harmful health effects generally begin at levels in the 100 to 250 mg/day range. Eating large amounts of zinc, even for a short time, can cause stomach cramps, nausea, and vomiting. Taken longer, it can cause anemia, pancreas damage, and lower levels of high-density lipoprotein cholesterol (the good form of cholesterol). Breathing large amounts of zinc (as dust or fumes) can cause a specific short-term disease called metal fume fever. This is believed to be an immune response affecting the lungs and body temperature. The long-term effects of breathing high levels of zinc or the effects on human reproduction are not known. Rats that were fed large amounts of zinc became infertile or had smaller babies. Irritation also was observed on the skin of rabbits, guinea pigs, and mice when exposed to some zinc compounds. Skin irritation will probably occur in humans.

No case studies or epidemiologic evidence has been presented to suggest that zinc is carcinogenic in humans by the oral or inhalation route. In animal studies, zinc sulfate in drinking water or zinc oleate in the diet of mice for a period of one year did not result in a statistically significant increase in tumors; however, in a 3-year, 5-generation study on tumor-resistant and tumor-susceptible strains of mice, exposure to zinc in drinking water resulted in increased frequencies of tumors. EPA has placed zinc in weight-of-evidence Group D: not classifiable as to human carcinogenicity due to inadequate evidence in humans and animals. There were no slope factors available for zinc in this BHHRA.

Chronic RfDs from EPA's IRIS were available for zinc. The RfDs used in the BHHRA for the oral and dermal routes of exposure were 3.00E-01 and 6.00E-02 mg/(kg × day), respectively. The dermal route RfD was based on a GI absorption factor of 20.

G4.2 ORGANIC COMPOUNDS

G4.2.1 1,1-Dichloroethene (CAS 000075-35-4) (RAIS)

1,1-DCE is an industrial chemical that is not found naturally in the environment. It is a colorless liquid with a mild, sweet smell. Also called 1,1-dichloroethylene, 1,1-DCE is used primarily in the production of polyvinyl chloride (PVC) copolymers and as an intermediate for synthesis of organic chemicals. 1,1-DCE is also used to make certain plastics, such as flexible films like food wrap; used in packaging materials; used to make flame retardant coatings for fiber and carpet backings; and used in piping, coating for steel pipes, and adhesive applications.

The main effect from breathing high levels (approximately 4000 ppm) of 1,1-DCE is on the central nervous system. Breathing high levels of the chemical may cause loss of breath and fainting. Breathing

Deleted: 06-064(E)/041406

lower levels of 1,1-DCE in air for a long time may damage the nervous system, liver, and lungs. Workers exposed to 1,1-DCE have reported a loss in liver function, but other chemicals were present. Animals that breathed high levels of 1,1-DCE had damaged livers, kidneys, and lungs. Animals that ingested high levels of 1,1-DCE had damaged livers, kidneys, and lungs. Spilling 1,1-DCE on skin or in eyes can cause irritation.

Studies on workers who breathed 1,1-DCE have not shown an increase in cancer. These studies, however, are not conclusive because of the small numbers of workers and the short time studied. Animal studies have shown mixed results. Several studies reported an increase in tumors in rats and mice, and other studies reported no such effects. In one inhalation study, statistically significant increases in renal adenocarcinomas were noted in male Swiss mice exposed to 25 ppm for 12 months. Also observed were statistically significant increases in mammary gland carcinomas in females and lung tumors in both sexes. Based on EPA guidelines, 1,1-DCE was assigned to weight-of-evidence group C: possible human carcinogen.

Cancer slope factors for 1,1-DCE are available from EPA's IRIS. The values used in the BHHRA are 6.00E-01, 1.75E-01, and 6.00E-01 $(mg/[kg \times day])^{-1}$ for the oral, inhalation, and dermal exposure routes, respectively. The slope factor for the dermal exposure route was calculated by assuming a GI absorption factor of 100%.

Chronic RfDs for 1,1-DCE are also available from EPA's IRIS. The value used in the BHHRA for the oral, inhalation, and dermal routes were 9.00E-03 mg/(kg × day). The inhalation RfD was extrapolated from the oral RfD and the dermal RfD was derived using a GI absorption factor of 100%.

G4.2.2 1,2-Dichloroethane (CAS 000107-06-2) (RAIS)

1,2-DCA is a manufactured chemical that is not found naturally in the environment. It is clear and has a pleasant smell and a sweet taste. Its most common use today is to make VC and other chemicals and to dissolve grease, glue, and dirt. It also is added to gasoline as a lead-scavenging agent. In the past, 1,2-DCA was used in home products such as cleaning solutions and paint removers.

1,2-DCA is absorbed through the lungs, GI system, and skin. Breathing high levels (75-125 ppm) of 1,2-DCA results in many harmful effects to humans. It causes damage to the heart, central nervous system, liver, kidneys, and lungs. These same effects have been seen with accidentally ingested high levels of the chemical. The effects for humans of breathing or ingesting lower levels of 1,2-DCA over a longer period of time are not known at this time. Studies in animals have found similar nervous system damage and kidney disease from breathing and ingesting the chemical. Other effects in animals include a reduced ability to fight infection. These effects have not been adequately studied in humans. Animal studies show that direct contact with 1,2-DCA can cause damage to the skin and eyes.

The DHHS has determined that 1,2-DCA may reasonably be anticipated to be a carcinogen. Human studies are inconclusive. Several studies have not shown an increase in tumors in workers exposed to 1,2-DCA. One study found an increase in colon and rectal cancer in humans who drank contaminated water, but other chemicals also were present in the water. There is good evidence from animal studies that ingesting large amounts of 1,2-DCA causes an increase in a variety of tumors. In some animal studies, it caused cancer when breathed or absorbed through the skin. 1,2-DCA is classified by EPA in Group B2 as a probable human carcinogen by both the oral and inhalation exposure routes based on animal studies.

Cancer slope factors for 1,2-DCA are available from EPA's IRIS. (The inhalation slope factor is a withdrawn value.) The slope factor used in the BHHRA for the oral, inhalation, and dermal exposure routes is 9.10E-02 $[mg/(kg \times day)]^{-1}$, respectively. The slope factor for the dermal exposure route was calculated by assuming a GI absorption factor of 100%.

Deleted: 06-064(E)/041406

Chronic RfDs for 1,2-DCA are available from EPA's NCEA. The values used in the BHHRA for the oral, inhalation, and dermal routes were 3.00E-02, 1.40E-03, and 3.00E-02 mg/(kg × day), respectively. The dermal RfD was derived using a GI absorption factor of 100%.

G4.2.3 *Cis*- and *trans*-1,2-Dichloroethene (CAS 000156-59-2 and CAS 000156-60-5) (RAIS)

1,2-DCE, also called 1,2-dichloroethylene, is a highly flammable, colorless liquid with a sharp, harsh odor. It is used to produce solvents and in chemical mixtures. Very small amounts of 1,2-DCE may be smelled in air (about 17 ppm). There are two forms of 1,2-DCE: *cis*-1,2-DCE and *trans*-1,2-DCE. Sometimes both forms are present as a mixture. Commercial use is not extensive, but *trans*-1,2-DCE and mixtures of *cis*- and *trans*-1,2-DCE have been used as intermediates in the production of other chlorinated solvents and compounds, as well as low temperature extraction solvents for dyes, perfumes, and lacquers. Additionally, *cis*- and *trans*-1,2-DCE react violently with potassium hydroxide, sodium, and sodium hydroxide and form shock-sensitive explosives when combined with dinitrogen tetraoxide. Both forms of 1,2-DCE are degradation products of TCE.

Humans are exposed to 1,2-DCE primarily by inhalation, but exposure also can occur by oral and dermal routes. Breathing high levels of 1,2-DCE can cause nauseous, drowsiness, and tiredness in humans; very high levels can cause death. Breathing high levels of *trans*-1,2-DCE caused liver and lung damage in animals, and the effects were more severe with longer exposure times. Animals that breathed very high levels of *trans*-1,2-DCE had damaged hearts. Animals that ingested extremely high doses of *cis*- or *trans*-1,2-DCE died. Lower doses of *cis*-1,2-DCE caused effects on the blood, such as decreased numbers of red blood cells, and also on the liver.

No cancer bioassays or epidemiological studies were available to assess the carcinogenicity of 1,2-DCE. EPA has placed both *cis*- and *trans*-1,2-DCE in weight-of-evidence group D: not classifiable as to human carcinogenicity, based on the lack of or negative human or animal cancer data. No cancer slope factors for *cis*- or *trans*-1,2-DCE are available; therefore, carcinogenicity from exposure could not be quantified in the BHHRA.

The oral and dermal chronic RfDs for *cis*-1,2-DCE used in the BHHRA are 1.00E-02 and 1.00E-02 mg/(kg × day), respectively. The oral and dermal chronic RfDs for *trans*-1,2-DCE used in the BHHRA are 2.00E-02 and 2.00E-02 mg/(kg × day), respectively. The oral RfDs for *cis*- and *trans*-1,2-DCE were from EPA's HEAST and IRIS, respectively. Inhalation RfDs used in the BHHRA were extrapolated from the oral RfDs. These inhalation RfDs were 1.00E-02 and 2.00E-02 (mg/kg × day) for *cis*- and *trans*-1,2-DCE, respectively. The dermal RfDs were derived from the oral toxicity value using a GI absorption factor of 100%.

G4.2.4 2-Propanol (CAS000067-63-5)

2-Propanol, or isopropyl alcohol, is a colorless liquid with a pleasant odor. It is highly flammable. Isopropyl alcohol is found in alcohol sponges, cleaning agents, and rubbing alcohol (though some rubbing alcohols contain ethanol), and is a good disinfectant. Most rubbing alcohol contains 70% isopropyl alcohol. Poisoning can occur through skin absorption, oral ingestion, or inhalation. Symptoms from ingestion, inhalation or absorption of large quantities include flushing, headache, dizziness, mental depression, nausea, vomiting, anesthesia, and coma.

Slope factors and RfDs for 2-propanol were not available; therefore, quantitative estimates of carcinogenicity and systemic toxicity due to 2-propanol exposure are not included in the BHHRA.

Deleted: 06-064(E)/041406

G4.2.5 Acetone (CAS 000067-64-1) (RAIS)

Acetone is a clear, colorless, highly flammable liquid. It is completely miscible in water and soluble in organics such as benzene and ethanol. Acetone is used primarily as a solvent and chemical intermediate, and it is also found in some consumer products such as nail polish remover. Acetone may be released into the environment as stack emissions and/or fugitive emissions and in wastewater effluents from facilities involved in its production and use as a chemical intermediate and solvent. Acetone also is a natural metabolic byproduct found in and released from plants and animals. Much of the acetone released into the environment will volatilize into the atmosphere where it will be subject to photo-oxidation (average half-life is 22 days). Volatilization from surface waters is moderately rapid (estimated half-life about 20 hours from a model river). If released onto the ground, acetone both will volatilize and leach into the soil, and relatively little will be adsorbed to soil particles. Acetone has been detected in groundwater and drinking water.

Acetone can be absorbed through the lungs, digestive tract, and the skin. Dermal uptake may occur following prolonged contact with the undiluted liquid. It is rapidly transported throughout the body and is not preferentially stored in any body tissue. The liver is the major organ of acetone metabolism, and excretion occurs mainly through the lungs and in the urine. Acute toxic effects following ingestion of 50 mL or more may include ataxia, sedation, coma; respiratory depression; GI disorders (vomiting and hematemesis); hyperglycemia and ketonemia; acidosis; and hepatic and renal lesions. Typical symptoms of inhalation exposure are central nervous system depression and irritation of the mucous membranes of the eyes, nose, and throat. Central nervous system effects can range from subtle neurobehavioral changes to narcosis depending on the magnitude and length of exposure. The available data indicate that individuals occupationally exposed to acetone may exhibit transient symptoms of toxicity; however, there is little evidence of permanent systemic damage even after many years of exposure.

No evidence is available that suggests acetone is carcinogenic in humans. Acetone is classified by EPA in weight-of-evidence Group D: not classifiable as to human carcinogenicity. There are no carcinogenic slope factors used in the BHHRA for acetone due to a lack of carcinogenic toxicity information.

A chronic oral RfD for acetone is available from EPA's IRIS. The value used in the BHHRA for the oral and inhalation routes was 1.00E-01 mg/(kg × day). The dermal RfD used was 8.30E-02 mg/(kg × day). The inhalation RfD was extrapolated from the oral RfD, and the dermal RfD was derived using a GI absorption factor of 83%.

G4.2.6 Benzene (CAS 000071-43-2) (RAIS)

Benzene is widely used in the United States; it ranks in the top 20 chemicals for production volume. Benzene is a colorless organic liquid with a sweet odor. It evaporates into the air very quickly and dissolves slightly in water. It is highly flammable and is formed from both natural processes and human activities. Benzene is used primarily in the production of other chemicals such as ethylbenzene, cumene, and cyclohexane. Benzene has also been used as a solvent, but this use is declining, coincidental with the replacement of benzene with other organic solvents. Benzene is emitted into the workplace and the environment from industrial and other manmade sources, including gasoline from filling stations, smoking tobacco products, and auto exhaust.

Because of benzene's high vapor pressure, inhalation is the most likely route of exposure to the chemical, particularly in the workplace. Benzene is absorbed via ingestion, inhalation, and skin application. Experimental data indicate that humans can absorb up to 80% of inhaled benzene (after 5 minutes of exposure). Lethal oral doses of benzene are estimated to be 10 mL in humans. Nonlethal oral

Deleted: 06-064(E)/041406

doses of benzene can impact the nervous, hematological, and immunological systems. Ingested and inhaled benzene produces symptoms of neurotoxicity at acute doses of 2 mL for humans. Inhalation of benzene vapor concentrations of 20,000 ppm for 5-10 minutes can be fatal to humans; death results from central nervous system depression.

Benzene is carcinogenic in humans by inhalation and in animals by the oral route of exposure. Occupational exposure to benzene has been associated mainly with increased incidences of acute myeloblastic or erythroblastic leukemias and chronic myeloid and lymphoid leukemias among workers. Studies in animals have demonstrated an association between oral and inhalation exposure to benzene and the development of a variety of tumors, including lymphoma and carcinomas of the Zymbal gland, oral cavity, mammary gland, ovaries, lung, and skin. Benzene has been placed in the EPA weight-of-evidence classification A: human carcinogen.

Cancer slope factors for benzene are available from EPA's IRIS. The slope factors used in the BHHRA for the oral, inhalation, and dermal exposure routes are 5.50E-02, 2.73E-02, and 5.67E-02 $[mg/(kg \times day)]^{-1}$, respectively. The slope factor for the dermal exposure route was calculated by assuming a GI absorption factor of 97 %.

Chronic RfDs for benzene are available from EPA's NCEA. The values used in the BHHRA for the oral, inhalation, and dermal routes were 3.00E-03, 1.69E-03, and 2.91E-03 mg/(kg × day), respectively. The dermal RfD was derived using a GI absorption factor of 97 %.

G4.2.7 Bromodichloromethane (CAS 000075-27-4) (ATSDR)

Bromodichloromethane is a colorless, nonflammable liquid. Small amounts are formed naturally by algae in the oceans. Some of it will dissolve in water, but it readily evaporates into air.

Only small quantities of bromodichloromethane are produced in the United States. The small quantities that are produced are used in laboratories or to make other chemicals. However, most bromodichloromethane is formed as a by-product when chlorine is added to drinking water to kill bacteria.

The most likely way people are exposed to bromodichloromethane is by drinking chlorinated water. Exposure also may occur when inhaling vapors released from chlorinated water in a swimming pool or in the home (cooking, washing dishes, bathing, etc.). Similarly, some bromodichloromethane exposure may occur to your skin when bathing or swimming.

People who live near a waste site containing bromodichloromethane could be exposed by drinking contaminated groundwater or breathing vapors released to the air. People who work at or live near a laboratory or factory that makes or uses this chemical could be exposed by breathing bromodichloromethane in the air.

No studies are available regarding health effects in people exposed to bromodichloromethane. Animal studies indicate that the liver, kidney, and central nervous system are affected by exposure to bromodichloromethane. The effects of high doses on the central nervous system include sleepiness and incoordination. Longer exposure to lower doses causes damage to the liver and kidneys. There is some evidence from animal studies that bromodichloromethane may cause birth defects at doses high enough to make the mother sick. It is not known if lower doses would cause birth defects.

There is evidence that eating or drinking bromodichloromethane causes liver, kidney, and intestinal cancer in rats and mice. The DHHS has determined that bromodichloromethane is reasonably anticipated

Deleted: 06-064(E)/041406

to be a human carcinogen. Bromodichloromethane is classified by EPA in Group B2 as a probable human carcinogen by both the oral route of exposure based on animal studies.

An oral cancer slope factor for bromodichloromethane is available from EPA's IRIS. An inhalation slope factor was extrapolated from the oral slope factor. The slope factors used in the BHHRA for the oral, inhalation, and dermal exposure routes are 6.20E-02, 6.20E-02, and 6.33E-02 $[mg/(kg \times day)]^{-1}$, respectively. The slope factor for the dermal exposure route was calculated by assuming a GI absorption factor of 98%.

A chronic oral RfD for bromodichloromethane is available from EPA's IRIS. An inhalation RfD was extrapolated from the oral RfD. The values used in the BHHRA for the oral, inhalation, and dermal routes were 2.00E-02, 2.00E-02, and 1.96E-02 mg/(kg × day), respectively. The dermal RfD was derived using a GI absorption factor of 98 %.

G4.2.8 Bromomethane (CAS 000074-83-9) (ATSDR)

Bromomethane is a manufactured chemical. It also occurs naturally in small amounts in the ocean where it is formed, probably by algae and kelp. It is a colorless, nonflammable gas with no distinct smell. Other names for bromomethane are methyl bromide, mono-bromomethane, and methyl fume. Trade names include Embafume and Terabol. Bromomethane is used to kill a variety of pests including rats, insects, and fungi. It also is used to make other chemicals or as a solvent to get oil out of nuts, seeds, and wool.

Deleted:

Formatted: Normal

Deleted: also

Bromomethane moves very quickly into the air when released to the environment or when present in soil or water. It breaks down slowly in air over several years and breaks down quickly in soil over a few days. Small amounts can move from the soil into the groundwater. It breaks down in groundwater over a period of several months.

Exposure to bromomethane may occur by breathing the low background levels in the environment, breathing contaminated air with high levels near waste sites, breathing air where it has been used as a pesticide, or breathing workplace air where it is made or used. Exposure through surface water, soil, or food is unlikely.

Breathing bromomethane may cause headache, weakness, and nausea. Breathing large amounts may cause fluid build up in lungs and breathing difficulty. At high dose, it could cause muscle tremors, seizures, kidney damage, nerve damage, and even death.

The respiratory, kidney, and neurologic effects are of the greatest concern to people. No cases of severe effects on the nervous system from long-term exposure to low levels have been noted in people, but studies in rabbits and monkeys have shown moderate to severe injury.

Swallowing bromomethane may cause stomach irritation. If bromomethane gets on human skin, it can cause itching, redness, and blisters. These effects are caused by levels that are higher than levels that are normally encountered.

There are no studies available to indicate that bromomethane is carcinogenic to people. Animal studies do not provide conclusive evidence. The EPA has determined that bromomethane is not classifiable (D) as to its human carcinogenicity; therefore, no cancer slope factors for bromomethane were available for use in the BHHRA.

Deleted: 06-064(E)/041406

Chronic RfDs for bromomethane are available from EPA's IRIS. The values used in the BHHRA for the oral, inhalation, and dermal routes were 1.40E-03, 1.40E-03, and 1.12E-03 mg/(kg × day), respectively. The dermal RfD was derived using a GI absorption factor of 80 %.

Formatted: Bullets and Numbering

G4.2.9 Carbon Tetrachloride (CAS 000056-23-5) (RAIS)

Carbon tetrachloride is a clear liquid with a sweet smell that can be detected at low levels. It is a manufactured organic compound that does not occur naturally; trade names include Benzinoform, Freon 10, Halon 104, Tetraform, or Tetrasol. Carbon tetrachloride is most often found as a colorless gas. It's not flammable and doesn't dissolve in water very easily. It was used in the production of refrigeration fluid and propellants for aerosol cans, as a pesticide, as a cleaning fluid and degreasing agent, in fire extinguishers, and in spot removers. Because of its harmful effects, these uses are now banned, and it is used only in some industrial applications. It can form explosive, impact-sensitive mixtures with particulates of metals including aluminum, barium, beryllium, potassium, lithium, sodium and zinc. Carbon tetrachloride also forms explosive mixtures with chlorine trifluoride, calcium hypochlorite, calcium disilicide, triethyldialuminum trichloride, decaborane, and dinitrogen tetraoxide. It will react violently with fluorine, boranes, allyl alcohol and other related chemicals.

High exposure to carbon tetrachloride by oral, inhalation, or dermal routes can cause liver, kidney, and central nervous system damage. The liver is especially sensitive to carbon tetrachloride because it swells and cells are damaged or destroyed. Kidneys also are damaged, causing a buildup of wastes in the blood. If exposure is low and then stops, the liver and kidneys can repair the damaged cells and function normally again. If exposure is very high, the nervous system, including the brain, is affected. Humans may feel intoxicated and experience headaches, dizziness, sleepiness, and nausea and vomiting. These effects may subside if exposure is stopped, but in severe cases, coma and even death can occur. Although an inhalation exposure of about 1000 ppm for a few minutes to hours will cause the narcotic effects in 100% of the population, large variations in sensitivity are seen. Alcohol intake greatly increases human sensitivity to carbon tetrachloride; consequently, exposure to 250 ppm for 15 minutes can be life threatening to an alcoholic. Subchronic and chronic exposure to doses as low as 10 ppm can result in liver and kidney damage.

Although data for the carcinogenicity of carbon tetrachloride in humans are inconclusive, there is ample evidence in animals that the chemical can cause liver cancer. Hepatocellular carcinomas have been induced in hamsters, rats and mice after oral carbon tetrachloride treatment for 16 to 76 weeks. Liver tumors also have been demonstrated in rats following inhalation exposure, but the doses were not quantitatively established. The EPA weight-of-evidence classification for both oral and inhalation exposure is B2: probable human carcinogen based on adequate animal evidence.

Cancer slope factors for carbon tetrachloride are available from EPA's IRIS. The slope factors used in the BHHRA for the oral, inhalation, and dermal exposure routes are 1.30E-01, 5.25E-02, 2.00E-01 $[mg/(kg \times day)]^{-1}$, respectively. The slope factor for the dermal exposure route was calculated by assuming a GI absorption factor of 65 percent.

An oral chronic RfD for carbon tetrachloride is available from EPA's IRIS. An inhalation RfD was extrapolated from the oral RfD. The values used in the BHHRA for the oral, inhalation, and dermal routes were 7.00E-04, 7.00E-04, and 4.55E-04 mg/(kg × day), respectively. The dermal RfD was derived using a GI absorption factor of 65%.

Deleted: 06-064(E)/041406

G4.2.10 Chloroform (CAS 000067-66-3) (RAIS)

Chloroform is an organic, colorless liquid with a pleasant, nonirritating odor and a slightly sweet taste. It will burn only when it reaches very high temperatures. In the past, chloroform was used as an inhaled anesthetic during surgery, but the Food and Drug Administration banned the use of chloroform as an ingredient in human drug and cosmetic products in July 1976. Today, chloroform is used to make other chemicals and can also be formed in small amounts when chlorine is added to water. Chloroform is widely used as an intermediate in the production of refrigerants, plastics, and pharmaceuticals, and as a general solvent or constituent of solvent mixtures.

Chloroform is rapidly absorbed from the lungs and the digestive tract and, to some extent, through the skin. Breathing about 900 parts of chloroform per million parts air (900 ppm) for a short time can cause dizziness, fatigue, and headache. Breathing air, eating food, or drinking water containing high levels of chloroform for long periods of time may damage the liver and kidneys. Large amounts of chloroform can cause sores when chloroform touches skin. Animal studies have shown that miscarriages occurred in rats and mice that breathed air containing 30 to 300 ppm chloroform during pregnancy and also in rats that ate chloroform during pregnancy. Offspring of rats and mice that breathed chloroform during pregnancy had birth defects. Abnormal sperm were found in mice that breathed air containing 400 ppm chloroform for a few days.

Epidemiological studies indicate a possible relationship between exposure to chloroform present in chlorinated drinking water and cancer of the bladder, large intestine, and rectum. Based on U.S. EPA guidelines, chloroform was assigned to weight-of-evidence Group B2: probable human carcinogen. Rats and mice that ate food or drank water with chloroform developed cancer of the liver and kidneys.

Cancer slope factors for chloroform are available from EPA's IRIS. The slope factors used in the BHHRA for the oral, inhalation, and dermal exposure routes are 6.10E-03, 8.05E-02, and 3.05E-02 $[mg/(kg \times day)]^{-1}$, respectively. The slope factor for the dermal exposure route was calculated by assuming a GI absorption factor of 20%.

Chronic oral and inhalation RfDs for chloroform are available from EPA's IRIS and NCEA, respectively. The values used in the BHHRA for the oral, inhalation, and dermal routes were 1.00E-02, 8.75E-05, and 2.00E-03 mg/(kg × day), respectively. The dermal RfD was derived using a GI absorption factor of 20%.

G4.2.11 Chloromethane (CAS 000074-87-3) (ATSDR)

Chloromethane is also known as methyl chloride. It is a clear, colorless gas. It has a faint, sweet odor that is noticeable only at levels that may be toxic. It is heavier than air, and it is extremely flammable.

Chloromethane is found in air, surface water, groundwater, soil, and sediment. It is present at very low concentrations throughout the atmosphere. Chloromethane breaks down very slowly in air. It also breaks down slowly in water, but certain microorganisms can break it down more quickly. Most of the chloromethane in soil will move to air, and it does not concentrate in plants, animals, or fish.

Some chloromethane is produced by industry. However, most of the chloromethane that is released into the environment is from natural sources, such as chemical reactions that occur in the oceans. It is also given off when materials like grass, wood, charcoal, and plastics are burned. It is present in lakes and streams and has been found in drinking water.

Formatted: Bullets and Numbering

Formatted: Bullets and Numbering

Deleted: 06-064(E)/041406

Chloromethane is an impurity in VC; exposure could occur from disposal of VC waste. Other sources of exposure are cigarette smoke, polystyrene insulation, aerosol propellants, and chlorinated swimming pools.

Breathing very high levels, even for a short time, can have serious effects on the nervous system, including convulsions and coma. Lower exposures can also cause staggering, blurred or double vision, dizziness, fatigue, personality changes, confusion, tremors, nausea, or vomiting. These symptoms can last for several months or years.

Exposure to chloromethane can harm your liver and kidneys. It could also affect the heart rate and blood pressure. Some animal studies showed that animals that breathed low levels of chloromethane experienced slower growth and had brain damage. In other animal studies, males that were exposed to chloromethane were less fertile, or even sterile, or produced damaged sperm. Females that became pregnant by these males lost their developing young.

There is no evidence that chloromethane causes cancer in people. In animal studies, male mice that breathed contaminated air for two years developed tumors in their kidneys, but female mice, and male and female rats did not. The EPA has determined that chloromethane is a possible human carcinogen: C classification.

Cancer slope factors for chloromethane are available from EPA's HEAST. The slope factors used in the BHHRA for the oral, inhalation, and dermal exposure routes are 1.30E-02, 6.30E-03, and 1.63E-02 $[mg/(kg \times day)]^{-1}$, respectively. The slope factor for the dermal exposure route was calculated by assuming a GI absorption factor of 80%.

An inhalation chronic RfD for chloromethane is available from EPA's IRIS. The value used in the BHHRA for the inhalation route was 2.57E-02 mg/(kg × day). Oral and dermal RfDs were not available.

Formatted: Bullets and Numbering

G4.2.12 Dibromochloromethane (CAS 000124-48-1) (ATSDR)

Dibromochloromethane is a colorless -to -yellow, heavy, nonflammable, liquid with a sweet odor. Small amounts are formed naturally by plants in the ocean. It is somewhat soluble in water and readily evaporates into the air. Most of the dibromochloromethane that enters the environment is formed as byproducts when chlorine is added to drinking water to kill bacteria.

Only small quantities of dibromochloromethane currently are produced in the United States. It was used in the past as solvents and flame retardants or to make other chemicals, but now it is used mainly as laboratory reagents.

When released to air, dibromochloromethane is slowly broken down by reactions with other chemicals and sunlight or can be removed by rain. In water, it will evaporate to the air and/or be broken down slowly by bacteria. When released to soil, it will evaporate to the air, be broken down by bacteria, and may filter into the groundwater.

The most likely way people are exposed to dibromochloromethane is by drinking chlorinated water. Vapors released from chlorinated water in a swimming pool or during showering and bathing also may be inhaled. Similarly, some dibromochloromethane may enter the body directly through the skin while bathing or swimming. People that live near a waste site containing dibromochloromethane could be exposed by drinking contaminated groundwater or breathing vapors released to the air. Exposure could occur by breathing dibromochloromethane in the air in or near a laboratory or factory that makes or uses this chemical; however, this is unlikely for most people.

Deleted: 06-064(E)/041406

No studies are available about health effects in people exposed to dibromochloromethane. Animals exposed to high amounts of dibromochloromethane developed liver and kidney injuries. Exposure to low levels of dibromochloromethane does not appear to seriously affect the brain, liver, or kidneys.

There is no conclusive evidence that dibromochloromethane causes cancer in humans because no cancer studies of humans exposed exclusively to these chemicals are available. Long-term oral exposure to bromoform produced intestinal tumors in female rats, and similar exposure to dibromochloromethane produced liver tumors in male and female mice.

The IARC concluded that dibromochloromethane is not classifiable as to human carcinogenicity. The EPA has classified dibromochloromethane as a possible human carcinogen (classified C).

An oral cancer slope factor for dibromochloromethane is available from EPA's IRIS. An inhalation slope factor was extrapolated from the oral slope factor. The slope factors used in the BHHRA for the oral, inhalation, and dermal exposure routes are 8.40E-02, 8.40E-02, and 1.40E-01 $[mg/(kg \times day)]^{-1}$, respectively. The slope factor for the dermal exposure route was calculated by assuming a GI absorption factor of 60%.

An oral chronic RfDs for dibromochloromethane is available from EPA's IRIS. An inhalation RfD was extrapolated from the oral RfD. The values used in the BHHRA for the oral, inhalation, and dermal routes were 2.00E-01, 2.00E-01, and 1.20E-02 mg/(kg × day), respectively. The dermal RfD was derived using a GI absorption factor of 60%.

G4.2.13 Methylene Chloride (CAS 000075-09-2) (RAIS)

Methylene chloride, also known as also known as dichloromethane, is a colorless organic liquid with a penetrating ether-like odor that does not occur naturally in the environment. Methylene chloride is used as a solvent in paint removers, degreasing agents, and aerosol propellants; as a polyurethane foam-blowing agent; as a process solvent in the pharmaceutical industry; and as an extraction solvent for spice oleoresins, hops, and caffeine.

Methylene chloride is readily absorbed from the lungs, the digestive tract and, to some extent through the skin. Breathing large amounts of methylene chloride may cause unsteadiness, dizziness, nausea, and a tingling or numbness of fingers and toes. Breathing smaller amounts of methylene chloride may decrease attention and accuracy in tasks requiring hand-eye coordination. Skin contact with methylene chloride causes burning and redness of the skin.

The primary adverse health effects associated with methylene chloride exposure are central nervous system depression and mild liver effects. Neurological symptoms described in individuals occupationally exposed to methylene chloride included headaches, dizziness, nausea, memory loss, paresthesia, tingling hands and feet, and loss of consciousness. Major effects following acute inhalation exposure include fatigue, irritability, analgesia, narcosis, and death.

It is not known whether methylene chloride causes cancer in humans. Studies of workers exposed to methylene chloride have not recorded a significant increase in cancer cases above the number of cases expected for nonexposed workers; however, an increased cancer risk was seen in mice breathing large amounts of methylene chloride for a long time. Tumors were found in lungs and liver of exposed mice. Rats showed increases of benign mammary tumors. Based on inadequate evidence of carcinogenicity in humans and sufficient evidence in animals, U.S. EPA has placed methylene chloride in weight-of-evidence group B2: probable human carcinogen.

Deleted: 06-064(E)/041406

Cancer slope factors for methylene chloride are available from EPA's IRIS. The slope factors used in the BHHRA for the oral, inhalation, and dermal exposure routes are 7.50E-03, 1.65E-03, and 7.89E-03 $[mg/(kg \times day)]^{-1}$, respectively. The slope factor for the dermal exposure route was calculated by assuming a GI absorption factor of 95%.

Chronic oral and inhalation RfDs for methylene chloride are available from EPA's IRIS and HEAST, respectively. The values used in the BHHRA for the oral, inhalation, and dermal routes were 6.00E-02, 8.57E-01, and 5.70E-02 mg/(kg × day), respectively. The dermal RfD was derived using a GI absorption factor of 95%.

G4.2.14 Tetrachloroethene (CAS 000127-18-4) (RAIS)

Tetrachloroethene is a manufactured organic chemical that is widely used for dry cleaning of fabrics and for metal degreasing. It is also used to make other chemicals and is used in some consumer products. Other names for tetrachloroethene include perchloroethylene, PCE, and tetrachloroethylene. It is a nonflammable liquid at room temperature that evaporates easily into the air and has a sharp, sweet odor.

Tetrachloroethene is rapidly absorbed by the lungs and the digestive tract, but not through the skin. High concentrations of tetrachloroethene in the air can cause dizziness, headache, sleepiness, confusion, nausea, difficulty in speaking and walking, unconsciousness, and death. Acute exposure to high concentrations of the chemical (estimated to be greater than 1500 ppm for a 30-minute exposure) may be fatal to humans. Irritation may result from repeated or extended skin contact with tetrachloroethene. These symptoms occur almost entirely in work (or hobby) environments due to accidental exposure to high concentrations or intentional use of tetrachloroethene to get a "high." In industry, most workers are exposed to levels lower than those causing obvious nervous system effects. The health effects of breathing air or drinking water with low levels of tetrachloroethene are not known. Results from some studies suggest that women who work in dry cleaning industries where exposures to tetrachloroethene can be quite high may have more menstrual problems and spontaneous abortions than women who are not exposed. It is not known, however, if tetrachloroethene was responsible for these problems because other possible causes were not considered. Results of animal studies, conducted with amounts much higher than those that most humans are exposed to, show that tetrachloroethene can cause liver and kidney damage.

Epidemiology studies of dry cleaning and laundry workers have demonstrated excesses in mortality due to various types of cancer, including liver cancer, but the data are regarded as inconclusive because of various confounding factors. The tenuous finding of an excess of liver tumors in humans is strengthened by the results of carcinogenicity bioassays, in which tetrachloroethene, administered either orally or by inhalation, induced hepatocellular tumors in mice. The chemical also induced mononuclear cell leukemia and renal tubular cell tumors in rats. Although U.S. EPA's Science Advisory Board recommended a weight-of-evidence classification of C-B2 continuum (C = possible human carcinogen; B2 = probable human carcinogen), the agency has not adopted a current position on the weight-of-evidence classification. The DHHS has determined that tetrachloroethene may reasonably be anticipated to be a carcinogen.

Cancer slope factors for tetrachloroethene are available from EPA's Superfund Health Risk Technical Support Center. The slope factors used in the BHHRA for the oral, inhalation, and dermal exposure routes are 5.20E-02, 2.00E-03, and 5.20E-02 $[mg/(kg \times day)]^{-1}$, respectively. The slope factor for the dermal exposure route was calculated by assuming a GI absorption factor of 100%.

Chronic oral and inhalation RfDs for tetrachloroethene are available from EPA's IRIS and Superfund Health Risk Technical Support Center, respectively. The values used in the BHHRA for the oral,

Deleted: 06-064(E)/041406

inhalation, and dermal routes were 1.00E-02, 1.71E-01, and 1.00E-02 mg/(kg × day), respectively. The dermal RfD was derived using a GI absorption factor of 100%.

G4.2.15 Trichloroethene (CAS 000079-01-6) (RAIS)

TCE, also known as trichloroethylene, is a colorless, highly volatile liquid that is miscible with water and a number of organic solvents. TCE is a man-made chemical and is not known to occur naturally. It is mainly used as a solvent in industrial degreasing and cleaning of metals, but it is also used as a solvent for waxes, fats, resins, oils, and in numerous other applications. Prior to 1977, TCE had been used as an anesthetic, grain fumigant, disinfectant, and extractant of spice oleoresins in food and of caffeine in the production of decaffeinated coffee. The evaluation of the toxicity of TCE is complicated by the presence or absence of other chemicals. Industrial grade TCE usually contains stabilizers that are known to be toxic such as triethylamine, triethanolamine, epichlorohydrin, or stearates. In the absence of stabilizers, TCE readily decomposes. These decomposition products also are toxic.

Human and animal data indicate that exposure to TCE can result in toxic effects on a number of organs and systems, including the liver, kidney, blood, skin, immune system, reproductive system, nervous system, and cardiovascular system. Breathing small amounts of TCE may cause headaches, lung irritation, dizziness, poor coordination, and difficulty concentrating. Breathing large amounts of TCE may cause impaired heart function, unconsciousness, and death. Breathing it for long periods may cause nerve, kidney, and liver damage. Drinking large amounts of TCE may cause nausea, liver damage, unconsciousness, impaired heart function, or death. Drinking small amounts of TCE for long periods may cause liver and kidney damage, impaired immune system function, and impaired fetal development in pregnant women, although the extent of some of these effects is not yet clear. Skin contact with TCE for short periods may cause skin rashes.

Epidemiologic studies have been inadequate to determine if a correlation exists between exposure to TCE and increased cancer risk in humans. Some human studies with exposure over long periods to high levels of TCE in drinking water or in workplace air have found evidence of increased cancer; however, these results are inconclusive because the cancer could have been caused by other chemicals. Some studies with mice and rats have suggested that high levels of TCE may cause liver or lung cancer. Although U.S. EPA's Science Advisory Board recommended a weight-of-evidence classification of C-B2 continuum (C = possible human carcinogen; B2 = probable human carcinogen), the agency has not adopted a current position on the weight-of-evidence classification. In an earlier evaluation, TCE was assigned to weight-of-evidence Group B2, probable human carcinogen. The IARC has determined that TCE is not classifiable as to human carcinogenicity.

Cancer slope factors for TCE are available from EPA's NCEA. The slope factors used in the BHHRA for the oral, inhalation, and dermal exposure routes are 1.10E-02, 6.00E-03, and 7.33E-02 $[mg/(kg \times day)]^{-1}$, respectively. The slope factor for the dermal exposure route was calculated by assuming a GI absorption factor of 15%.

A chronic oral RfD for TCE is available from EPA's Superfund Health Risk Technical Support Center. An inhalation RfD was extrapolated from the oral RfD. The values used in the BHHRA for the oral, inhalation, and dermal routes were 6.00E-03, 6.00E-03, and 9.00E-04 mg/(kg × day), respectively. The dermal RfD was derived using a GI absorption factor of 15%.

G4.2.16 Vinyl Chloride (CAS 000075-01-4) (RAIS)

VC, also known as chloroethene, is a halogenated aliphatic hydrocarbon. It is a colorless gas with a mild sweetish odor that is slightly soluble in water and soluble in hydrocarbons, oil, alcohol, chlorinated

Deleted: 06-064(E)/041406

solvents, and most common organic liquids. VC is produced by thermal cracking of ethylene chloride and does not occur naturally. It is used primarily as an intermediate in the manufacture of PVC; limited quantities are used as a refrigerant and as an intermediate in the production of chlorinated compounds. It is a biodegradation product of TCE, tetrachloroethylene, and 1,1,1-TCA. VC may leach into groundwater from spills, landfills, and industrial sources.

VC is rapidly absorbed from the digestive tract and lungs. Breathing high levels of VC can cause dizziness or sleepiness. Breathing very high levels can cause passing out, and breathing extremely high levels can cause death. Humans exposed to VC in air for long periods of time can develop changes to the structure of their livers. Workers exposed to VC have developed nerve damage and immune reactions. Other workers have developed problems with the blood flow in their hands: the tips of their fingers turn white and hurt when they are in cold temperatures. Sometimes, the bones in the tips of their fingers have broken down. The effects of drinking high levels of VC are unknown. If VC is spilled on skin, numbness, redness, and blisters may occur. Animal studies have shown that long-term (365 days or longer) exposure to VC can damage the sperm and testes. It has not been proven that VC causes birth defects in humans, but animal studies have shown that breathing VC can harm unborn offspring and also may cause increases in early miscarriages.

Studies show that VC causes liver cancer in humans. On the basis of sufficient evidence for carcinogenicity in human epidemiology studies, VC is considered to best fit the weight-of-evidence Category “A,” according to current EPA Risk Assessment Guidelines. Agents classified into this category are considered known human carcinogens. This classification is supported by positive evidence for carcinogenicity in animal bioassays including several species and strains, and strong evidence for genotoxicity.

Cancer slope factors for VC are available from EPA’s IRIS. The slope factors used in the BHHRA for the oral, inhalation, and dermal exposure routes are 1.40E+00, 3.08E-02, and 1.40E+00 $[\text{mg}/(\text{kg} \times \text{day})]^{-1}$, respectively. The slope factor for the dermal exposure route was calculated by assuming a GI absorption factor of 100%.

Chronic RfDs for VC are available from EPA’s IRIS. The values used in the BHHRA for the oral, inhalation, and dermal routes were 3.00E-03, 2.86E-02, and 3.00E-03 mg/(kg × day), respectively. The dermal RfD was derived using a GI absorption factor of 100%.

G4.3 RADIONUCLIDES

Radionuclides are unstable atoms of chemical elements that will emit charged particles or energy or both to achieve a more stable state. These charged particles are termed “alpha and beta radiation”; energy is termed “neutral gamma rays.” Interaction of these charged particles (and gamma rays) with matter will produce ionization events, or radiation, which may cause living cell tissue damage. Because the deposition of energy by ionizing radiation is a random process, sufficient energy may be deposited (in a critical volume) within a cell and result in cell modification or death. In addition, ionizing radiation has sufficient energy that interactions with matter will produce an ejected electron and a positively charged ion (known as free radicals) that are highly reactive and may combine with other elements, or compounds within a cell, to produce toxins or otherwise disrupt the overall chemical balance of the cell. These free radicals also can react with deoxyribonucleic acid (DNA), causing genetic damage, cancer induction, or even cell death.

Radionuclides are characterized by the type and energy level of the radiation emitted. Radiation emissions fall into two major categories: particulate (electrons, alpha particles, beta particles, and protons)

Deleted: 06-064(E)/041406

or electromagnetic radiation (gamma and x-rays). Therefore, all radionuclides are classified by the EPA as Group A carcinogens based on their property of emitting ionizing radiation and on the extensive weight of evidence provided by epidemiological studies of humans with cancers induced by high doses of radiation. Alpha particles are emitted at a characteristic energy level for differing radionuclides. The alpha particle has a charge of +2 and a comparably large size. Alpha particles have the ability to react (and/or ionize) with other molecules, but they have very little penetrating power and lack the ability to pass through a piece of paper or human skin. However, alpha-emitting radionuclides are of concern when there is a potential for inhalation or ingestion of the radionuclide. Alpha particles are directly ionizing and deposit their energy in dense concentrations (termed high linear energy transfer [high LET]), resulting in short paths of highly localized ionization reactions. The probability of cell damage increases as a result of the increase in ionization events occurring in smaller areas; this also may be the reason for increased cancer incidence caused by inhalation of radon gas. In addition, the cancer incidence in smokers may be directly attributed to the naturally occurring alpha emitter, polonium-210, in common tobacco products.

Beta emissions generally refer to beta negative particle emissions. Radionuclides with an excess of neutrons achieve stability by beta decay. Beta radiation, like alpha radiation, is directly ionizing but, unlike alpha activity, beta particles deposit their energy along a longer track length (low LET), resulting in more space between ionization events. Beta-emitting radionuclides can cause injury to the skin and superficial body tissue, but are most destructive when inhaled or ingested. Many beta emitters are similar chemically to naturally occurring essential nutrients and will, therefore, tend to accumulate in certain specific tissues. For example, strontium-90 is chemically similar to calcium and, as a result, accumulates in the bones, where it causes continuous exposure. The health effects of beta particle emissions depend upon the target organ. Those seeking the bones would cause a prolonged exposure to the bone marrow and affect blood cell formation, possibly resulting in leukemia, other blood disorders, or bone cancers. Those seeking the liver would result in liver diseases or cancer, while those seeking the thyroid would cause thyroid and metabolic disorders. In addition, beta radiation may lead to damage of genetic material (DNA), causing hereditary defects.

Gamma emissions are the energy that has been released from transformations of the atomic nucleus. Gamma emitters and x-rays behave similarly, but differ in their origin: gamma emissions originate in nuclear transformations, and x-rays result from changes in the orbiting electron structure. Radionuclides that emit gamma radiation can induce internal and external effects. Gamma rays have high penetrating ability in living tissue and are capable of reaching all internal body organs. Without such sufficient shielding as lead, concrete, or steel, gamma radiation can penetrate the body from the outside and does not require ingestion or inhalation to penetrate sensitive organs. Gamma rays are characterized as low-LET radiation, as is beta radiation; however, the behavior of beta radiation differs from that of gamma radiation in that beta particles deposit most of their energy in the medium through which they pass, while gamma rays often escape the medium because of higher energies, thereby creating difficulties in determining actual internal exposure. For this reason, direct whole-body measurements are necessary to detect gamma radiation, while urine/fecal analyses are usually effective in detecting beta radiation.

People receive gamma radiation continuously from naturally occurring radioactive decay processes going on in the earth's surface, from radiation naturally occurring inside their bodies, from the atmosphere as fallout from nuclear testing or explosions, and from space or cosmic sources. ^{137}Cs (from nuclear fallout) decays to barium-137, the highest contributor to fallout-induced gamma radiation. Beta radiation from the soil is a less penetrating form of radiation, but has many contributing sources. ^{40}K, ^{137}Cs, lead-214, and bismuth-214 are among the most common environmental beta emitters. Tritium is also a beta emitter but contributes little to the soil beta radiation because of the low energy of its emission and its low concentration in the atmosphere. Alpha radiation also is emitted by the soil, but is not measurable more than a few centimeters from the ground surface. The majority of alpha emissions are

Deleted: 06-064(E)/041406

attributable to ^{222}radon and ^{220}radon and their decay products. This contributes to what is called background exposure to radiation.

The general health effects of radiation can be divided into stochastic (related to dose) and nonstochastic (not related to dose) effects. The risk of development of cancer from exposure to radiation is a stochastic effect. Examples of nonstochastic effects include acute radiation syndrome and cataract formation, which occur only at high levels of exposures.

Radiation can damage cells in different ways. It can cause damage to DNA within the cell, and the cell either may not be able to recover from this type of damage or may survive but function abnormally. If an abnormally functioning cell divides and reproduces, a tumor or mutation in the tissue may develop. The rapidly dividing cells that line the intestines and stomach and the blood cells in bone marrow are extremely sensitive to this damage. Organ damage results from the damage caused to the individual cells. This type of damage has been reported with doses of 10 to 500 rads (0.1 to 5.0 gray, in SI units). Acute radiation sickness is seen only after doses of >50 rads (0.5 gray), which is a dose rate usually achieved only in a nuclear accident.

When the radiation-damaged cells are reproductive cells, genetic damage can occur in the offspring of the person exposed. The developing fetus is especially sensitive to radiation. The type of malformation that may occur is related to the stage of fetal development and the cells that are differentiating at the time of exposure. Radiation damage to children exposed in the womb is related to the dose the pregnant mother receives. Mental retardation is a possible effect of fetal radiation exposure.

The most widely studied population that has had known exposure to radiation is the atomic bomb survivors of Hiroshima and Nagasaki, Japan. Data indicate an increase in the rate of leukemia and cancers in this population. However, the rate at which cancer incidence is significantly affected by low radiation exposures, such as results of exposure to natural background and industrially contaminated sites, is still undergoing study and is uncertain. In studies conducted to determine the rate of cancer and leukemia increase, as well as genetic defects, several radionuclides must be considered.

G4.3.1 Neptunium-237 (CAS 013994-20-2)

Specific literary information for ^{237}Np is limited. However, available literature states that during neutron bombardment, ^{237}Np breaks down to ^{238}Pu , which produces small masses of high capacity energy that is useful for satellites and spacecraft (Moskalev et al. 1979).

The most common route of ^{237}Np exposure is inhalation of aerosols. According to studies conducted on rats, acute effects include injury to the liver and kidney and circulation disorders. Long-term effects include osteosarcomas and lung cancer. Extremely high doses cause immediate or premature death by destruction of the lungs (Moskalev et al. 1979).

Oral, inhalation, and external exposure cancer slope factors used in the BHHRA for ^{237}Np are 6.74E-11 risk/pCi, 1.77E-08 risk/pCi, and 7.97E-07 [(risk × g)/(pCi × yr)], respectively. The slope factors for ^{237}Np include ingrowth of short-lived degradation products. A dermal cancer slope factor was not calculated because this route of exposure is not considered significant for radionuclides and is not evaluated in the BHHRA. Oral, dermal, and inhalation RfDs are not available for this element; therefore, systemic toxicity due to exposure to ^{237}Np is not quantified in the BHHRA.

Deleted: 06-064(E)/041406

G4.3.2 Technetium-99 (CAS 014133-76-7)

Technetium is a radioactive element that occurs in a number of isotopic forms. Technetium is found in some extraterrestrial material (i.e., stars); however, no appreciable amounts have been found in nature due to the relatively short half-lives of its radioactive isotopes (Kutegov et al. 1968). While no isotopes of technetium are stable, the existence of three technetium isotopes is well established. Two common forms of technetium, ^{97}Tc and ^{98}Tc, have half-lives of 2.6×10^6 and 1.5×10^6 years, respectively. The third isotope, ^{99}Tc, has a half-life of 2.12×10^5 years. None, however, possesses a half-life sufficiently long to allow technetium to occur naturally (Boyd 1959). Technetium is made artificially for industrial use, and natural technetium, particularly ^{99}Tc, has been identified and isolated from the spontaneous fission of uranium, as well as other fissionable material or via the irradiation of molybdenum (Venugopal and Luckey 1978; Clarke and Podbielski 1988).

Technetium is an emitter of beta particles of low specific activity (Boyd 1959). It does not release nuclear energy at a rate sufficient to make the element attractive for the conventional applications of radioactivity (Boyd 1959). ^{99}Tc is the only long-lived isotope that is readily available and is the isotope on which most of the chemistry of technetium is based. Although gamma radiation has not been associated with ^{99}Tc, the secondary X rays may become important with larger amounts of the element.

Oral, inhalation, and external exposure cancer slope factors used in the BHHRA for ^{99}Tc are 2.75E-12 risk/pCi, 1.41E-11 risk/pCi, and 8.14E-11 ([risk × g]/[pCi × yr]), respectively. A dermal cancer slope factor was not calculated because this route of exposure is not evaluated in the BHHRA. Oral, dermal, and inhalation RfDs are not available for this element; therefore, systemic toxicity due to exposure to ^{99}Tc is not quantified in the BHHRA.

G4.3.3 Thorium-230 (CAS 014269-63-7) (ATSDR)

Thorium is a naturally occurring, radioactive substance. In the environment, thorium exists in combination with other minerals, such as silica. Small amounts of thorium are present in all rocks, soil, water, plants, and animals. Soil contains an average of about 6 parts of thorium per million parts of soil (6 ppm).

Only a small portion of naturally occurring thorium exists as ^{230}Th. More than 99% of natural thorium exists in the form of ^{232}Th. ^{230}Th breaks down into two parts-a small part called "alpha" radiation and a large part called the decay product. The decay product also is not stable and continues to break down through a series of decay products until a stable product is formed. During these decay processes, radioactive substances are produced. These include radium and radon. These substances give off radiation, including alpha and beta particles, and gamma radiation. The half-life for ^{230}Th is 75,400 years.

Some rocks in underground mines contain thorium in a more concentrated form. After these rocks are mined, thorium is usually concentrated and changed into thorium dioxide or other chemical forms. After most of the thorium is removed, the rocks are called “depleted” ore or tailings.

Thorium is used to make ceramics, gas lantern mantles, and metals used in the aerospace industry and in nuclear reactions. Thorium also can be used as a fuel for generating nuclear energy.

Oral, inhalation, and external exposure cancer slope factors used in the BHHRA for ^{230}Th are 9.10E-11 risk/pCi, 2.85E-08 risk/pCi, and 8.19E-10 (risk × g)/(pCi × yr), respectively. A dermal cancer slope factor was not calculated because this route of exposure is not considered significant for radionuclides and is not evaluated in the BHHRA. Oral, dermal, and inhalation RfDs are not available for this element; therefore, systemic toxicity due to exposure to americium is not quantified in the BHHRA.

Deleted: 06-064(E)/041406

G4.3.4 Uranium (CAS 007440-62-2 for metal, CAS 013966-29-5 for U-234, CAS 015117-96-1 for U-235, and CAS 007440-61-1 for U-238) (ATSDR)

Uranium is a mildly radioactive element that occurs widely in the earth's crust. It is found in all soils, most rocks, and, in lesser concentrations, in water, vegetation, and animals, including humans. Uranium emits a low level of alpha particles and a much lower level of gamma rays. Alpha particles are unable to penetrate skin, but can travel short distances in the body if ingested or inhaled. Consequently, uranium represents a significant carcinogenic hazard only when taken into the body, where alpha particle energy is absorbed by small volumes of tissue. Although the penetrating (gamma) radiation of uranium is not considered to be significant (ATSDR 1989), one of its daughter radionuclides is a strong gamma emitter; therefore, gamma radiation may be a concern in areas containing uranium.

Natural uranium contains the uranium isotopes ^{238}U (which averages 99.27% of total uranium mass), ^{235}U (0.725), and ^{234}U (0.0056%), each of which undergoes radioactive decay. Natural uranium, therefore, contains the radionuclide daughter products from the decay of ^{238}U and ^{235}U (Bowen 1979; ATSDR 1989). The half-lives of the isotopes are 200,000, 700 million, and 5 billion years for ^{234}U, ^{235}U, and ^{238}U, respectively.

Uranium is a radioactive element, but it is also a metallic element. Toxicological effects from the ingestion of uranium are the result of the action of uranium as a metal and its radioactive properties. The primary toxic chemical effect of uranium is seen in kidney damage. Studies in rabbits, mice, and dogs showed effects on the kidney to be dose-related. Fetal skeletal abnormalities and fetal death were found in pregnant mice exposed to 6 mg/kg or uranyl acetate dihydrate.

The primary human exposure studies to uranium have been studies of uranium miners or uranium factory workers. These studies have shown an increase in lung cancer deaths among these workers, which may be attributable to the decay of uranium into radon and its daughters. These workers are exposed to high levels of uranium dust and fumes and other radioactive elements in confined conditions (ATSDR 1989).

Oral, inhalation, and external exposure cancer slope factors used in the BHHRA for ^{234}U are 7.00E-11 risk/pCi, 1.14E-08 risk/pCi, and 2.52E-10 ([risk × g]/[pCi × yr]), respectively. Oral, inhalation, and external exposure cancer slope factors used in the BHHRA for ^{238}U are 8.71E-11 risk/pCi, 9.25E-09 risk/pCi, and 1.14E-07 [(risk × g)/(pCi × yr)], respectively. The slope factors for ^{238}U include ingrowth of short-lived degradation products. A dermal cancer slope factor was not calculated for the uranium isotopes because this route of exposure is not considered significant for radionuclides and is not evaluated in the BHHRA. Oral, dermal, and inhalation RfDs are available for uranium and are listed earlier in this section.

G4.4 CHEMICALS FOR WHICH NO EPA TOXICITY VALUES ARE AVAILABLE

Over all COPCs identified for RGA groundwater associated with the Southwest Plume, oral RfD values exist for all of the inorganic chemical COPCs except silicon. Oral RfDs exist for all of the organic COPCs included except 2-propanol and chloromethane.

All the inorganic chemical COPCs, except aluminum, barium, and manganese lack inhalation RfD values. However, the only organic compound that lacks an inhalation RfD value is 2-propanol.

Absorbed dose RfD values exist for all of the inorganic chemical COPCs included in the BHHRA except silicon. Absorbed dose RfDs exist for all organic compound COPCs included in the BHHRA except benzene, chloromethane, and VC.

Deleted: 06-064(E)/041406

Arsenic is the only inorganic chemical COPC with an oral slope factor. The organic compound COPCs without an oral slope factor are *cis*-1,2-DCE, *trans*-1,2-DCE, 2-propanol, acetone, and bromomethane.

EPA-approved inhalation slope factors are available for only a few of the COPCs. Inorganic chemical COPCs with inhalation slope factors are arsenic and chromium. Most organic compound COPCs have an approved inhalation slope factor. Those without an inhalation slope factor are *cis*-1,2-DCE, *trans*-1,2-DCE, 2-propanol, acetone, and bromomethane.

COPCs with absorbed dose slope factors mirror those with oral slope factors. The COPCs without absorbed dose slope factors are arsenic, *cis*-1,2-DCE, *trans*-1,2-DCE, 2-propanol, acetone, and bromomethane. All radionuclide COPCs have oral, inhalation, and external exposure slope factors.

G4.5 UNCERTAINTIES RELATED TO TOXICITY INFORMATION

Standard EPA RfDs and slope factors were used to estimate potential noncarcinogenic and carcinogenic health effects from exposure to chemical contaminants detected. Considerable uncertainty is associated with the methodology applied to derive slope factors and RfDs. EPA working groups review all relevant human and animal studies for each compound and select the studies pertinent to the derivation of the specific RfD and slope factor. These studies often involve data from experimental studies in animals, high exposure levels, and exposures under acute or occupational conditions. Extrapolation of these data to humans under low-dose, chronic conditions introduces uncertainties. The magnitude of these uncertainties is addressed by applying uncertainty factors to the dose response data for each applicable uncertainty. These factors are incorporated to provide a margin of safety for use in human health assessments.

The dose-response relationship between cancer and ionizing radiation has been evaluated in many reports. Derivation of risk factors is extrapolated from the cancer risk established using the Japanese Atomic Bomb Survivors database and a relative risk projection model. EPA methodology for estimating radionuclide carcinogenic risks is currently being reevaluated.

G4.6 SUMMARY OF TOXICITY ASSESSMENT

A breakdown of the COPCs and their available toxicity information by SWMU is provided in the following subsections.

G4.6.1 Southwest Plume COPC Toxicity Summary

RGA groundwater contains 37 COPCs. Fifteen are inorganic chemicals, of which 14 have toxicity information; 17 are organic compounds, of which 16 have toxicity information; and 5 are radionuclides, all of which have toxicity information.

G4.6.2 SWMU 1 COPC Toxicity Summary

SWMU 1 has 13 COPCs. Eight are inorganic chemicals, all of which have toxicity information; 4 are organic compounds, all of which have toxicity information; and 1 is a radionuclide that has toxicity information.

Deleted: 06-064(E)/041406

G4.6.3 C-720 Building Area COPC Toxicity Summary

The C-720 Building area contains 14 COPCs. Eight are inorganic chemicals, all of which have toxicity information; 5 are organic compounds, all of which have toxicity information; and 1 is a radionuclide that has toxicity information.

G4.6.4 Storm Sewer COPC Toxicity Summary

The storm sewer has two COPCs. Both are organic compounds that have toxicity information.

Deleted: <#>**SWMU 4 COPC Toxicity Summary ¶**
SWMU 4 has 28 COPCs. Nine are inorganic chemicals, all of which have toxicity information; 15 are organic compounds, of which 14 have toxicity information; and 4 are radionuclides that have toxicity information.

G.5 RISK CHARACTERIZATION

Risk characterization is the final step in the risk assessment process. In this step, the information from the exposure and toxicity assessments is integrated to quantitatively estimate both carcinogenic health risks and noncarcinogenic hazard potential. For this assessment, risk is defined as both the lifetime probability of excess cancer incidence for carcinogens and the estimate of daily intake exceeding intake that may lead to toxic effects for noncarcinogens.

G5.1 DETERMINATION OF POTENTIAL FOR NONCANCER EFFECTS

In this BHHRA, the numeric estimate of the potential for noncancer effects posed by a single chemical within one pathway of exposure is derived as the ratio of the chronic daily intake of a chemical from a single pathway to the appropriate RfD. This ratio is also referred to as a hazard quotient (HQ). This value is calculated as shown in the following equation:

$$\mathbf{HQ} = \frac{\mathbf{CDI}}{\mathbf{RfD}}$$

where:

HQ is the hazard quotient, dimensionless
CDI is the chronic daily intake of a particular chemical, mg/(kg × day)
RfD is the chronic reference dose for a particular chemical and pathway, mg/(kg × day)

When performing this calculation, the proper RfD was used for each chronic daily intake. For CDIs that reflect ingestion, the RfD used was that for administered dose. For CDIs that reflect absorption, as in dermal contact, the RfD used was that for absorbed dose. Finally, for CDIs that reflect inhalation exposure, the RfD used was that for inhalation. Similarly, the RfD appropriate for the duration of exposure was used. For all adult exposures, the period of exposure was greater than 7 years; therefore, the chronic RfD was used. For all exposures to children, regardless of duration, the chronic RfD was used (Risk Methods Document). Generally, only chronic RfDs were used for adults because this assessment only considered lifetime exposures.

If several chemicals may reach a receptor through a common pathway, guidance (RAGS, Risk Methods Document) recommends adding the HQs of all chemicals reaching the receptor through the common pathway to calculate a pathway HI. This can be represented by the following equation:

Deleted: 06-064(E)/041406

$$\text{Pathway HI} = HQ_1 + HQ_2 + HQ_3 + ... + HQ_n$$

where:

Pathway HI is the sum of the individual chemical HQs, dimensionless
HQ_1 to HQ_n are the individual chemical hazard quotients relevant to the pathway, dimensionless

Similarly, guidance (Risk Methods Document) recommends summing the pathway HIs for all pathways relevant to an individual receptor to develop a total HI. The total HI is not an estimate of the systemic toxicity posed by all contaminants that may reach the receptor, but can be used to estimate if a toxic effect may result if all contaminants reaching the receptor have additive effects over all pathways. This can be represented as in the following equation:

$$\text{Total HI} = HI_1 + HI_2 + HI_3 + ... + HI_n$$

where:

Total HI is the sum of all pathways relevant to a single receptor, dimensionless
HI_1 to HI_n are the individual pathway HIs

Note that the HQ, the pathway HI, and the total HI do not define a dose-response relationship. That is, the magnitude of the HQ or HI does not represent a statistical probability of incurring an adverse effect. If the HQ is less than 1, the estimated exposure to a substance may be judged to be below a level that could present a toxic effect. If the HQ is greater than 1, a toxic effect may or may not result depending on the assumptions used to develop the CDI and assumptions used in deriving the RfD. Similarly, if the pathway HI is less than 1, then the estimated exposure to multiple chemicals contributing to the pathway HI should not be expected to present a toxic effect. If the pathway HI is greater than 1, then exposure may or may not result in a toxic effect depending on what assumptions were used to develop the pathway and how the chemicals included in the pathway interact. Finally, if the total HI is less than 1, then the estimated exposure to multiple chemicals over multiple pathways should not be expected to result in a toxic effect. If the total HI is greater than 1, then a toxic effect may or may not result depending on the rigor used to develop the conceptual site model for all pathways and the interaction between pathways and individual chemicals.

After summing within and over pathways, the risk was further evaluated if the sum was greater than 1. In this evaluation, chemicals with similar effects were segregated to determine if the HQs of these chemicals also summed to a value greater than 1. This evaluation was performed because the belief is that if the sum of the HQs of chemicals with common effects is greater than 1, then there is greater confidence in stating that exposure to several chemicals within a pathway or over several pathways may lead to a toxic effect. This and other uncertainties related to this method of determining the potential for systemic toxicity are discussed in more detail in Section 6.

G5.2 DETERMINATION OF EXCESS LIFETIME CANCER RISK

Estimates of the potential for cancer induction are measured by calculating estimates of ELCR. Generally, ELCR can be defined as the incremental increase in the probability that a receptor may develop cancer if the receptor is exposed to chemicals or radionuclides or both. ELCRs developed using the procedures used by EPA are specific for the conceptual site model used to define the routes and magnitude of exposure. The magnitude of the ELCRs could vary markedly if the exposure assumptions used to develop the conceptual site model are varied.

Deleted: 06-064(E)/041406

G5.2.1 Chemical Excess Cancer Risk

The numeric estimate of the ELCR resulting from exposure to a single chemical carcinogen is derived by multiplying the CDI through a particular pathway by the slope factor appropriate to that pathway. The resulting value is referred to as a chemical-specific ELCR. This value is calculated as shown in the following equation:

$$\textbf{Chemical} - \textbf{specific ELCR} = \textbf{CDI} \times \textbf{SF}$$

where:

Chemical specific ELCR is an estimate of the excess lifetime probability of developing cancer that results because of exposure to the specific chemical, dimensionless
CDI is the chronic daily intake of the chemical [mg/(kg × day)]
SF is the slope factor for the specific chemical $[(mg/(kg \times day)]^{-1}$

As with the calculation used to derive HQs, when performing this calculation the proper slope factor was used for each CDI. For CDIs that reflect ingestion, the slope factor was that for an administered dose. For CDIs that reflect absorption, the slope factor was that for absorbed dose. Finally, for CDIs that reflect inhalation exposure, the slope factor was that for inhalation.

Deleted: If several chemicals may reach a receptor through a common pathway, the chemical specific ELCRs of all chemicals reaching the receptor through the common pathway are summed to calculate a pathway ELCR. This can be represented by the following equation:¶

$$\textbf{Pathway ELCR} = \textbf{ELCR}_1 + \textbf{EL}$$

¶
where:¶
Pathway ELCR is the sum of the chemical-specific ELCRs, dimensionless¶
$ELCR_1$ to $ELCR_n$ are the chemical-specific ELCRs relevant to the pathway; dimensionless

Deleted: Similarly, the pathway

ELCRs for all pathways relevant to an individual receptor are summed to develop a total ELCR. The total ELCR is not an actuarial estimate of an individual developing cancer, but can be used to estimate the total ELCR that may result if all contaminants reaching the receptor have additive effects over all pathways. This can be represented as in the following equation:

$$\textbf{Total ELCR} = \textbf{ELCR}_{\textbf{P1}} + \textbf{ELCR}_{\textbf{P2}} + \textbf{ELCR}_{\textbf{P3}} + \ldots + \textbf{ELCR}_{\textbf{Pn}}$$

where:

Total ELCR is the sum of all pathways relevant to a single receptor, dimensionless
$ELCR_{P1}$ to $ELCR_{P2}$ is the individual pathway ELCRs

Unlike the HQ, the pathway HI, and the total HI, the chemical-specific ELCR, the pathway ELCR, and total ELCR define a dose-response relationship. That is, the ELCRs do represent a statistical probability of the increased risk of developing cancer that exists in receptors exposed under the assumptions used in the calculation of the CDI. However, like pathway HI and total HI, additional evaluation of the risk characterization should be performed if the total ELCR exceeds 1×10^{-4}. Uncertainties related to this method of calculating ELCR are discussed in more detail in Subsection 6.

Deleted: If the total ELCR exceeds 1×10^{-4}, then chemicals contributing to the ELCR should be segregated by common effect. This analysis is performed to decrease the uncertainty in the risk presentation and raise the confidence of any subsequent risk management decision. This and other

Deleted: u

G5.2.2 Radionuclide Excess Cancer Risk

Calculation of cancer risk due to exposure to radionuclides through ingestion or inhalation is conceptually similar to calculation of risks for chemical carcinogens. In performing this calculation, ELCR due to exposure to a particular radionuclide within a specific pathway is calculated by multiplying the intake of the radionuclide by the route-specific cancer slope factor. This can be represented by the following equation:

$$\textbf{Radionuclide} - \textbf{specific ELCR} = \textbf{CDI} \times \textbf{SF}$$

where:

Deleted: 06-064(E)/041406

Radionuclide specific ELCR is an estimate of the excess lifetime probability of developing cancer that results because of exposure to the specific radionuclide, dimensionless
CDI is the ingestion and inhalation chronic daily intake of the radionuclide, pCi
SF is the ingestion and inhalation slope factor for the specific radionuclide, risk/pCi
(Note: For external exposure, the units for CDI and SF are pCi-year/g and risk-g/pCi-year, respectively.)

As with the calculation used to derive chemical-specific ELCRs, when performing this calculation the proper slope factor was used for each CDI. For CDIs that reflect ingestion, the slope factor was that for ingestion. Similarly, for CDIs that reflect inhalation exposure, the slope factor was that for inhalation.

Both the pathway ELCR for radionuclides and the total ELCR from exposure to multiple radionuclides within a pathway and over multiple pathways, respectively, are calculated as illustrated for chemical carcinogens in Subsection 5.2. These equations will not be presented in this risk assessment. The uncertainties related to this method of determining ELCR from exposure to radionuclides is discussed in detail in Section 6.

In this risk assessment, ELCRs from exposure to chemicals and radionuclides were summed within pathways and over all pathways to indicate the potential health risk to a receptor that may be exposed to radionuclides and chemicals over all pathways. The uncertainties associated with combining radionuclide and chemical ELCRs are discussed in detail in Section 6.

G5.3 RISK CHARACTERIZATION FOR RESIDENTIAL USE OF GROUNDWATER DRAWN FROM THE RGA

This subsection presents the risk for residential use of groundwater drawn from the RGA. Tables and discussion in this subsection provide the total HI or ELCR for the each source area and over the Southwest Plume and list the major exposure routes and COPCs contributing to the total HI or ELCR. This subsection does not select either land use scenarios of concern, POCs, or COCs. The selection of land use scenarios of concern, POCs, and COCs is in Subsections G5.6.1, G5.6.2, and G5.6.3, respectively.

Tables G.50 through G.53 and G.54 through G.57 present the systemic toxicity for each source and over the Southwest Plume for residential use of groundwater by a child and adult, respectively. Tables G.58 through G.61 present the ELCR for each source and over the Southwest Plume for lifetime exposure. In each table, the risk for each contaminant within each pathway, the risk for each contaminant across all pathways, the risk from each pathway, and the total risk across all pathways are presented.

Deleted: 7
Deleted: 61
Deleted: 62
Deleted: 66
Deleted: 67
Deleted: 71

Deleted: 06-064(E)/041406

Table G.50. HI (child) for all Southwest Plume RGA groundwater COPCs[a]

Deleted: 7

Deleted: 06-064(E)/041406

Chemical	Units	Exposure Point Concentration	Child Ingestion Hazard	Child Dermal Hazard	Child Shower Inhalation Hazards	Child Household Inhalation Hazard	Total Hazard Child	Percent of Total
				Inorganic Chemicals (Metals)				
Aluminum	mg/L	2.40E+00	1.59E-01	2.29E-03			1.61E-01	0.1%
Arsenic	mg/L	3.46E-03	7.64E-01	2.68E-03			7.66E-01	0.4%
Barium	mg/L	1.75E-01	1.66E-01	3.41E-03			1.69E-01	0.1%
Chromium	mg/L	8.49E-02	3.74E-03	1.08E-03			4.82E-03	<0.1%
Cobalt	mg/L	2.30E-02	2.53E-02	4.56E-05			2.54E-02	<0.1%
Copper	mg/L	1.98E-02	3.54E-02	1.70E-04			3.56E-02	<0.1%
Iron	mg/L	2.63E+01	5.79E+00	5.56E-02			5.85E+00	2.7%
Manganese	mg/L	1.34E+00	3.69E+00	1.33E-01			3.83E+00	1.7%
Molybdenum	mg/L	5.98E-02	7.91E-01	3.00E-03			7.94E-01	0.4%
Nickel	mg/L	1.67E-01	5.53E-01	2.95E-03			5.56E-01	0.3%
Selenium	mg/L	3.94E-03	5.21E-02	1.70E-04			5.23E-02	<0.1%
Uranium	mg/L	3.50E-01	3.86E+01	6.54E-02			3.86E+01	17.7%
Vanadium	mg/L	1.91E-02	1.80E-01	2.59E-02			2.06E-01	0.1%
Zinc	mg/L	1.38E-01	3.03E-02	2.18E-04			3.06E-02	<0.1%
				Organic Compounds				
1,1-Dichloroethene	mg/L	1.86E-02	1.37E-01	1.76E-03	7.51E-02	5.44E-01	7.57E-01	0.3%
1,2-Dichloroethane	mg/L	9.17E-02	2.02E-01	1.54E-03	2.37E+00	1.71E+01	1.97E+01	9.0%
Acetone	mg/L	4.90E-02	3.24E-02	3.20E-05	1.77E-02	1.28E-01	1.78E-01	0.1%
Benzene	mg/L	1.60E-02	3.53E-01	1.10E-02	3.41E-01	2.47E+00	3.18E+00	1.5%
Bromodichloromethane	mg/L	1.00E-03	3.31E-03	2.82E-05	1.81E-03	1.31E-02	1.82E-02	<0.1%
Bromomethane	mg/L	3.87E-03	1.83E-01	1.15E-03	9.79E-02	7.09E-01	9.92E-01	0.5%
Carbon Tetrachloride	mg/L	2.45E-02	2.32E+00	1.13E-01	1.27E+00	9.20E+00	1.29E+01	5.9%
Chloroform	mg/L	2.73E-02	1.80E-01	1.16E-02	1.15E+01	8.32E+01	9.49E+01	43.4%
Chloromethane	mg/L	1.00E-02			1.40E-02	1.02E-01	1.16E-01	0.1%
Dibromochloromethane	mg/L	2.00E-03	6.61E-03	6.19E-05	3.61E-03	2.62E-02	3.64E-02	<0.1%
Methylene Chloride	mg/L	6.63E-02	7.31E-02	4.98E-04	2.79E-03	2.02E-02	9.66E-02	<0.1%
Tetrachloroethylene	mg/L	4.00E-03	2.65E-02	1.41E-02	8.43E-04	6.10E-03	4.75E-02	<0.1%
Trichloroethylene	mg/L	5.01E-01	5.52E+00	8.49E-01	3.03E+00	2.20E+01	3.14E+01	14.3%
Vinyl Chloride	mg/L	3.16E-02	6.96E-01	7.32E-03	3.99E-02	2.89E-01	1.03E+00	0.5%
cis-1,2-Dichloroethene	mg/L	4.53E-02	3.00E-01	4.32E-03	1.64E-01	1.19E+01	1.66E+00	0.8%
trans-1,2-Dichloroethylene	mg/L	4.10E-02	1.36E-01	2.15E-04	7.43E-02	5.38E-01	7.48E-01	0.3%
Total			6.10E+01	1.31E+00	1.90E+01	1.38E+02	**2.19E+02**	
Percent of Total			27.9%	0.6%	8.7%	62.9%		

[a] Only COPCs that can be quantitatively evaluated are listed.

Table G.51. HI (child) for RGA groundwater COPCs at SWMU 1[a]

Chemical	Units	Exposure Point Concentration	Child Ingestion Hazard	Child Dermal Hazard	Child Shower Inhalation Hazards	Child Household Inhalation Hazard	Child Household Inhalation Hazard (Vapor Intrusion)	Total Hazard Child	Percent of Total
Inorganic Chemicals (Metals)									
Arsenic	mg/L	4.36E-03	9.61E-01	3.38E-03				9.64E-01	1.0%
Barium	mg/L	4.62E-01	4.36E-01	8.98E-03				4.45E-01	0.5%
Chromium	mg/L	2.97E-02	1.31E-03	3.77E-04				1.69E-03	<0.1%
Cobalt	mg/L	2.11E-01	2.33E-01	4.19E-04				2.33E-01	0.2%
Iron	mg/L	5.57E+00	1.23E+00	1.18E-02				1.24E+00	1.3%
Manganese	mg/L	3.97E+00	1.09E+01	3.94E-01				1.13E+01	11.4%
Nickel	mg/L	1.47E-01	4.86E-01	2.59E-03				4.89E-01	0.5%
Zinc	mg/L	3.15E-02	6.94E-03	5.00E-05				6.99E-03	<0.1%
Organic Compounds									
1,1-Dichloroethene	mg/L	7.00E-04	5.14E-03	6.59E-05	2.82E-03	2.04E-02		2.84E-02	<0.1%
Chloroform	mg/L	3.20E-03	2.12E-02	1.36E-03	1.35E+00	9.77E+00		1.11E+01	11.2%
Trichloroethene	mg/L	7.80E-01	8.60E+00	1.32E+00	4.72E+00	3.42E+01	2.17E+01	7.05E+01	71.2%
cis-1,2-Dichloroethene	mg/L	6.70E-02	4.43E-01	6.38E-03	2.43E-01	1.76E+00	2.75E-01	2.73E+00	2.8%
Total			2.29E+01	1.74E+00	6.07E+00	4.40E+01	2.17E+01	**9.91E+01**	
Percent of Total	_	_	23.1%	1.8%	6.1%	44.4%	21.9%	_	_

[a] Only COPCs that can be quantitatively evaluated are listed.

Deleted: 8
Deleted: Chemical ... [39]
Formatted Table
Deleted: 06-064(E)/041406
Formatted: Not Highlight
Deleted: entration
Formatted Table
Deleted: 0.97
Deleted: 45
Deleted: 0.00%
Deleted: 24
Deleted: 25
Deleted: 39
Deleted: 49
Deleted: 0.01%
Deleted: 0.03%
Deleted: 24
Deleted: 17
Deleted: 75
Deleted: 09
Formatted: Not Highlight
Deleted: 76
Formatted: Not Highlight
Deleted: 3
Deleted: 38
Formatted: Not Highlight
Deleted: 89
Formatted: Not Highlight

051706

Table G.52. HI (child) for RGA groundwater COPCs at the C-720 Building area[a]

COPC	Units	Exposure Point Concentration	Child Ingestion Hazard	Child Dermal Hazard	Child Shower Inhalation Hazards	Child Household Inhalation Hazard	Child Household Inhalation Hazard (Vapor Intrusion)	Total Hazard Child	Percent of Total
				Inorganic Chemicals (Metals)					
Arsenic	mg/L	4.26E-03	9.39E-01	3.30E-03				9.42E-01	0.9%
Barium	mg/L	4.22E-01	3.99E-01	8.20E-03				4.07E-01	0.4%
Chromium	mg/L	3.80E-01	1.68E-02	4.82E-03				2.16E-02	<0.1%
Cobalt	mg/L	2.86E-02	3.15E-02	5.67E-05				3.16E-02	<0.1%
Copper	mg/L	5.50E-02	9.83E-02	4.72E-04				9.88E-02	0.1%
Iron	mg/L	3.12E+01	6.88E+00	6.60E-02				6.95E+00	6.8%
Manganese	mg/L	4.25E+00	1.17E+01	4.22E-01				1.21E+01	11.9%
Nickel	mg/L	7.01E-01	2.32E+00	1.24E-02				2.33E+00	2.3%
				Organic Compounds					
1,1-Dichloroethene	mg/L	5.40E-02	3.97E-01	5.09E-03	2.17E-01	1.57E+00		2.19E+00	2.2%
Trichloroethene	mg/L	7.38E-01	8.14E+00	1.25E+00	4.47E+00	3.23E+01	2.81E+01	7.43E+01	73.1%
Vinyl chloride	mg/L	2.10E-03	4.63E-02	4.87E-04	2.65E-03	1.92E-02	3.39E-01	4.08E-01	0.4%
cis-1,2-Dichloroethene	mg/L	3.10E-02	2.05E-01	2.95E-03	1.12E-01	8.13E-01	3.54E-01	1.49E+00	1.5%
trans-1,2-Dichloroethene	mg/L	1.40E-02	4.63E-02	7.33E-05	2.54E-02	1.84E-01	4.43E-02	3.00E-01	0.3%
Total			3.12E+01	1.78E+00	4.83E+00	3.49E+01	2.88E+01	1.02E+02	
Percent of Total	-	-	30.7%	1.8%	4.8%	34.4%	28.4%	-	-

[a] Only COPCs that can be quantitatively evaluated are listed.

Deleted: 9
Deleted: Chemical ... [40]
Deleted: 06-064(E)/041406
Deleted:
Formatted: Highlight
Deleted: 93
Deleted: 0
Deleted: 0.02%
Deleted: 0.03%
Deleted: 0
Deleted: 4
Deleted: 4
Deleted: 0
Deleted: 16
Deleted: 3
Deleted: 0
Deleted: 46
Deleted: 0
Deleted: 4
Deleted: 75
Deleted: 75
Deleted: 36
Deleted: 0

051706

Table G.53. HI (child) for RGA groundwater COPCs at the storm sewer[a]

Chemical	Units	Exposure Point Concentration	Child Ingestion Hazard	Child Dermal Hazard	Child Shower Inhalation Hazards	Child Household Inhalation Hazard	Total Hazard Child	Percent of Total
				Organic Compounds				
1,1-Dichloroethene	mg/L	1.00E-04	7.35E-04	9.42E-06	4.03E-04	2.92E-03	4.06E-03	0.6%
Trichloroethene	mg/L	1.00E-02	1.10E-01	1.69E-02	6.05E-02	4.38E-01	6.26E-01	99.4%
Total			1.11E-01	1.69E-02	6.09E-02	4.41E-01	**6.30E-01**	
Percent of Total			17.6%	2.7%	9.7%	70.0%		

[a] Only COPCs that can be quantitatively evaluated are listed.

Deleted: 60

Deleted: 06-064(E)/041406

Deleted: Table G.61. HI (child) for RGA groundwater COPCs at SWMU 4[a]
Chemical ... [41]

051706

Deleted: Page Break

Deleted: 62

Deleted: 06-064(E)/041406

Table G.54. HI (adult) for all Southwest Plume RGA groundwater COPCs[a]

Chemical	Units	Exposure Point Concentration	Adult Ingestion Hazard	Adult Dermal Hazard	Adult Shower Inhalation Hazards	Adult Household Inhalation Hazard	Total Hazard Adult	Percent of Total
				Inorganic Chemicals (Metals)				
Aluminum	mg/L	2.40E+00	6.58E-02	1.20E-03			6.70E-02	0.1%
Arsenic	mg/L	3.46E-03	3.16E-01	1.40E-03			3.18E-01	0.5%
Barium	mg/L	1.75E-01	6.86E-02	1.78E-03			7.04E-02	0.1%
Chromium	mg/L	8.49E-02	1.55E-03	5.63E-04			2.11E-03	<0.1%
Cobalt	mg/L	2.30E-02	1.05E-02	2.38E-05			1.05E-02	<0.1%
Copper	mg/L	1.98E-02	1.47E-02	8.88E-05			1.48E-02	<0.1%
Iron	mg/L	2.63E+01	2.40E+00	2.90E-02			2.43E+00	4.2%
Manganese	mg/L	1.34E+00	1.53E+00	6.94E-02			1.60E+00	2.7%
Molybdenum	mg/L	5.98E-02	3.28E-01	1.57E-03			3.29E-01	0.6%
Nickel	mg/L	1.67E-01	2.29E-01	1.54E-03			2.31E-01	0.4%
Selenium	mg/L	3.94E-03	2.16E-02	8.90E-05			2.17E-02	<0.1%
Uranium	mg/L	3.50E-01	1.60E+01	3.41E-02			1.60E+01	27.4%
Vanadium	mg/L	1.91E-02	7.46E-02	1.35E-02			8.82E-02	0.2%
Zinc	mg/L	1.38E-01	1.26E-02	1.14E-04			1.27E-02	<0.1%
				Organic Compounds				
1,1-Dichloroethene	mg/L	1.86E-02	5.68E-02	9.17E-04	1.55E-02	1.13E-01	1.86E-01	0.3%
1,2-Dichloroethane	mg/L	9.17E-02	8.38E-02	8.06E-04	4.90E-01	3.55E+00	4.13E+00	7.1%
Acetone	mg/L	4.90E-02	1.34E-02	1.67E-05	3.67E-03	2.66E-02	4.37E-02	0.1%
Benzene	mg/L	1.60E-02	1.46E-01	5.74E-03	7.06E-02	5.12E-01	7.34E-01	1.3%
Bromodichloromethane	mg/L	1.00E-03	1.37E-03	1.47E-05	3.74E-04	2.71E-03	4.47E-03	<0.1%
Bromomethane	mg/L	3.87E-03	7.58E-02	6.02E-04	2.03E-02	1.47E-01	2.44E-01	0.4%
Carbon Tetrachloride	mg/L	2.45E-02	9.59E-01	5.89E-02	2.63E-01	1.91E+00	3.19E+00	5.5%
Chloroform	mg/L	2.73E-02	7.47E-02	6.03E-03	2.38E+00	1.72E+01	1.97E+01	33.7%
Chloromethane	mg/L	1.00E-02			2.91E-03	2.11E-02	2.40E-02	<0.1%
Dibromochloromethane	mg/L	2.00E-03	2.74E-03	3.23E-05	7.48E-04	5.42E-03	8.94E-03	<0.1%
Methylene Chloride	mg/L	6.63E-02	3.03E-02	2.60E-04	5.79E-04	4.19E-03	3.53E-02	0.1%
Tetrachloroethene	mg/L	4.00E-03	1.10E-02	7.36E-03	1.75E-04	1.26E-03	1.98E-02	<0.1%
Trichloroethene	mg/L	5.01E-01	2.29E+00	4.43E-01	6.28E-01	4.55E+00	7.91E+00	13.5%
Vinyl Chloride	mg/L	3.16E-02	2.88E-01	3.82E-03	8.27E-03	5.99E-02	3.60E-01	0.6%
cis-1,2-Dichloroethene	mg/L	4.53E-02	1.24E-01	2.25E-03	3.40E-02	2.46E-01	4.07E-01	0.7%
trans-1,2-Dichloroethene	mg/L	4.10E-02	5.62E-02	1.12E-04	1.54E-02	1.11E-01	1.83E-01	0.3%
Total			2.53E+01	6.84E-01	3.93E+00	2.85E+01	**5.84E+01**	
Percent of Total			43.3%	1.2%	6.7%	48.8%		

[a] Only COPCs that can be quantitatively evaluated are listed.

051706

Table G.55. HI (adult) for RGA groundwater COPCs at SWMU 1[a]

Chemical	Units	Exposure Point Concentration	Adult Ingestion Hazard	Adult Dermal Hazard	Adult Shower Inhalation Hazards	Adult Household Inhalation Hazard	Adult Household Inhalation Hazard (Vapor Intrusion)	Total Hazard Adult	Percent of Total
Inorganic Chemicals (Metals)									
Arsenic	mg/L	4.36E-03	3.98E-01	1.76E-03				4.00E-01	1.5%
Barium	mg/L	4.62E-01	1.81E-01	4.69E-03				1.86E-01	0.7%
Chromium	mg/L	2.97E-02	5.42E-04	1.97E-04				7.39E-04	<0.1%
Cobalt	mg/L	2.11E-01	9.63E-02	2.19E-04				9.65E-02	0.4%
Iron	mg/L	5.57E+00	5.09E-01	6.15E-03				5.15E-01	2.0%
Manganese	mg/L	3.97E+00	4.53E+00	2.06E-01				4.74E+00	18.1%
Nickel	mg/L	1.47E-01	2.01E-01	1.35E-03				2.02E-01	0.8%
Zinc	mg/L	3.15E-02	2.88E-03	2.61E-05				2.91E-03	<0.1%
Organic Compounds									
1,1-Dichloroethene	mg/L	7.00E-04	2.13E-03	3.44E-05	5.84E-04	4.23E-03		6.98E-03	<0.1%

05102007

Deleted: 63
Deleted: 06-064(E)/041406
Deleted: Chemical ... [42]
Deleted: *Inorganic Chemicals (Metals)*
Deleted: Arsenic ... [43]
Deleted: Barium ... [44]
Deleted: Chromium ... [45]
Deleted: Cobalt ... [46]
Deleted: Iron ... [47]
Deleted: Manganese ... [48]
Deleted: Nickel ... [49]
Deleted: Zinc ... [50]
Deleted: *Organic Compounds*
Deleted: 1,1-Dichloroethene ... [51]
Deleted: Chloroform ... [52]
Deleted: Trichloroethene ... [53]
Deleted: *cis*-1,2-Dichloroethen ... [54]
Deleted: Total ... [55]
Deleted: Percent of Total ... [56]
Formatted: Highlight
Deleted: 3
Deleted: 1
Deleted: 0.00%
Deleted: 37
Deleted: 1.97
Deleted: 2
Deleted: 77
Deleted: 0.01%
Deleted: 0.03%

051706

Chloroform	mg/L	3.20E-03	8.77E-03	7.08E-04	2.79E-01	2.02E+00		2.31E+00	8.8%
Trichloroethene	mg/L	7.80E-01	3.56E+00	6.90E-01	9.77E-01	7.08E+00	4.50E+00	1.68E+01	64.3%
cis-1,2-Dichloroethene	mg/L	6.70E-02	1.84E-01	3.33E-03	5.03E-02	3.64E-01	2.75E-01	8.77E-01	3.4%
Total			9.67E+00	9.14E-01	1.31E+00	9.47E+00	4.78E+00	**2.61E+01**	
Percent of Total	_	_	37.0%	3.5%	5.0%	36.2%	18.3%	_	_

[a] Only COPCs that can be quantitatively evaluated are listed.

FINAL PROCESSING NEEDS TO ACTUALLY DELETE ORIGINAL TABLE

Deleted: 3
Deleted: 06-064(E)/041406
Deleted: 0
Deleted: 35
Deleted: 1
Deleted: 0
Deleted: 0
Deleted: 2
Deleted: 27

051706

Table G.56. HI (adult) for RGA groundwater COPCs at the C-720 Building area[a]

FINAL PROCESSING NEEDS TO ACTUALLY DELETE ORIGINAL TABLE

Chemical	Units	Exposure Point Concentration	Adult Ingestion Hazard	Adult Dermal Hazard	Adult Shower Inhalation Hazards	Adult Household Inhalation Hazard	Adult Household Inhalation Hazard (Vapor Intrusion)	Total Hazard Adult	Percent of Total
Inorganic Chemicals (Metals)									
Arsenic	mg/L	4.26E-03	3.89E-01	1.72E-03				3.91E-01	1.7%
Barium	mg/L	4.22E-01	1.65E-01	4.28E-03				1.69E-01	0.7%
Chromium	mg/L	3.80E-01	6.94E-03	2.52E-03				9.46E-03	<0.1%
Cobalt	mg/L	2.86E-02	1.31E-02	2.96E-05				1.31E-02	<0.1%
Copper	mg/L	5.50E-02	4.07E-02	2.46E-04				4.09E-02	0.2%
Iron	mg/L	3.12E+01	2.85E+00	3.45E-02				2.88E+00	12.5%
Manganese	mg/L	4.25E+00	4.85E+00	2.20E-01				5.07E+00	21.9%
Nickel	mg/L	7.01E-01	9.60E-01	6.46E-03				9.66E-01	4.2%
Organic Compounds									
1,1-Dichloroethene	mg/L	5.40E-02	1.64E-01	2.66E-03	4.50E-02	3.26E-01		5.38E-01	2.3%
Trichloroethene	mg/L	7.38E-01	3.37E+00	6.53E-01	9.25E-01	6.70E+00	5.81E-01	1.22E+01	52.9%
Vinyl chloride	mg/L	2.10E-03	1.92E-02	2.54E-04	5.50E-04	3.98E-03	7.02E-02	9.42E-02	0.4%
cis-1,2-Dichloroethene	mg/L	3.10E-02	8.49E-02	1.54E-03	2.33E-02	1.68E-01	7.32E-02	3.51E-01	1.5%
trans-1,2-Dichloroethene	mg/L	1.40E-02	1.92E-02	3.83E-05	5.25E-03	3.80E-02	9.17E-03	3.51E-01	1.5%
Total			1.29E+01	9.27E-01	9.94E-01	7.20E+00	7.24E-01		
Percent of Total			55.9%	4.0%	4.3%	31.2%	3.1%	**2.31E+01**	

[a] Only that can be quantitatively evaluated are listed.

Deleted: 4
Deleted: 06-064(E)/041406
Deleted: Chemical ... [57]
Deleted: *Inorganic Chemicals (Metals)*
Deleted: Arsenic ... [58]
Deleted: Barium ... [59]
Deleted: Chromium ... [60]
Deleted: Cobalt ... [61]
Deleted: Copper ... [62]
Deleted: Iron ... [63]
Deleted: Manganese ... [64]
Deleted: Nickel ... [65]
Deleted: *Organic Compounds*
Deleted: 1,1-Dichloroethene ... [66]
Deleted: Trichloroethene ... [67]
Deleted: Vinyl chloride ... [68]
Deleted: *cis*-1,2-Dichloroethen ... [69]
Deleted: *trans*-1,2-Dichloroeth ... [70]
Deleted: Total ... [71]
Formatted ... [72]
Deleted: [a] Only that can be ... [73]
Deleted: Percent of Total ... [74]
Deleted: 69
Deleted: 3
Deleted: 0.04%
Deleted: 0.06%
Deleted: 18
Deleted: 48
Deleted: 4
Deleted: 18
Deleted: 3
Deleted: 2
Deleted: 1
Deleted: 2
Deleted: 2

Table G.57. HI (adult) for RGA groundwater COPCs at the storm sewer[a]

Deleted: 6

Deleted: 06-064(E)/041406

Chemical	Units	Exposure Point Concentration	Adult Ingestion Hazard	Adult Dermal Hazard	Adult Shower Inhalation Hazards	Adult Household Inhalation Hazard	Total Hazard Adult	Percent of Total
				Organic Compounds				
1,1-Dichloroethene	mg/L	1.00E-04	3.04E-04	4.92E-06	8.34E-05	6.04E-04	9.97E-04	0.6%
Trichloroethene	mg/L	1.00E-02	4.57E-02	8.84E-03	1.25E-02	9.07E-02	1.58E-01	99.4%
Total			4.60E-02	8.85E-03	1.26E-02	9.13E-02	**1.59E-01**	
Percent of Total			29.0%	5.6%	7.9%	57.5%		

[a] Only COPCs that can be quantitatively evaluated are listed.

051706

Table G.58. ELCR for all Southwest Plume RGA groundwater COPCs[a]

COPC	Units	Exposure Point Concentration	Total Ingestion Risk	Total Dermal Risk	Total Shower Inhalation Risk	Total Household Inhalation Risk	Total Risk	Percent of Total
Inorganic Chemicals (Metals)								
Arsenic, Inorganic	mg/L	3.46E-03	9.86E-05	4.10E-07			9.90E-05	3.5%
Organic Compounds								
1,1-Dichloroethene	mg/L	1.86E-02	2.12E-04	3.22E-06	2.20E-05	1.59E-04	3.96E-04	13.9%
1,2-Dichloroethane	mg/L	9.17E-02	1.58E-04	1.43E-06	5.62E-05	4.07E-04	6.23E-04	21.9%
Benzene	mg/L	1.60E-02	1.67E-05	6.16E-07	2.94E-06	2.13E-05	4.15E-05	1.5%
Bromodichloromethane	mg/L	1.00E-03	1.18E-06	1.19E-08	4.17E-07	3.02E-06	4.63E-06	0.2%
Carbon Tetrachloride	mg/L	2.45E-02	6.05E-05	3.48E-06	8.66E-06	6.27E-05	1.35E-04	4.8%
Chloroform	mg/L	2.73E-02	3.16E-06	2.39E-07	1.48E-05	1.07E-04	1.25E-04	4.4%
Chloromethane	mg/L	1.00E-02	2.47E-06	2.21E-08	4.24E-07	3.07E-06	5.98E-06	0.2%
Dibromochloromethane	mg/L	2.00E-03	3.19E-06	3.53E-08	1.13E-06	8.19E-06	1.25E-05	0.4%
Methylene Chloride	mg/L	6.63E-02	9.44E-06	7.61E-08	7.36E-07	5.33E-06	1.56E-05	0.5%
Tetrachloroethene	mg/L	4.00E-03	3.95E-06	2.49E-06	5.38E-08	3.90E-07	6.88E-06	0.2%
Trichloroethene	mg/L	5.01E-01	1.05E-04	1.90E-05	2.02E-05	1.47E-04	2.90E-04	10.2%
Vinyl Chloride	mg/L	3.16E-02	8.39E-04	1.04E-05	6.54E-06	4.74E-05	9.03E-04	31.7%
Radionuclides								
Neptunium-237	pCi/L	1.59E+00	2.77E-06				2.77E-06	0.1%
Technetium-99	pCi/L	1.70E+02	1.21E-05				1.21E-05	0.4%
Thorium-230	pCi/L	2.07E-01	4.87E-07				4.87E-07	<0.1%
Uranium-234	pCi/L	4.08E+01	7.48E-05				7.48E-05	2.6%
Uranuim-238	pCi/L	4.21E+01	9.49E-05				9.49E-05	3.3%
Total			1.70E-03	4.15E-05	1.34E-04	9.71E-04	**2.84E-03**	
Percent of Total			59.7%	1.5%	4.7%	34.1%		

[a] Only COPCs that can be quantitatively evaluated are listed.

Deleted: Table G.66. HI (adult) for RGA groundwater COPCs at SWMU 4[a]
Chemical ... [75]

Deleted: 06-064(E)/041406

Deleted: Page Break

Deleted: 67

G-131

051706

Table G.59. ELCR for RGA groundwater COPCs at SWMU 1[a]

FINAL PROCESSING NEEDS TO ACTUALLY DELETE ORIGINAL TABLE

COPC	Units	Exposure Point Concentration	Total Ingestion Risk	Total Dermal Risk	Total Shower Inhalation Risk	Total Household Inhalation Risk	Total Household Inhalation Risk (Vapor Intrusion)	Total Risk	Percent of Total
Inorganic Chemicals (Metals)									
Arsenic	mg/L	4.36E-03	1.24E-04	5.15E-07				1.25E-04	18.2%
Organic Compounds									
1,1-Dichloroethene	mg/L	7.00E-04	7.97E-06	1.21E-07	8.24E-07	5.97E-06		1.49E-05	2.2%
Chloroform	mg/L	3.20E-03	3.70E-07	2.81E-08	1.73E-06	1.26E-05		1.47E-05	2.2%
Trichloroethene	mg/L	7.80E-01	1.63E-04	2.96E-05	3.15E-05	2.28E-04	7.82E-05	5.30E-04	77.5%
Radionuclides									
Technetium-99	pCi/L	2.39E+01	1.70E-06	-	-	-	-	1.70E-06	0.3%
Total			2.97E-04	3.03E-05	3.41E-05	2.47E-04	7.82E-05	6.84E-04	
Percent of Total	-	-	43.4%	4.4%	5.0%	36.0%	11.4%	-	-

[a] Only COPCs that can be quantitatively evaluated are listed.

Deleted: 68
Deleted: 06-064(E)/041406
Deleted: COPC ... [76]
Deleted: *Inorganic Chemicals (Metals)*
Deleted: Arsenic ... [77]
Deleted: *Organic Compounds*
Deleted: 1,1-Dichloroethene ... [78]
Deleted: Chloroform ... [79]
Deleted: Trichloroethene ... [80]
Deleted: *Radionuclides*
Deleted: Technetium-99 ... [81]
Deleted: **Total** ... [82]
Formatted: Not Highlight
Deleted: [a] Only COPCs that can be quantitatively evaluated are listed.
Deleted: **Percent of Total** ... [83]
Formatted: Highlight
Deleted: 19
Deleted: 17
Deleted: 15
Deleted: 48
Deleted: 25
Deleted: 0… ... [84]

051706

Table G.60. ELCR for RGA groundwater COPCs at the C-720 Building area[a]

COPC	Units	Exposure Point Concentration	Total Ingestion Risk	Total Dermal Risk	Total Shower Inhalation Risk	Total Household Inhalation Risk	Total Household Inhalation Risk (Vapor Intrusion)	Total Risk	Percent of Total
Inorganic Chemicals (Metals)									
Arsenic	mg/L	4.26E-03	1.21E-04	5.04E-07				1.22E-04	6.8%
Organic Compounds									
1,1-Dichloroethene	mg/L	5.40E-02	6.15E-04	9.32E-06	6.36E-05	4.61E-04		1.15E-03	63.9%
Trichloroethene	mg/L	7.38E-01	1.54E-04	2.80E-05	2.98E-05	2.16E-04	1.01E-05	4.38E-04	24.4%
Vinyl chloride	mg/L	2.10E-03	5.58E-05	6.94E-07	4.35E-07	3.15E-06	3.00E-05	9.01E-05	5.0%
Radionuclides									
Technetium-99	pCi/L	9.34E+01	6.65E-06	-	-	-	-	6.65E-06	0.4%
Total			9.52E-04	3.85E-05	9.38E-05	6.80E-04	4.01E-05	1.80E-03	
Percent of Total	-	-	53.0%	2.1%	5.2%	37.8%	2.2%	-	-

[a] Only COPCs that can be quantitatively evaluated are listed

Deleted: 9
Deleted: COPC ... [85]
Deleted: 06-064(E)/041406
Deleted: 76
Deleted: 89
Deleted: 35
Deleted: 1
Deleted: 37
Deleted: 52.96
Deleted: 4
Deleted: 2
Deleted: 2
Deleted: 3

Table G.61. ELCR for RGA groundwater COPCs at the storm sewer[a]

COPC	Units	Exposure Point Concentration	Total Ingestion Risk	Total Dermal Risk	Total Shower Inhalation Risk	Total Household Inhalation Risk	Total Risk	Percent of Total
				Organic Compounds				
1,1-Dichloroethene	mg/L	1.00E-04	1.14E-06	1.73E-08	1.18E-07	8.53E-07	2.13E-06	26.8%
Trichloroethene	mg/L	1.00E-02	2.09E-06	3.79E-07	4.04E-07	2.92E-06	5.79E-06	73.2%
Total			3.23E-06	3.96E-07	5.22E-07	3.78E-06	**7.92E-06**	
Percent of Total			40.7%	5.0%	6.6%	47.7%		

[a] Only COPCs that can be quantitatively evaluated are listed.

Deleted: 70

Deleted: 06-064(E)/041406

Deleted: Table G.71. ELCR for RGA groundwater COPCs at SWMU 4[a]¶ COPC ... [86]

051706

G5.3.1 Systemic toxicity

Tables G.50 through G.53 summarize the HIs for exposure routes for the child resident. As shown in these tables, the total scenario HIs are greater than 1 for the Southwest Plume (total HI = 219) and for all but the storm sewer source (total HI = 0.6). The greatest HI is for Southwest Plume (total HI (child) = 95. In each case, the driving exposure routes are ingestion of groundwater, inhalation of gases emitted while using groundwater in the home, and vapor intrusion from the groundwater into basements, which together account for about 90% of the total HI. Also, in each case, the dermal exposure route contributes least to total HI.

Tables F.50 through G.53 also indicate the percentage of the total HI contributed by each COPC. As shown, the organic compounds chloroform and TCE are the primary driving COPCs. Metals also are important contributors for the Southwest Plume (uranium) and at SWMU 1 (manganese) and the C-720 Building area (manganese).

Tables G.54 through G.57 summarize the HIs for exposure routes for the adult resident. As shown in these tables, the total scenario HIs are greater than 1 for the Southwest Plume (total HI = 60) and for all but the storm sewer source (total HI = 0.2). The greatest HI is for Southwest Plume (total HI = 59. In each case, the driving exposure route is ingestion of groundwater, inhalation of gases emitted while using groundwater in the home, and vapor intrusion from the groundwater into basements, which together account for about 90% of the total HI. Also, in each case, the dermal exposure route contributes least to total HI.

Tables G.54 through G.57 also indicate the percentage of the total HI contributed by each COPC. As shown, the organic compounds chloroform and TCE are the primary driving COPCs in each case. Metals also are important contributors over all the Southwest Plume (uranium) and at SWMU 1 (manganese) and the C-720 Building area (iron and manganese).

G5.3.2 Excess lifetime cancer risk

Tables G.58 through 61 summarize the ELCRs for exposure routes for the resident over a lifetime. As shown in these tables, the total ELCRs are greater than 1×10^{-4} for all but the storm sewer source (total ELCR = 8×10^{-6}). The source with the greatest total ELCR is Southwest Plume (total ELCR = 3×10^{-3}). In each case, the driving exposure routes are ingestion of groundwater, inhalation of gases emitted while using groundwater in the home, and vapor intrusion from the groundwater into basements, which account for about 90% of the total ELCR. Also, in each case, the dermal exposure route contributes least to total ELCR.

Tables G.58 through G.61 also indicate the percentage of the total ELCR for the resident contributed by each COPC. As shown, organic compounds (especially 1,2-DCA; 1,1-DCE; TCE; and VC) are the driving COPCs. The single metal COPC (arsenic) and the radionuclides are of much less importance.

G5.4 RISK CHARACTERIZATION FOR RESIDENTIAL USE OF GROUNDWATER AT FUTURE MODELED CONCENTRATIONS

This subsection discusses the potential future risks to a hypothetical resident using RGA groundwater contaminated by migration of COPCs from the SWMU 1 and C-720 Building area sources. As discussed in Section 2 of this BHHRA, the POEs to which contaminants were modeled were the PGDP plant boundary, PGDP property boundary, and near the Ohio River. Information about the methods used in the model is in Section 5 and Appendix F of the SI.

Deleted: 7
Deleted: 61
Deleted: 00
Deleted: 102SWMU 4 (total HI (child) = 900)
Deleted: and
Deleted:
Deleted: 7
Deleted: 61
Deleted: also
Deleted: 62
Deleted: 66
Deleted: 60SWMU 4 (total HI = 200)
Deleted: and
Deleted: ,
Deleted:
Deleted: 62
Deleted: 66
Deleted: 67
Deleted: 7
Deleted: 2.84
Deleted: .SWMU 4 (total ELCR = 6×10^{-3})
Deleted: The total ELCR for the Southwest Plume (3×10^{-3}) is similar to the SWMU 4 total ELCR.
Deleted: and
Deleted: ,
Deleted:
Deleted: 67
Deleted: 7
Deleted: ,
Deleted: and SWMU 4
Deleted: 06-064(E)/041406

Table G.62 presents the chemical-specific HIs for the child and adult rural residents from exposure to the 95% UCL of the modeled peak median concentration of TCE and the maximum modeled concentrations of other contaminants in the RGA at the POEs based on household use of water and basement vapor intrusion. As shown in this table, total HI for the child for migration from the C-720 Building area source is less than 1 at all three POEs. Total HI for the child for migration from the SWMU 1 source exceeds 1 at the plant boundary POE with TCE driving the result.

Table G.63 presents the chemical-specific ELCRs for a rural resident from exposure to maximum modeled concentrations of contaminants in the RGA at the POEs based on household use of water and basement vapor intrusion. As shown in this table, total ELCRs resulting from COPC migration are above or equal to 1 × 10^{-6} at both the plant boundary and property boundary POEs for all sources. The COPCs contributing most to total ELCR is TCE and VC.

Deleted: 7

Deleted: for household use of water by

Deleted: the

Deleted: Finally, total HI for the child for migration from the SWMU 4 source exceeds 1 at the plant boundary and property boundary POEs, with TCE and *cis*-1,2-DCE driving these results.

Deleted: 7

Deleted: household use of water by

Deleted:

Deleted:

Deleted: The SWMU 4 source also has a total ELCR greater than 1 × 10^{-4} at the plant boundary POE. For both sources, t

G5.5 RISK CHARACTERIZATION FOR LEAD

Unlike the other analytes included in this risk assessment, the risks from exposure to lead are estimated through comparison of detected concentrations to a regulatory screening value provided in the Risk Methods Document (i.e., primary MCL of 15 µg/L). (The Risk Methods Document also notes that the EPA Integrated Exposure Uptake Biokinetic [IEUBK] Model for Lead should also be run when characterizing the risks for lead. This model was run for SWMUs 1 and the C-720 Building area in the previous BHHRAs. Those results indicate that lead is a COC at each of the source units when exposure is to both soil and groundwater.)

Deleted: and 4

Deleted: 06-064(E)/041406

Table G.62. HIs at POEs at the plant boundary, property boundary, and near the Ohio River for household use of groundwater water contaminated by COPC migration from the C-720 Building area, and SWMU 1

COPC[a]	HI (child) at POE Plant Boundary	HI (child) at POE Property Boundary	HI (child) at POE Near Ohio River	HI (adult) at POE Plant Boundary	HI (adult) at POE Property Boundary	HI (adult) at POE Near Ohio River
C-720 Building area Variable Degradation Scenario						
Trichloroethene	1.18E-01	<0.1	<0.1	2.99E-02	<0.1	<0.1
cis-1,2-Dichloroethene	1.17E-01	7.69E-02	NR	2.88E-02	1.89E-02	NR
trans-1,2-Dichloroethene	2.74E-03	1.28E-03	NR	6.70E-04	3.13E-04	NR
Vinyl chloride	2.61E-03	1.31E-03	NR	9.13E-04	4.57E-04	NR
Total HI [b]	**2.39E-01**	**<0.1**	<0.1	**6.03E-02**	**1.20E-01**	<0.1
C-720 Building area Fixed Degradation Scenario						
Trichloroethene	4.04E-01	1.76E-01	<0.1	1.02E-01	4.43E-02	<0.1
cis-1,2-Dichloroethene	1.17E-01	7.69E-02	NR	2.88E-02	1.89E-02	NR
trans-1,2-Dichloroethene	2.74E-03	1.28E-03	NR	6.70E-04	3.13E-04	NR
Vinyl chloride	2.61E-03	1.31E-03	NR	9.13E-04	4.57E-04	NR
Total HI [b]	5.26E-01	2.56E-01	<0.1	**1.07E-01**	**<0.1**	**<0.1**
SWMU 1- Variable Degradation Scenario						
Trichloroethene	6.18E+00	2.23E-01	<0.1	1.56E+00	5.46E-02	<0.1
cis-1,2-Dichloroethene	5.90E-01	1.14E-01	NR	1.45E-01	2.79E-02	NR
trans-1,2-Dichloroethene	3.72E-01	6.57E-02	NR	9.11E-02	1.61E-02	NR
Vinyl chloride	5.23E-03	9.80E-04	NR	1.83E-03	3.42E-04	NR
Total HI [b]	**7.12E+00**	**3.99E-01**	**<0.1**	**1.70E+00**	**1.01E-01**	**<0.1**
SWMU 1- Fixed Degradation Scenario						
Trichloroethene	4.62E+00	7.73E-01	<0.1	1.17E+00	1.95E-01	<0.1
cis-1,2-Dichloroethene	5.90E-01	1.14E-01	NR	1.45E-01	2.79E-02	NR
trans-1,2-Dichloroethene	3.72E-01	6.57E-02	NR	9.11E-02	1.61E-02	NR
Vinyl chloride	5.23E-03	9.80E-04	NR	1.83E-03	3.42E-04	NR
Total HI [b]	5.59E+00	9.54E-01	**<0.1**	1.41E+00	2.39E-01	<0.1

NR = no modeling result available.

[a] *Results for TCE are from probabilistic modeling, other COPC results from deterministic evaluation (see Appendix F)*

[b] Total HIs are calculated by summing chemical-specific HIs derived using maximum concentrations because all COPCs are expected to reach their maximum concentration at the POEs at approximately the same time.

FINAL PROCESSING NEEDS TO ACTUALLY DELETE TABLE ROWS

Deleted: 7
Deleted: , and SWMU 4
Deleted: 4.74E-01
Deleted: *Scenerio*
Deleted: *Scenerio*
Deleted: *SWMU 4*
Deleted: Trichloroethene
Deleted: 1.10E+01
Deleted: 1.10E+00
Deleted: <0.1
Deleted: 2.73E+00
Deleted: 2.77E-01
Deleted: <0.1
Deleted: *cis*-1,2-Dichloroethene
Deleted: 6.37E+00
Deleted: 2.75E+00
Deleted: 9.45E-01
Deleted: 1.57E+00
Deleted: 6.76E-01
Deleted: 2.32E-01
Deleted: *trans*-1,2-Dichloroethene
Deleted: NR
Deleted: NR
Deleted: NR
Deleted: NR
Deleted: NR
Deleted: NR
Deleted: Vinyl chloride
Deleted: 1.21E-01
Deleted: 5.23E-02
Deleted: 6.54E-03
Deleted: 4.22E-02
Deleted: 1.83E-02
Deleted: 2.28E-03
Deleted: **Total HI [b]**
Deleted: **1.72E+01**
Deleted: **3.85E+00**
Deleted: **9.47E-01**
Deleted: **4.34E+00**
Deleted: **9.71E-01**
Deleted: **2.32E-01**
Formatted: Not Highlight
Deleted: 06-064(E)/041406

Table G.63. ELCRs at POEs at the plant boundary, property boundary, and near the Ohio River for household use of groundwater water contaminated by COPC migration from the C-720 Building area, and SWMU 1

COPC[a]	ELCR at POE: Plant Boundary	Property Boundary	Near Ohio River
C-720 Building area – Variable Degradation Scenario			
Trichloroethene	2.72E-07	<1.00E-06	<1.00E-06
cis-1,2-Dichloroethene	NC	NC	NC
trans-1,2-Dichloroethene	NC	NC	NC
Vinyl chloride	2.29E-06	1.14E-06	NR
Total ELCR[b]	2.56E-06	1.14E-06	0.00E+00
C-720 Building area – Fixed Degradation Scenario			
Trichloroethene	3.14E-06	1.2E-06	<1.00E-06
cis-1,2-Dichloroethene	NC	NC	NC
trans-1,2-Dichloroethene	NC	NC	NC
Vinyl chloride	2.29E-06	1.14E-06	NR
Total ELCR[b]	5.70E-06	2.36E-06	0.00E+00
SWMU 1– Variable Degradation Scenario			
Trichloroethene	1.45E-05	5.49E-07	<1.00E-06
cis-1,2-Dichloroethene	NC	NC	NC
trans-1,2-Dichloroethene	NC	NC	NC
Vinyl chloride	4.57E-06	8.57E-07	NR
Total ELCR[b]	1.91E-05	1.41E-06	0.00E+00
SWMU 1 – Fixed Degradation Scenario			
Trichloroethene	3.88E-05	5.32E-06	1.25E-07
cis-1,2-Dichloroethene	NC	NC	NC
trans-1,2-Dichloroethene	NC	NC	NC
Vinyl chloride	4.57E-06	8.57E-07	NR
Total ELCR[b]	4.34E-05	6.12E-06	0.00E+00

NC = not a carcinogen; NR = no modeling result available

[a] *Results for TCE are from probabilistic modeling, other COPC results from deterministic evaluation (see Appendix F).*

[b] Total ELCRs are calculated by summing chemical-specific ELCRs derived using maximum concentrations because all COPCs are expected to reach their maximum concentration at the POEs at approximately the same time.

FINAL PROCESSING NEEDS TO ACTUALLY DELETE TABLE ROWS

Table G.64 presents the comparison between the maximum concentrations for lead in groundwater at each source and over all the Southwest Plume to the screening value. This table shows that the maximum concentrations for lead in RGA groundwater in all data sets were less than the screening value; therefore, lead is not a COC for RGA groundwater in this BHHRA.

Deleted: 7
Deleted: , and SWMU 4
Deleted: *Degradetion*
Deleted: *Scenrio*
Deleted: *Degradetion*
Deleted: *Scenrio*
Deleted: *Degradetion*
Deleted: *Scenrio*
Deleted: *Degradetion*
Deleted: *Scenrio*
Deleted: *SWMU 4*
Deleted: Trichloroethene
Deleted: 2.54E-05
Deleted: 2.49E-06
Deleted: <1.00E-06
Deleted: *cis*-1,2-Dichloroethene
Deleted: NC
Deleted: NC
Deleted: NC
Deleted: *trans*-1,2-Dichloroethene
Deleted: NC
Deleted: NC
Deleted: NC
Deleted: Vinyl chloride
Deleted: 1.06E-04
Deleted: 4.57E-05
Deleted: 5.71E-06
Deleted: **Total ELCR[b]**
Deleted: **1.31E-04**
Deleted: **4.82E-05**
Deleted: **5.71E-06**
Formatted: Not Highlight
Deleted: 74
Deleted: 06-064(E)/041406

G5.6 IDENTIFICATION OF LAND USE SCENARIOS, PATHWAYS, MEDIA, AND COCS

This subsection identifies the land use scenarios of concern, POCs, media of concern, and COCs for each source and over the Southwest Plume. Section G8 presents the RGOs for each location and land use combination using the information compiled here.

To determine land use scenarios of concern, risk characterization results for total HI and total ELCR for each land use scenario at each location are compared to benchmarks of 1 and 1×10^{-6} for HI and ELCR, respectively. Land use scenarios with total HIs exceeding the benchmark of 1 are deemed land use scenarios of concern for HI. Land use scenarios with a total ELCR exceeding the benchmark of 1×10^{-6} are deemed land use scenarios of concern for ELCR. To determine COCs, the chemical-specific HI and

Table G.64. Comparison of lead EPCs to regulatory screening value[a]

Deleted: 7

Location	Lead EPC	Screening Value Exceeded?[b]
Southwest Plume	5.56 µg/L	No
SWMU 1	Not a COPC[c]	No
C-720 Building area	Not a COPC	No
Storm sewer	Not a COPC	No

Deleted: SWMU 4

Deleted: Not a COPC

Deleted: No

[a] The lead screening value is the primary maximum contaminant level (MCL) of 15 µg/L.
[c] When selecting COPCs, maximum detected results are compared to a lead no action screening value of 15 µg/L.

ELCR contributed by each COPC over all pathways within a land use scenario of concern are compared to benchmarks of 0.1 and 1×10^{-6} for chemical-specific HI and ELCR, respectively. COPCs with chemical-specific HIs or ELCRs that exceed these benchmarks are deemed COCs for that land use scenario of concern. To determine POCs, the exposure route HI and ELCR over all COPCs within the land use scenarios of concern are compared to benchmarks of 0.1 and 1×10^{-6} for exposure route HI and ELCR, respectively. Exposure routes with HIs and ELCRs that exceed these benchmarks are deemed POCs for that land use scenario of concern. Media of concern are determined by examining the POCs and selecting any medium that appears in a POC as a medium of concern.

G5.6.1 Land Use Scenarios of Concern

As noted previously, if the total HI or total risk for a land use scenario exceeds 1 or 1×10^{-6}, respectively, then that land use scenario is a land use scenario of concern for the location. Table G.65 shows that the residential use of groundwater is a scenario of concern for HI at each source except the storm sewer and at all three POEs examined as part of fate and transport modeling.

Deleted: 7

Deleted: 06-064(E)/041406

Table G.65. Scenario total HIs and ELCRs

Location	Total HI (child)[a]	Total ELCR[a]	Scenario of Concern?
At Source			
Southwest Plume	200	3×10^{-3}	Yes
SWMU 1	99	7×10^{-4}	Yes
C-720 Building area	102	2×10^{-3}	Yes
Storm Sewer	0.6	8×10^{-6}	Yes
At Plant Boundary POE used in Modeling – Variable Degradation			
SWMU 1	7	2×10^{-5}	Yes
C-720 Building area	0.2	3×10^{-6}	Yes
Storm Sewer	Not a source	Not a source	No
At Plant Boundary POE used in Modeling – Fixed Degradation			
SWMU 1	7	4×10^{-5}	Yes
C-720 Building area	0.5	6×10^{-6}	Yes
Storm Sewer	Not a source	Not a source	No
At Property Boundary POE used in Modeling – Variable Degradation			
SWMU 1	0.4	1×10^{-6}	Yes
C-720 Building area	<0.1	1×10^{-6}	Yes
Storm Sewer	Not a source	Not a source	No
At Property Boundary POE used in Modeling – Fixed Degradation			
SWMU 1	1	6×10^{-6}	Yes
C-720 Building area	0.3	2×10^{-6}	Yes
Storm Sewer	Not a source	Not a source	No
At Ohio River POE used in Modeling– Variable Degradation			
SWMU 1	0	0	No
C-720 Building area	0	0	No
Storm Sewer	Not a source	Not a source	No
At Ohio River POE used in Modeling – Fixed Degradation			
SWMU 1	0	0	No
C-720 Building area	0	0	No
Storm Sewer	Not a source	Not a source	No

[a] All values are rounded to one significant digit.

G5.6.2 COCs

Only those COPCs with chemical-specific ELCRs summed over all pathways within a land use scenario of concern greater than or equal to 1×10^{-6} or with HQs summed over all pathways greater than or equal to 0.1 are COCs. The COCs for HI and ELCR across all locations are summarized in Table G.66. As shown, there are a total of 21, 9, 9, and 0 COCs for HI in groundwater drawn from the RGA across the Southwest Plume and at SWMU 1, the C-720 Building area, and the storm sewer, respectively. There also are totals of 17, 5, 5, and 2 COCs for ELCR in groundwater drawn from the RGA across the Southwest Plume and at SWMU 1, the C-720 Building area, and the storm sewer, respectively. Of these COCs, the following are "priority COCs" because they have a chemical-specific HI or ELCR greater than or equal to 1 or 1×10^{-4} in one or more scenarios.

- Southwest Plume – arsenic; iron; manganese; uranium; 1,1-DCE; 1,2-DCA; benzene; bromomethane; carbon tetrachloride; chloroform; TCE; VC; and *cis*-1,2-DCE.
- SWMU 1 – arsenic; iron; manganese; chloroform; TCE; and *cis*-1,2-DCE.
- C-720 Building area – arsenic; iron; manganese; nickel; 1,1-DCE; TCE; and *cis*-1,2-DCE.
- Storm sewer – None.

Deleted: 7
Deleted: 80
Deleted: 6
Deleted: 70
Deleted: SWMU 4
Deleted: 900
Deleted: 7×10^{-3}
Deleted: Yes
Deleted: *Degradetion*
Deleted: SWMU 4
Deleted: 17
Deleted: 1×10^{-4}
Deleted: Yes
Deleted: *Degradetion*
Deleted: *Degradetion*
Deleted: 0.5
Deleted: SWMU 4
Deleted: 4
Deleted: 5×10^{-5}
Deleted: Yes
Deleted: *Degradetion*
Deleted: *Degradetion*
Deleted: SWMU 4
Deleted: 1
Deleted: 6×10^{-6}
Deleted: Yes
Deleted: *Degradetion*
Deleted: 7
Deleted: , and 15
Deleted: , and SWMU 4
Deleted: , and 11
Deleted: , and SWMU 4
Deleted: ^{2}
Deleted: 06-064(E)/041406

For the modeled POEs, the COCs for SWMU 1 are TCE; *cis*-1,2-DCE; *trans*-1,2-DCE; and VC. The COCs for the C-720 Building area are TCE; *cis*-1,2-DCE; and VC. Of these, only TCE has a HI or ELCR greater than 1 or 1 × 10^{-4} and is a "priority COC" for contaminant migration at SWMU 1. The C-720 Building area does not have any "priority COCs." "Priority COCs" are identified in this section as an aid to risk managers during decision making.

G5.6.3 Pathways of Concern

Only those pathways with a pathway HI for adults or children greater than 0.1 or a pathway ELCR greater than 1 × 10^{-6} over all contaminants within a land use scenario of concern are POCs. As shown in Tables G.50 through G.63, each of the pathways included in the BHHRA is a POC.

G5.6.4 Media of concern

Media of concern are those media that appear in at least one POC. Based on the information presented in earlier in this subsection, RGA groundwater is a medium of concern at the four sources to the Southwest Plume assessed and over the Southwest Plume.

G5.7 SUMMARY OF RISK CHARACTERIZATION

Tables G.67 to G.70 present summaries of the risk characterizations for each location considered in the BHHRA. Each of these tables present land use scenarios of concern, COCs, and POCs. Along with this information, each table lists the risk posed to a receptor under each land use scenario of concern, the percent of risk each pathway of concern contributes to the total risk, and the percent of risk each COC contributes to the total risk.

Deleted: <#>SWMU 4 – iron; manganese; 1,1-DCE; 1,2-DCA; benzene; bromomethane; carbon tetrachloride; chloroform; TCE; VC; and *cis*-1,2-DCE. ¶

Deleted: and SWMU 4

Deleted: 2

Deleted: For SWMU 4, TCE; *cis*-1,2-DCE; and VC are "priority COCs."

Deleted: 2.

Deleted: Although

Deleted: p

Deleted: , all COCs will be addressed through remediation, removal, management, or other enforceable control

Deleted: 7

Deleted: 71

Deleted: 7

Deleted: 81

Deleted: 06-064(E)/041406

Table G.66. COCs for each location

COPC[a]	Southwest Plume Total Hazard Child	Southwest Plume Total ELCR	SWMU 1 Total Hazard Child	SWMU 1 Total ELCR	C-720 Building area Total Hazard Child	C-720 Building area Total ELCR	Storm Sewer Total Hazard Child	Storm Sewer Total ELCR
Inorganic Chemicals (Metals)								
Aluminum	2E-01							
Arsenic	8E-01	1.E-04	1E+00	1E-04	9E-01	1E-04		
Barium	2E-01		4E-01		4E-01			
Cobalt			2E-01					
Copper								
Iron	6E+00		1E+00		7E+00			
Manganese	4E+00		1E+01		1E+01			
Molybdenum	8E-01							
Nickel	6E-01		5E-01		2E+00			
Uranium	4E+01							
Vanadium	2E-01							
Organic Compounds								
1,1-Dichloroethene	8E-01	4E-04		1E-05	2E+00	1E-03		2E-06
1,2-Dichloroethane	2E+01	6E-04						
Acetone	2E-01							
Benzene	3E+00	4E-05						
Bromodichloromethane		5E-06						
Bromomethane	1E+00							
Carbon Tetrachloride	1E+01	1E-04						
Chloroform	9E+01	1E-04	1E+01	1E-05				
Chloromethane	1E-01	6E-06						
Dibromochloromethane		1E-05						
Methylene Chloride		2E-05						
Tetrachloroethene		7E-06						
Trichloroethene	3E+01	3E-04	7E+01	5E-04	7E+01	4E-04		6E-06
Vinyl Chloride	1E+00	9E-04				9E-05		
cis-1,2-Dichloroethene	2E+00		3E+00		1E+00			
trans-1,2-Dichloroethene	7E-01				3E-01			
Radionuclides								
Neptunium-237		3E-06						
Technetium-99		1E-05		2E-06		7E-06		
Uranium-234		7E-05						
Uranium-238		9E-05						

[a] Only COPCs that exceed a chemical-specific HI of 0.1 or a chemical-specific ELCR of 1 × 10^{-6} within a scenario of concern are listed. All values are rounded to one significant digit.

FINAL PROCESSING NEEDS TO ACTUALLY DELETE TABLE COLUMNS

Deleted: 7
Deleted: 06-064(E)/041406
Deleted: SWMU 4
Deleted: Total Hazard Child ... [87]
Deleted: 3E-01
Deleted: 1E+00
Deleted: 4E+00
Deleted: 8E-01
Deleted: 1E+00 ... [88]
Deleted: 1E+01 ... [89]
Deleted: 2E-01
Deleted: 3E+00 ... [90]
Deleted: 1E+00
Deleted: 5E+01 ... [91]
Deleted: 5E+02 ... [92]
Deleted: 1E-05
Deleted: 1E-05
Deleted: 7E-06
Deleted: 4E+02 ... [93]
Deleted: 6
Deleted: 6E-01 ... [94]
Deleted: 2
Deleted: 2E+01
Deleted: 6E-01
Deleted: 1E-05
Formatted: Not Highlight

051706

Deleted: 06-064(E)/041406

Table G.67. Summary of risk characterization for the Southwest Plume[a]

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs	% Total HI
Future child rural resident at current concentrations (RGA groundwater only)	NA	NA	NA	NA	NA	219	Aluminum Arsenic Barium Iron Manganese Molybdenum Nickel Uranium Vanadium 1,1-Dichloroethene 1,2-Dichloroethane Acetone Benzene Bromomethane Carbon tetrachloride Chloroform Chloromethane Trichloroethene Vinyl chloride *cis*-1,2-Dichloroethene *trans*-1,2-Dichloroethene	<1 <1 <1 3 2 <1 <1 18 <1 <1 9 <1 2 <1 6 43 <1 14 <1 <1 <1	Ingestion of groundwater Dermal contact Inhalation while showering Inhalation household use	28 <1 9 63
Future adult rural resident at current concentrations (RGA groundwater only)	2.8×10^{-3}	Arsenic 1,1-Dichloroethene 1,2-Dichloroethane Benzene Bromodichloromethane Carbon tetrachloride Chloroform Chloromethane Dibromochloromethane Methylene chloride Tetrachloroethene Trichloroethene Vinyl chloride Neptunium-237 Technetium-99 Uranium-234 Uranium-238	4 14 22 2 <1 5 4 <1 <1 <1 <1 10 32 <1 <1 3 3	Ingestion of groundwater Dermal contact Inhalation while showering Inhalation household use	60 1 5 34	58.4	Arsenic Iron Manganese Molybdenum Nickel Uranium 1,1-Dichloroethene 1,2-Dichloroethane Benzene Bromomethane Carbon tetrachloride Chloroform Trichloroethene Vinyl chloride *cis*-1,2-Dichloroethene *trans*-1,2-Dichloroethene	<1 4 3 <1 <1 27 <1 7 1 <1 6 34 14 <1 <1 <1	Ingestion of groundwater Dermal contact Inhalation while showering Inhalation household use	43 1 7 49

Deleted: 7

Formatted: Not Highlight

Deleted: 06-064(E)/041406

Deleted: 7

Deleted: 06-064(E)/041406

051706

Table G.67. Summary of risk characterization for the Southwest Plume[a] (continued)

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs	% Total HI
Future child rural resident at modeled concentrations (RGA groundwater drawn at property boundary)	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE
Future adult rural resident at modeled concentrations (RGA groundwater drawn at property boundary)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

Note: NA = ELCR not applicable to child and teen cohorts. ELCR for adult include exposure as child and teen.
NE = Land use scenario not evaluated because it is not applicable to this assessment.
[a] Total ELCR and total HI columns reflect values from BHHRAs completed as part of the Southwest Plume SI.

051706

Table G.68. Summary of risk characterization for SWMU 1[a]

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs
Future child rural resident at current concentrations (RGA groundwater only)	NA	NA	NA	NA	NA	99	Arsenic Barium Cobalt Iron Manganese Nickel Chloroform Trichloroethene *cis*-1,2-Dichlroethene	1 <1 <1 1 11 <1 11 71 3	Ingestion of groundwater Dermal contact Inhalation while showering Inhalation household use Vapor Intrusion
Future adult rural resident at current concentrations (RGA groundwater only)	6.8×10^{-4}	Arsenic 1,1-Dichloroethene Chloroform Trichloroethene Technetium-99	18 2 2 74 <1	Ingestion of groundwater Dermal contact Inhalation while showering Inhalation household use Vapor Intrusion	43 4 5 36 11	26.1	Arsenic Barium Iron Manganese Nickel Chloroform Trichloroethene *cis*-1,2-Dichloroethene	2 <1 2 18 <1 9 64 3	Ingestion of groundwater Dermal contact Inhalation while showering Inhalation household use Vapor Intrusion
Future child rural resident at modeled concentrations (RGA groundwater drawn at property boundary variable degradation)	NA	NA	NA	NA	NA	0.4	Trichloroethene *cis*-1,2-Dichloroethene	56 29	NE
Future child rural resident at modeled concentrations (RGA groundwater drawn at property boundary fixed degradation)	NA	NA	NA	NA	NA	1.4	Trichloroethene *cis*-1,2-Dichloroethene	83 10	NE
Future adult rural resident at modeled concentrations (RGA groundwater drawn at property boundary variable degradation)	1.4×10^{-6}	Trichloroethene Vinyl chloride	39 61	Not determined	---	0.1	NE	NE	NE
Future adult rural resident at modeled concentrations (RGA groundwater drawn at property boundary fixed degradation)	6.1×10^{-6}	Trichloroethene Vinyl chloride	87 14	Not determined	---	0.2	NE	NE	NE

Note:
NA = ELCR not applicable to child and teen cohorts. ELCR for adult include exposure as child and teen.
NE = Land use scenario not of concern or land use not evaluated because contact with medium is not possible.
[a] Total ELCR and total HI columns reflect values from BHHRAs completed as part of the Southwest Plume SI.

Deleted: 7
Deleted: 06-064(E)/041406
Deleted: 77....1 ... [95]
Deleted: 30
Deleted: 2
Deleted: 8¶ ... [96]
Deleted: 15
Deleted: 14
Deleted: 63¶
Deleted: 49
Deleted: 21.4
Deleted: 45
Deleted: 5¶
Deleted: 6¶ ... [97]
Deleted: 22
Deleted: 6¶ ... [98]
Deleted: Intrusioon
Deleted: 11
Deleted: 58¶
Deleted: 3... ... [99]
Deleted: degradetion
Formatted ... [100]
Deleted: degradetion
Formatted ... [101]
Formatted ... [102]
Deleted: 1
Deleted: 3.8
Formatted ... [103]
Deleted: 77
Formatted ... [104]
Deleted: degradetion
Deleted: 2
Deleted: degradetion

05102007

Table G.69. Summary of risk characterization for the C-720 Building area[a]

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs
Future child rural resident at current concentrations (RGA groundwater only)	NA	NA	NA	NA	NA	102	Arsenic Barium Iron Manganese Nickel 1,1-Dichloroethene Trichloroethene *cis*-1,2-Dichlroethene *trans*-1,2-Dichloroethene	<1 <1 7 12 2 2 73 1 <1	Ingestion of groundwater Dermal contact Inhalation while showering Inhalation household use Vapor Intrusion
Future adult rural resident at current concentrations (RGA groundwater only)	1.8 × 10^{-3}	Arsenic 1,1-Dichloroethene Trichloroethene Vinyl chloride Technetium-99	7 64 24 5 <1	Ingestion of groundwater Dermal contact Inhalation while showering Inhalation household use Vapor Intrusion	53 2 5 38 2	23	Arsenic Barium Iron Manganese Nickel 1,1-Dichloroethene Trichloroethene *cis*-1,2-Dichlroethene	2 <1 12 22 4 2 53 2	Ingestion of groundwater Dermal contact Inhalation while showering Inhalation household use Vapor Intrusion
Future child rural resident at modeled concentrations (RGA groundwater drawn at property boundary variable degradation)	NA	NA	NA	NA	NA	<0.1	NE	NE	NE
Future child rural resident at modeled concentrations (RGA groundwater drawn at property boundary fixed degradation)	NA	NA	NA	NA	NA	0.3	Trichloroethene *cis*-1,2-Dichloroethene	69 30	NE
Future adult rural resident at modeled concentrations (RGA groundwater drawn at property boundary variable degradation)	1.1 × 10^{-6}	Vinyl chloride	>95	Not determined	---	<0.1	NE	NE	NE
Future adult rural resident at modeled concentrations (RGA groundwater drawn at property boundary fixed degradation)	2.4 × 10^{-6}	Trichloroethene Vinyl chloride	51 48	Not determined	---	0.2	Trichloroethene *cis*-1,2-Dichloroethene	82 11	NE

Note: NA = ELCR not applicable to child and teen cohorts. ELCR for adult include exposure as child and teen.
NE = Land use scenario not of concern or land use not evaluated because contact with medium is not possible.
[a] Total ELCR and total HI columns reflect values from BHHRAs completed as part of the Southwest Plume SI.

Deleted: 7
Deleted: 06-064(E)/041406
Deleted: 72.8
Deleted: 43
Deleted: 1¶
Deleted: 10
Deleted: 7
Deleted: 17
Deleted: 48
Deleted: 3¶ 3 ... [105]
Deleted: 64
Deleted: 2
Deleted: 22.1
Deleted: 5
Deleted: 54¶
Deleted: 59¶
Deleted: 2¶
Deleted: 13
Deleted: 4¶
Deleted: 3
Deleted: 5¶ ... [106]
Deleted: 23
Deleted: 5¶
Deleted: 33¶
Deleted: 1
Deleted: degradetion
Formatted ... [107]
Deleted: degradetion
Deleted: degradetion
Deleted: degradetion

051706

Table G.70. Summary of risk characterization for the storm sewer[a]

Deleted: 8

Deleted: 06-064(E)/041406

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs	% Total HI
Future child rural resident at current concentrations (RGA groundwater only)	NA	NA	NA	NA	NA	0.6	NE	NE	NE	NE
Future adult rural resident at current concentrations (RGA groundwater only)	7.9×10^{-6}	1,1-Dichloroethene Trichloroethene	27 73	Ingestion of groundwater Inhalation household use	41 48	0.2	NE	NE	NE	NE
Future child rural resident at modeled concentrations (RGA groundwater drawn at property boundary)	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE
Future adult rural resident at modeled concentrations (RGA groundwater drawn at property boundary)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

Note: NA = ELCR not applicable to child and teen cohorts. ELCR for adult include exposure as child and teen.
NE = Land use scenario not of concern or land use not evaluated because contact with medium is not possible.

[a] Total ELCR and total HI columns reflect values from BHHRAs completed as part of the Southwest Plume SI.

Deleted: Table G.81. Summary of risk characterization for SWMU 4ᵃ¶ Receptor ... [108]

Formatted: Bullets and Numbering

G.6 UNCERTAINTY IN THE RISK ASSESSMENT

Uncertainties are associated with each step of the risk assessment process. The potential effect of the uncertainties on the final risk characterization must be considered when interpreting the results of the risk characterization because a number of assumptions are made during the risk assessment. Types of uncertainty to consider are divided into four broad categories. These are those associated with data, exposure assessment, toxicity assessment, and risk characterization.

Specific uncertainties in each of these categories are discussed in the following sections. In the discussion, the magnitude of the effect of the uncertainty on the risk characterization is categorized as small, moderate, or large. Uncertainties categorized as small are assumed to not affect the risk estimates by more than one order of magnitude; those categorized as moderate are assumed to affect the risk estimates by between one and two orders of magnitude, and uncertainties categorized as large are assumed to affect the risk estimate by more than two orders of magnitude.

In evaluating these uncertainties and their estimated effect on the risk estimates, it should be remembered that the following uncertainties are neither independent nor mutually exclusive; therefore, the total effect of all uncertainties on the risk estimates (i.e., total ELCRs and HIs) is not necessarily the sum of the estimated effects.

G6.1 UNCERTAINTIES ASSOCIATED WITH DATA AND DATA EVALUATION

Several uncertainties are associated with the data set and the selection of COPCs. Specific uncertainties that will be discussed in the following subsections are selection of COPCs, determination of EPCs under current and future conditions, and use of concentrations from total versus filtered samples for inorganic compounds in groundwater.

G6.1.1 Selection of COPCs

Some uncertainty is involved with the selection of COPCs. This uncertainty is derived from several sources. The first uncertainty related to the selection of COPCs is the retention of infrequently detected or analyzed for chemicals in the list of COPCs. As can be seen in the tables in Section 2, several of the chemicals retained in the list of COPCs were detected in less than 10% of the samples taken and in some cases were analyzed for in few samples. Of greatest concern is that some of these COPCs are retained as COCs. Fortunately, these COCs contribute far less to total ELCR and HI than the "priority COCs"[2] listed in Section 5; therefore, the estimated effect of the uncertainty on the risk estimates is small.

Deleted: [3]

The second uncertainty related to selection of COPCs in the BHHRA is that temporal patterns in detection of analytes were not considered when selecting COPCs. If temporal patterns were considered, the final risk results in this BHHRA may be quite different depending on the times in the future at which risks were estimated. However, in the time frame considered in this BHHRA (i.e., 40 years), the assumed effect of this uncertainty on the risk estimates is small.

---

[2] "Priority COCs" are identified as an aid to risk managers during decision making; however, all COCs will be addressed through remediation, removal, management, or other enforceable control.

Deleted: 06-064(E)/041406

The third uncertainty related to selection of COPCs in the BHHRA concerns the quantitation limits used for some analytes. As shown in the comparisons performed in Section 2, many organic compound analytes have a quantitation limit that exceeds its residential use no action screening values. Because the quantitation limits exceed the screening levels, it is possible that these chemicals are present at concentrations that pose a risk, but may not be retained as COPCs and be quantitatively evaluated. However, because these organic compounds tend to be unrelated to processes at the PGDP and because risk from "priority COCs"[2] is significantly higher than the ELCR and HI targets used to develop the no action screening, the estimated effect of this uncertainty on the risk estimates is small.

Deleted: [3]

A fourth uncertainty related to the selection of COPCs is the inclusion of common laboratory contaminants in the COPC list. In this assessment, both acetone and methylene chloride were retained as COPCs and became COCs in a location's assessment. However, as is shown in the risk characterization tables in Section 5, the contribution of these COCs to total ELCR and HI is minimal compared to that from the "priority COCs"[2]; therefore, the estimated effect of the uncertainty on the risk estimates is small.

Deleted: "[4];

A fifth uncertainty related to the selection of the COPCs is the use of a toxicity screen to determine the final COPC lists. In this BHHRA, the maximum detected concentrations of analytes within each medium at each SWMU were compared to residential use no action screening values from the Risk Methods Document. Analytes with maximum concentrations less than these screening criteria were removed from the list of COPCs.

To examine the effect the toxicity screen may have had on the COPC lists and on the resulting risk estimates developed in the BHHRA, marginal HI and ELCR contributions for analytes removed based on this screen were calculated. Marginal HI and ELCR contributions are defined as the estimated increase in the final hazard and risk estimates that would be seen if the analytes removed from the list of COPCs had been left on the list. This analysis showed that the final ELCRs and HIs would have increased little if analytes had not been removed from the COPC lists using the toxicity screen; therefore, the estimated effect of this uncertainty on the final risk estimates is small.

A seventh uncertainty related to the selection of the COPCs is not using a background screen to determine the final COPC lists. As shown in Section 2, few inorganic chemical and radionuclide COPCs would have been removed from the COPC lists based on this screen. Additionally, because most "priority COCs"[2] are organic compounds that have an estimated background value of 0, removing a few inorganic chemicals using a background screen would have reduced total ELCR and HI little; therefore, the estimated effect of not using a background screen to develop the final list of COPCs is small.

Deleted: [3]

G6.1.2 Determination of EPCs—current conditions

The uncertainty in the calculated EPCs under current conditions is estimated to have had little effect on the final ELCR and HI estimates. Sampling data came from sources of known quality, and the data set was generated from samples collected and analyzed using EPA-approved protocols. Additionally, because the ELCR and HI estimates are driven by contaminants known to be present at the Southwest Plume sources, the effect of this uncertainty on the final risk estimates is believed to be small.

An evaluation of sampling results indicates that the ELCR and HI results for the assessment of the Southwest Plume were biased high by the inclusion of samples collected near the plume's source areas. This is seen by comparing the results from the assessment that included data collected at source areas (see Tables

Deleted: 06-064(E)/041406

G.50, G.54, and G.58) versus the results from an assessment that excluded source area data. (See Tables G.71, G.72, and G.73.) As seen in this comparison, the Total HIs and ELCR for the assessment of results collected away from source areas are lower than, but similar to those, derived including results collected at

Deleted: 7

Deleted: 62

Deleted: 67

Deleted: 82

Deleted: 83

Deleted: 84

Deleted: 06-064(E)/041406

Deleted: 82

Deleted: 06-064(E)/041406

Table G.71. HI (child) for Southwest Plume RGA groundwater data collected outside of source areas[a]

Chemical	Units	Exposure Point Concentration	Child Ingestion Hazard	Child Dermal Hazard	Child Shower Inhalation Hazards	Child Household Inhalation Hazard	Total Hazard Child	Percent of Total
				Inorganic Chemicals (Metals)				
Aluminum	mg/L	2.93E+00	1.94E-01	2.79E-03			1.96E-01	0.3%
Arsenic	mg/L	3.23E-03	7.12E-01	2.50E-03			7.15E-01	0.9%
Barium	mg/L	1.67E-01	1.58E-01	3.24E-03			1.61E-01	0.2%
Chromium	mg/L	7.92E-02	3.49E-03	1.01E-03			4.50E-03	<0.1%
Cobalt	mg/L	1.30E-02	1.44E-02	2.59E-05			1.44E-02	<0.1%
Copper	mg/L	1.98E-02	3.54E-02	1.70E-04			3.56E-02	<0.1%
Iron	mg/L	2.37E+01	5.22E+00	5.01E-02			5.27E+00	6.9%
Manganese	mg/L	1.30E+00	3.58E+00	1.29E-01			3.71E+00	4.9%
Molybdenum	mg/L	5.98E-02	7.91E-01	3.00E-03			7.94E-01	1.0%
Nickel	mg/L	1.51E-01	5.01E-01	2.67E-03			5.03E-01	0.7%
Selenium	mg/L	3.87E-03	5.12E-02	1.68E-04			5.14E-02	0.1%
Uranium	mg/L	3.50E-01	3.86E+01	6.54E-02			3.86E+01	50.9%
Vanadium	mg/L	1.95E-02	1.84E-01	2.66E-02			2.11E-01	0.3%
Zinc	mg/L	1.47E-01	3.24E-02	2.33E-04			3.27E-02	<0.1%
				Organic Compounds				
1,1-Dichloroethene	mg/L	6.74E-03	4.96E-02	6.35E-04	2.72E-02	1.97E-01	2.74E-01	0.4%
Acetone	mg/L	1.09E-02	7.23E-03	7.15E-06	3.95E-03	2.86E-02	3.98E-02	0.1%
Bromodichloromethane	mg/L	1.00E-03	3.31E-03	2.82E-05	1.81E-03	1.31E-02	1.82E-02	<0.1%
Carbon tetrachloride	mg/L	3.15E-03	2.98E-01	1.45E-02	1.63E-01	1.18E+00	1.66E+00	2.2%
Chloroform	mg/L	3.84E-03	2.54E-02	1.63E-03	1.62E+00	1.17E+01	1.34E+01	17.6%
Chloromethane	mg/L	2.80E-03			3.93E-03	2.84E-02	3.24E-02	<0.1%
Tetrachloroethene	mg/L	3.12E-03	2.07E-02	1.10E-02	6.58E-04	4.77E-03	3.71E-02	<0.1%
Trichloroethene	mg/L	1.41E-01	1.56E+00	2.39E-01	8.53E-01	6.18E+00	8.83E+00	11.6%
Vinyl chloride	mg/L	6.00E-03	1.32E-01	1.39E-03	7.58E-03	5.49E-02	1.96E-01	0.3%
cis-1,2-Dichloroethene	mg/L	2.72E-02	1.80E-01	2.59E-03	9.86E-02	7.14E-01	9.95E-01	1.3%
trans-1,2-Dichloroethene	mg/L	9.48E-03	3.13E-02	4.97E-05	1.72E-02	1.24E-01	1.73E-01	0.2%
Total			5.24E+01	5.57E-01	2.79E+00	2.02E+01	**7.59E+01**	
Percent of Total			68.9%	0.7%	3.7%	26.7%		

[a] COPCs presented in this table were selected following the same procedures used earlier in the BHHRA.

051706

Table G.72. HI (adult) for Southwest Plume RGA groundwater data collected outside of source areas[a]

Deleted: 83

Deleted: 06-064(E)/041406

Chemical	Units	Exposure Point Concentration	Adult Ingestion Hazard	Adult Dermal Hazard	Adult Shower Inhalation Hazards	Adult Household Inhalation Hazard	Total Hazard Adult	Percent of Total
Inorganic Chemicals (Metals)								
Aluminum	mg/L	2.93E+00	8.02E-02	1.46E-03			8.16E-02	0.3%
Arsenic	mg/L	3.23E-03	2.95E-01	1.31E-03			2.96E-01	1.1%
Barium	mg/L	1.67E-01	6.53E-02	1.69E-03			6.70E-02	0.3%
Chromium	mg/L	7.92E-02	1.45E-03	5.25E-04			1.97E-03	<0.1%
Cobalt	mg/L	1.30E-02	5.96E-03	1.35E-05			5.97E-03	<0.1%
Copper	mg/L	1.98E-02	1.47E-02	8.88E-05			1.48E-02	0.1%
Iron	mg/L	2.37E+01	2.16E+00	2.61E-02			2.19E+00	8.2%
Manganese	mg/L	1.30E+00	1.48E+00	6.73E-02			1.55E+00	5.8%
Molybdenum	mg/L	5.98E-02	3.28E-01	1.57E-03			3.29E-01	1.2%
Nickel	mg/L	1.51E-01	2.07E-01	1.39E-03			2.09E-01	0.8%
Selenium	mg/L	3.87E-03	2.12E-02	8.75E-05			2.13E-02	0.1%
Uranium	mg/L	3.50E-01	1.60E+01	3.41E-02			1.60E+01	59.9%
Vanadium	mg/L	1.95E-02	7.64E-02	1.39E-02			9.02E-02	0.3%
Zinc	mg/L	1.47E-01	1.34E-02	1.22E-04			1.36E-02	0.1%
Organic Compounds								
1,1-Dichloroethene	mg/L	6.74E-03	2.05E-02	3.32E-04	5.62E-03	4.07E-02	6.72E-02	0.3%
Acetone	mg/L	1.09E-02	3.00E-03	3.73E-06	8.18E-04	5.92E-03	9.74E-03	<0.1%
Bromodichloromethane	mg/L	1.00E-03	1.37E-03	1.47E-05	3.74E-04	2.71E-03	4.47E-03	<0.1%
Carbon tetrachloride	mg/L	3.15E-03	1.23E-01	7.58E-03	3.38E-02	2.45E-01	4.10E-01	1.5%
Chloroform	mg/L	3.84E-03	1.05E-02	8.49E-04	3.35E-01	2.43E+00	2.77E+00	10.4%
Chloromethane	mg/L	2.80E-03			8.14E-04	5.89E-03	6.71E-03	<0.1%
Tetrachloroethene	mg/L	3.12E-03	8.56E-03	5.75E-03	1.36E-04	9.88E-04	1.54E-02	0.1%
Trichloroethene	mg/L	1.41E-01	6.44E-01	1.25E-01	1.77E-01	1.28E+00	2.23E+00	8.3%
Vinyl chloride	mg/L	6.00E-03	5.48E-02	7.26E-04	1.57E-03	1.14E-02	6.85E-02	0.3%
cis-1,2-Dichloroethene	mg/L	2.72E-02	7.46E-02	1.35E-03	2.04E-02	1.48E-01	2.44E-01	0.9%
trans-1,2-Dichloroethene	mg/L	9.48E-03	1.30E-02	2.59E-05	3.56E-03	2.58E-02	4.23E-02	0.2%
Total			2.17E+01	2.91E-01	5.79E-01	4.19E+00	**2.68E+01**	
Percent of Total			81.1%	1.1%	2.2%	15.7%		

[a] COPCs presented in this table were selected following the same procedures used earlier in the BHHRA.

051706

Table G.73. ELCR for Southwest Plume RGA groundwater data collected outside of source areas[a]

Deleted: 84

Deleted: 06-064(E)/041406

COPC	Units	Exposure Point Concentration	Total Ingestion Risk	Total Dermal Risk	Total Shower Inhalation Risk	Total Household Inhalation Risk	Total Risk	Percent of Total
				Inorganic Chemicals (Metals)				
Arsenic	mg/L	3.23E-03	9.20E-05	3.82E-07			9.24E-05	8.2%
				Organic Compounds				
1,1-Dichloroethene	mg/L	6.74E-03	7.68E-05	1.16E-06	7.94E-06	5.75E-05	1.43E-04	12.7%
Bromodichloromethane	mg/L	1.00E-03	1.18E-06	1.19E-08	4.17E-07	3.02E-06	4.63E-06	0.4%
Carbon tetrachloride	mg/L	3.15E-03	7.78E-06	4.48E-07	1.11E-06	8.07E-06	1.74E-05	1.5%
Chloroform	mg/L	3.84E-03	4.44E-07	3.37E-08	2.08E-06	1.51E-05	1.76E-05	1.6%
Chloromethane	mg/L	2.80E-03	6.90E-07	6.17E-09	1.19E-07	8.59E-07	1.67E-06	0.1%
Tetrachloroethene	mg/L	3.12E-03	3.08E-06	1.94E-06	4.20E-08	3.05E-07	5.37E-06	0.5%
Trichloroethene	mg/L	1.41E-01	2.95E-05	5.35E-06	5.70E-06	4.13E-05	8.18E-05	7.2%
Vinyl chloride	mg/L	6.00E-03	1.59E-04	1.98E-06	1.24E-06	9.01E-06	1.72E-04	15.2%
				Radionuclides				
Neptunium-237	pCi/L	3.85E+00	6.72E-06				6.72E-06	0.6%
Technetium-99	pCi/L	1.94E+02	1.38E-05				1.38E-05	1.2%
Thorium-230	pCi/L	1.02E-01	2.41E-07				2.41E-07	0.0%
Uranium-234	pCi/L	1.90E+02	3.49E-04				3.49E-04	30.8%
Uranium-238	pCi/L	1.00E+02	2.26E-04				2.26E-04	20.0%
Total			9.67E-04	1.13E-05	1.87E-05	1.35E-04	**1.13E-03**	
Percent of Total			85.4%	1.0%	1.6%	11.9%		

[a] COPCs presented in this table were selected following the same procedures used earlier in the BHHRA.

source areas. The COCs driving the Total HIs and ELCR, however, do differ with metals and radionuclides becoming relatively more important and organic compounds becoming less important.

Another evaluation of the bias that resulted from the including data from source areas is depicted in Figs. G.8, G.9, and G.10. These figures display total HI and ELCR estimates derived from assessment of results collected from individual wells and borings. In these figures, wells and borings with a total HI greater than 10 are presented in red, those with a total HI less than 10 but greater than 1 are presented in blue, and those with a total HI less than 1 are presented in green. Similarly, wells and borings with a total ELCR greater than 1×10^{-4} are presented in red, those with a total ELCR less than 1×10^{-4} but greater than 1×10^{-6} are presented in blue, and those with a total ELCR less than 1×10^{-6} are presented in green. As shown in these figures, the wells and borings with the greater total HIs and ELCR tend to be located near source areas or in areas known to be characterized by high TCE concentrations.

G6.1.3 Determination of EPCs—future conditions

Uncertainty is involved in characterizing EPCs under future conditions in this BHHRA. In calculating the EPCs at the Southwest Plume sources, the concentrations of COPCs are kept constant throughout the exposure period. That is, the risk assessment does not consider that concentrations of some COCs may be lower or higher in the future because of processes such as degradation and attenuation. However, because the COCs driving risk at the SWMUs are not expected to degrade significantly throughout a lifetime, the effect of this uncertainty is estimated to be small.

A second uncertainty is the potential risk that may develop as COPCs in media at the Southwest Plume sources migrate to groundwater below the SWMU and are transported off-site. To address this uncertainty, results from a fate and transport model were used. (See Appendix F.) While the modeling estimated contaminant transport though multiple media and focused on COCs identified in earlier modeling efforts completed as part of the WAG 27 RI, uncertainty still exists in the POE at which exposure may occur in the future and the contaminant mass that is present in the source areas. These uncertainties are discussed in Appendix F. Generally, the estimated effect of all the modeling uncertainties is moderate to small, indicating that the ELCR and HI estimates generated using the modeled concentrations can be expected to vary by less than an order of magnitude.

Uncertainty is involved in estimating vapor concentrations and associated risks associated with inhalation of volatiles as a result of vapor intrusion into home basements. Predicted exposure point concentrations were based on vapor transport modeling using a one-dimensional analytical solution to estimate convective and diffusive vapor transport. The model relates the vapor concentration in the indoor space to the vapor concentration in the soils/groundwater directly beneath or in close proximity to the indoor space. The model is a screening level model with a limited number of parameter inputs. The resulting risks calculated from the predicted vapor concentrations may be unrealistic as an infinite source was used to calculate the vapor concentrations, the predicted vapor concentrations were used as steady-state exposure concentrations over the entire exposure period, and default parameters used in the risk calculations do not account for differences in air exchange rates throughout the home and associated residence times. Because of this uncertainty, response action decisions based on risks from inhalation of volatiles as a result of vapor intrusion should include additional evaluation of this exposure route.

G6.1.4 Use of Concentrations from Total Versus Filtered Samples

In this BHHRA, all analyte concentrations in water came from the analyses of unfiltered or total samples. The use of data from analyses of total samples is consistent with the Risk Methods Document, but introduces an additional uncertainty to the BHHRA for some water use pathways. Note that the magnitude of the effect of

Deleted: and WAG 3

Deleted: s

Formatted: Not Highlight

Deleted: i

Deleted:

Deleted: 06-064(E)/041406

this uncertainty upon the risk estimates is difficult to determine because it is not known to what extent the quality of water (in terms of total solids) from a residential well would vary from the quality of water taken during the recent sampling effort. However, because the results for metals and radionuclides used in this BHHRA came from samples from wells and not from those collected using driven rods, the solids content in water samples should have been similar to that expected in water from a residential well. Additionally, because most "priority contaminants" are organic compounds not expected to be significantly affected by the presence of solids in the sample, the estimated effect on the final ELCR and HI estimates is small.

G6.2 UNCERTAINTIES ASSOCIATED WITH EXPOSURE ASSESSMENT

Uncertainties associated with the exposure assessment are from three sources. These are uncertainties in biota fate and transport modeling, in use of the RME scenario, and in the development of the conceptual site model and selection of pathways. Each of these uncertainties is discussed in the following material.

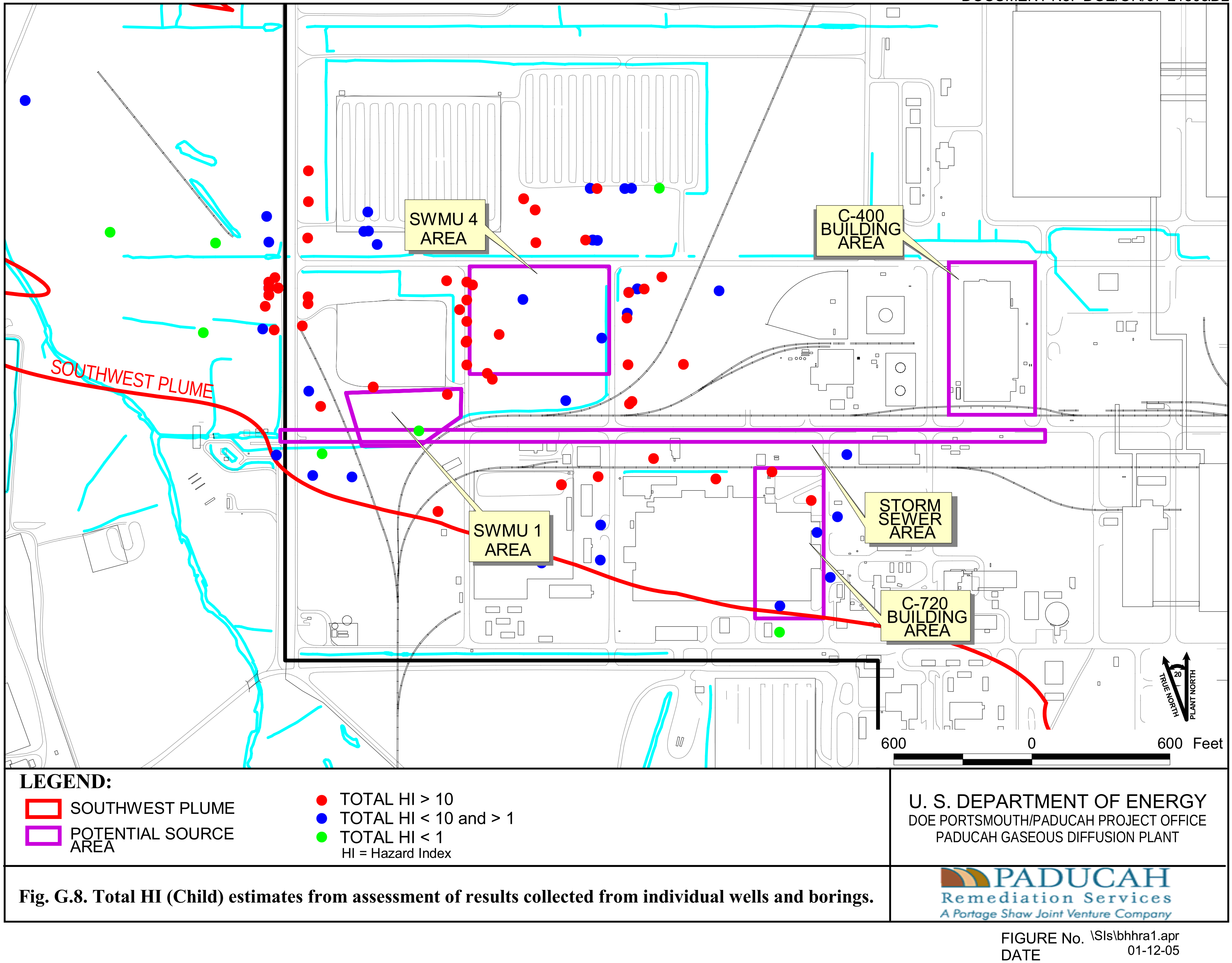
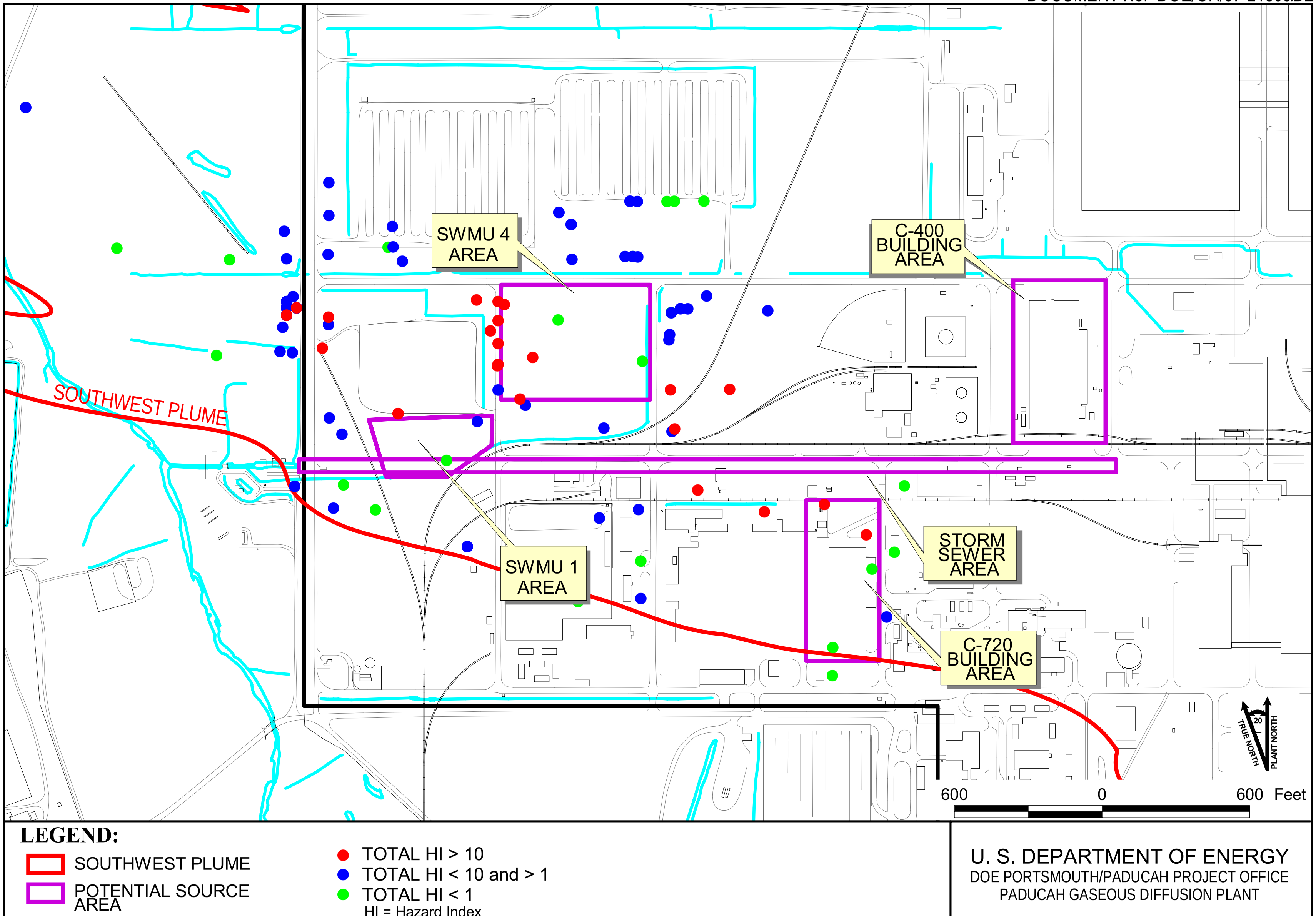


Fig. G.8. Total HI (Child) estimates from assessment of results collected from individual wells and borings.

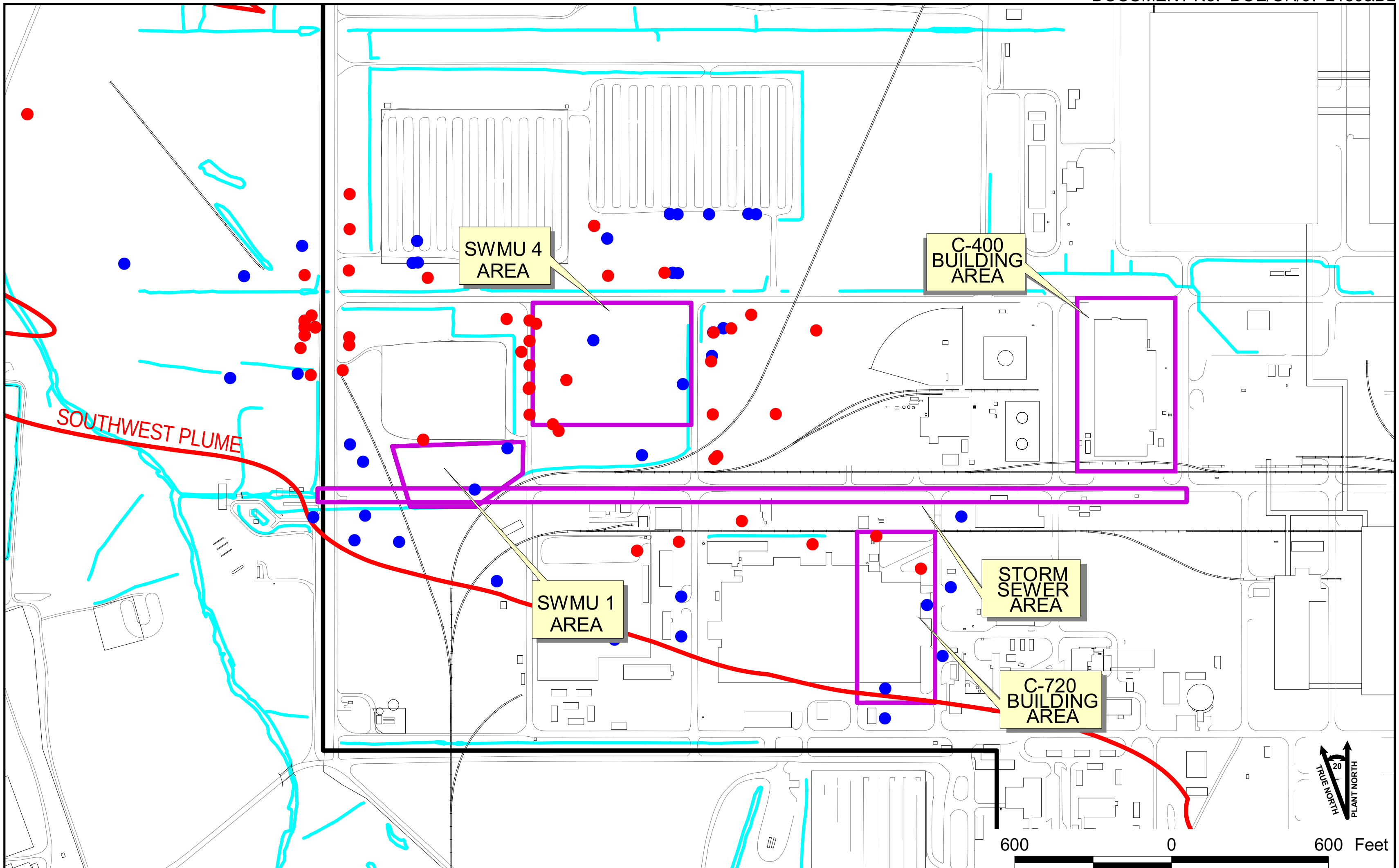


U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH Remediation Services
A Portage Shaw Joint Venture Company

Fig. G.9.Total HI (Adult) estimates from assessment of results collected from individual wells and borings.

FIGURE No. \SIs\bhhra1.apr
DATE 01-12-05



LEGEND:

- SOUTHWEST PLUME
- POTENTIAL SOURCE AREA
- TOTAL ELCR > 1 × 10-4
- TOTAL ELCR < 1 × 10-4 and > 1 × 10-6
- TOTAL ELCR < 1 × 10-6

ELCR = Excess Lifetime Cancer Risk

U. S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH Remediation Services
A Portage Shaw Joint Venture Company

Fig. G.10. Total ELCR estimates from assessment of results collected from individual wells and borings.

FIGURE No. \SIs\bhhra1.apr
DATE 01-12-05

G6.2.1 Uncertainties in Biota Fate and Transport Modeling

No biota fate and transport modeling was performed in this BHHRA. As discussed in Section 3, biota fate and transport modeling was not performed because the assessment considered exposure to groundwater, to which it is unlikely that biota could be exposed without man's help, and because consideration of man's help would have required using modeled concentrations in the biota fate and transport modeling, making the biota EPCs generated highly uncertain. Not including potential ELCR and HI from biota consumption resulted in lower total ELCRs and HIs as indicated by the results of an earlier BHHRA performed as part of the GWOU Feasibility Study. The estimated effect on this BHHRA, however, is estimated to be small, because ELCR and HI from direct contact with groundwater calculated in this BHHRA are high.

G6.2.2 Uncertainties in Use of RME Scenarios

For each exposure pathway modeled, assumptions were made about the number of times a year an activity could occur, routes of exposure, and rate of intake of contaminated media. Because site-specific data were not available for many parameters, defaults from the Risk Methods Document were used. Because most of these defaults are conservative to prevent the underestimation of risk estimates, the risk estimates tend to be conservative. Generally, when several upper-bound values are combined, the resulting value tends to exceed the level of exposure that may be reasonable. In consideration of this problem, attention should be focused not on the fact that any individual dose model is overly conservative, because most are not, but on the fact that if results from several conservative dose models are combined, then the resulting total dose is an overestimate. For this BHHRA, this uncertainty is estimated to have a small effect because the total ELCR and HI calculated were large and because the assessment was limited to residential groundwater use, which contain much less uncertainty than the BHHRAs that consider exposure to soil and sediment.

Deleted: Examples of this would be the use of Kentucky d

Deleted: D

Deleted: efault absoption factor for dermal exposure to soil/sediments used in WAG 27, which are as much as 50 time those of the EPA and the default skin surface area for child receptors, which are

Deleted: is

Deleted: 9% higher

Deleted: e

Deleted: th

Deleted: e

Deleted: an

Deleted: n

Deleted: that recommended by the EPA in RAGS Part E, Appendix C.

G6.2.3 Uncertainties Related to Development of the Conceptual Site Model

Generally, the level of uncertainty in the development of the site conceptual models is small. Data used to develop these models were from several previous studies of the site and from local experts. However, there is one uncertainty related to the development of the conceptual site model that needs to be noted. This is not considering exposure to other contaminated media (e.g., soil and sediment) when calculating risks at the source units. As seen by considering the results from previous BHHRAs (see Sections 1 and Attachment G2), total ELCR and HI over all media could be as much as an order of magnitude higher at SWMU 1 if contact with other media is included in a calculation of total scenario risks. To address this uncertainty, the BHHRA summary in Section 7 includes tables with the ELCR and HI resulting from contact with other media to provide information that can be used to estimate total site ELCR and HI for the industrial use, excavation worker, recreational use, and residential use scenarios.

Deleted: and 4

G6.2.4 Uncertainties Related to Use of Default Values when Estimating Dermal Absorbed Dose

In this assessment, the default dermal absorption factors for groundwater in the Risk Methods Document were used when chemical-specific values were not available. Because these values were for dermal contact with water, which has little impact on the final ELCR and HI estimates, the estimated effect of this uncertainty is small.

G6.3 UNCERTAINTIES ASSOCIATED WITH TOXICITY ASSESSMENT

Uncertainties related to the toxicity assessment are from the following three sources: uncertainty because of lack of toxicity values for some COPCs, uncertainty in the calculation of toxicity values by

Deleted: 06-064(E)/041406

EPA, and uncertainty in the calculation of absorbed dose toxicity values from administered dose toxicity values. Each of these is discussed in the following paragraphs.

G6.3.1 Uncertainties Because of Lack of Toxicity Values for Some Chemicals

Because virtually all COPCs had a toxicity value for either HI or ELCR, the only uncertainty to consider here is the use of provisional or withdrawn values in the BHHRA. The uncertainty from the use of provisional or withdrawn values is important to the results of the BHHRA. Some COPCs did not have approved toxicity values, so a provisional or withdrawn value was used. Another uncertainty is the use of toxicity values that were current at the time the BHHRA was developed, but have since been superseded. The toxicity values used in the BHHRA were those that were the most current approved values in 2003. However, the use of these and other provisional values is well accepted, making the estimated effect of this uncertainty small. The most notable exception was TCE, which is a "priority COC"[2] at all sources and for the Southwest Plume. The toxicity values used for TCE were those that were originally reported in EPA's NCEA data base. Recently EPA has added new provisional values that have yet to be approved. These provisional values, if approved, could result in an increase in HI and ELCR values by a factor of 5 and 17, respectively.

Deleted: outdated
Deleted: superceded
Deleted: do not reflex recent updates
Deleted:
Deleted: The most notable of these COPCs was TCE, which is a "priority COC"[2] at all sources and for the Southwest Plume.
Deleted: is
Deleted: priorty
Deleted: increasing
Formatted: Heading 3

G6.3.2 Uncertainties in Deriving Toxicity Values

Standard EPA RfDs and slope factors were used to estimate potential noncarcinogenic and carcinogenic health effects from exposure to chemicals. Considerable uncertainty is associated with the method applied to derive slope factors and RfDs. The EPA has working groups that review all relevant human and animal studies for each compound and select the studies pertinent to the derivation of the specific RfD and slope factor. These studies often involve data from experimental studies in animals, high exposure levels, and exposures under acute or occupational conditions. Extrapolation of these data to humans under low-dose, chronic conditions introduces uncertainties. The magnitude of these uncertainties is addressed by applying uncertainty factors to the dose response data for each applicable uncertainty. These factors are incorporated to provide a margin of safety for use in human health risk assessments. The effect of uncertainties in calculation of chemical toxicity values is moderate.

Unlike the uncertainty associated with chemical toxicity values, the uncertainty associated with radionuclide toxicity values is small. The dose-response relationship between cancer and ionizing radiation has been evaluated in many reports and is well established. In addition, unlike toxicity values for chemicals, risk factors for radionuclides are extrapolated from the cancer risk established using the Japanese Atomic Bomb Survivors database and a relative risk projection model; therefore, these values are based on human data.

G6.3.3 Uncertainties Because of Calculation of Absorbed Dose Toxicity Values from Administered Dose Toxicity Values

Formatted: Bullets and Numbering

Uncertainty exists in the validity of the calculations used to convert an administered dose toxicity value to an absorbed dose. Of greatest importance is the lack of consideration of point-of-contact effects in this calculation. For example, some organic analytes can cause a toxic or cancer response in skin. This effect is not considered in the calculation of absorbed dose toxicity values from administered dose toxicity values using EPA protocols. Similarly, the administered dose response for many chemicals relies on the delivery of a high concentration of contaminants to the liver via the portal system after ingestion; this effect is not seen if a contaminant is absorbed through the skin because of the larger distribution space for the contaminant absorbed through the skin. However, even with these uncertainties, the effect of the uncertainty in calculation of absorbed dose toxicity values from administered dose toxicity values upon the risk estimates is estimated to be small.

Deleted: 06-064(E)/041406

G6.4 UNCERTAINTIES ASSOCIATED WITH RISK CHARACTERIZATION

Deleted: ¶

Formatted: Bullets and Numbering

Two uncertainties are related to risk characterization. The first is the method used to combine HQs and chemical-specific ELCRs over pathways and combine pathway HIs and ELCRs to calculate total HI and ELCR. The second is the uncertainty added to the assessment by combining risks from chemicals and radionuclides. These uncertainties are discussed in the following subsections.

G6.4.1 Combining chemical-specific Risk Values and Pathway Risk Values

The primary uncertainty in risk characterization is the method used to combine HQs and chemical-specific ELCRs over pathways and combine pathway HIs and ELCRs to calculate total HI and ELCR. The uncertainties in this method are discussed in the following text.

The method used to calculate pathway HIs and ELCRs in the BHHRA followed EPA protocols (Risk Methods Document). This guidance calls for the simple summation of HQs and chemical-specific ELCRs to calculate pathway HIs and ELCRs, respectively. This method assumes that all effects between chemicals are additive. EPA makes this assumption because information concerning the effect of chemical mixtures is lacking. Specific limitations of this approach for systemic toxicity effects (HI) have been reported by EPA.

- Little is known about the effects of chemical mixtures; although additivity is assumed, the interaction of multiple chemicals possibly could be synergistic or antagonistic.
- The RfDs and reference concentrations (RfCs) do not have equal accuracy or precision and are not based on the same severity of effects.
- Dose additivity is most properly applied to compounds that induce the same effect by the same mechanism of action. While the approach recommended by EPA is a useful screening-level approach, the potential for at least noncarcinogenic effects to occur can be overestimated for chemicals that act by different mechanisms and on different target organs.

The effect of this uncertainty on the estimate of HI depends on how many contaminants drive HI and if the contaminants have different endpoints. In this BHHRA, several contaminants do affect HI, and these contaminants do have differing endpoints. However, because only a few "priority COCs"[2] drive HI, as shown in Section 5, and because the HI from each of these "priority COCs"[2] alone is great enough that a systemic toxic effect may be reasonably expected, the effect of this uncertainty on HIs is small.

Deleted: [4]

Deleted: "[5]

Specific limitations for this approach in regard to chemical carcinogenesis also have been reported by EPA in RAGS:

- Cancer risks (i.e., ELCRs) are based on slope factors that represent an upper 95th percentile estimate of potency; the upper 95th percentiles of probability distributions are not strictly additive. Summing these risks can result in an overly conservative estimate of lifetime ELCR.
- Cancer risks may not be additive. Similar to HI, the endpoints may differ, and mechanisms of effect may vary.

Deleted: 06-064(E)/041406

- Not all slope factors contain the same weight-of-evidence for human carcinogenicity. As explained in Section 4, EPA recognizes this by placing weight-of-evidence classifications on all slope factors. Those contaminants with an A weight-of-evidence should probably receive more attention in the selection of a remedial design than contaminants with a B or C classification. Similarly, a contaminant with a B classification should probably receive greater attention than one with a C classification. The simple combination of ELCRs does not take this hierarchy into account.

The uncertainties involved in combining chemical-specific ELCRs and pathway ELCRs are considerable. The effect of these uncertainties on the total ELCRs presented in the BHHRA is small because as noted above, only a few "priority COCs"[2] dominate the pathway ELCR for most pathways; therefore, the potential effect of mixtures is reduced.

Deleted: However, t

Deleted: "[6]

Deleted: .

Deleted: T

G6.4.2 Combining Risks from Chemicals with Those from Radionuclides

Uncertainty associated with adding risks from chemical exposure to those from exposure to radionuclides arises from two sources. First, as noted in Section 4, the slope factors used to characterize the risk from chemicals are derived differently from the slope factors used to characterize risk from radionuclides. This difference may result in estimates of chemical exposure risks that may be considered to be upper-bound risk estimates and estimates of radionuclide exposure risks that may be considered to be central tendency (i.e., "best") estimates; therefore, combining chemical exposure and radionuclide exposure risk estimates to estimate total risk for a land use scenario may place too much emphasis on chemical exposure risk. Second, the mechanism by which chemicals may cause cancer may vary from the mechanism by which radionuclides may cause cancer (see Section 4). This difference in mechanism of action inflates the uncertainties discussed in Subsection 6.4.1 that assume cancer risks are additive. Overall, the effect of this uncertainty on the total ELCR and HI estimates is small because, as discussed in Subsection 6.4.1, a few "priority COCs"[2] drive the risks assessed. At sites where there are multiple chemicals and radionuclides driving risk, the effect of this uncertainty could be greater.

Deleted: [5]

G6.5 SUMMARY OF UNCERTAINTIES

As is shown in the previous subsections, the risk estimates could vary if different assumptions were used in deriving the risk estimates or if better information was available for some parameters. The following text summarizes the estimated effects of each uncertainty mentioned previously.

No uncertainties were estimated to have a large effect on the risk characterization, and only two were estimated to have a moderate effect.

Following is a list of uncertainties with effects estimated to be moderate:

- migration of groundwater to off-site receptors may underestimate risk and
- calculation of toxicity values for chemicals.

Following is a list of uncertainties with effects estimated to be small:

- inclusion of infrequently detected COPCs,
- inclusion of infrequently analyzed for COPCs,

Deleted: 06-064(E)/041406

- determination of temporal patterns in data,
- use of quantitation limits that exceed residential use no action screening values,
- inclusion of common laboratory contaminants in the data,
- contribution of analytes removed based on comparison to residential use no action screening values,
- not including a background screen,
- determination of exposure points for current concentrations,
- determination of exposure points for future concentrations,
- use of total water samples versus filtered,
- not including biota exposure pathways,
- use of RME default exposure values instead of central tendency exposure values,
- evaluation of groundwater separately from soil at source units,
- use of default dermal absorption values,
- use of provisional and withdrawn toxicity values,
- determination of radionuclide toxicity values,
- use of absorbed toxicity values calculated from administered toxicity values,
- combination of risk from chemicals and radionuclides in pathways, and
- combination of chemical with radiological ELCRs.

G.7 CONCLUSIONS AND SUMMARIES

This section summarizes the results of the BHHRA and draws conclusions from the results. The primary purpose of this section is to provide a concise summary of each of the BHHRA steps without the use of tables, extensive explanations, or justifications. This section also includes a series of observations in which the results of the BHHRA are combined with the uncertainties in the risk assessment.

G7.1 CHEMICALS OF POTENTIAL CONCERN

COPCs were selected from groundwater data collected in the recently completed Southwest Plume SI, the WAG 27 and 3 RIs, and routine monitoring. This data set was screened to produce final COPCs lists aggregated by location. For groundwater, the only depth considered was RGA water, which provided the only new information collected during the SI. Results for other media that appear in later summary tables in this section were from earlier BHHRAs.

Through a series of screening steps, which follow regulatory agency approved procedures, the data sets were reduced to lists of COPCs for the entire Southwest Plume and for the following sources, SWMU 1, the C-720 Building area, and the storm sewer (part of SWMU 102).

Deleted: , and SWMU 4

G7.2 EXPOSURE ASSESSMENT

Historical information and newly collected data were used to develop a conceptual site model. After consideration of the available data and scope of the SI, the scenario selected for assessment was rural residential use of groundwater. This scenario is hypothetical for the source areas because the current and future land use of these areas is industrial. The POEs to which contaminants might migrate also were assessed using rural residential use of groundwater. This also is a hypothetical scenario at all three POEs considered (i.e., at the plant boundary, property boundary, and near the Ohio River) because the areas containing the POEs currently are used for recreational and industrial purposes and do not contain residences. The exposure routes considered for the rural resident are listed below.

Deleted: 06-064(E)/041406

Deleted: 06-064(E)/041406

Future on-site rural resident

- Ingestion of groundwater
- Dermal contact with groundwater while showering
- Inhalation of vapors emitted by groundwater during household use and
- Inhalation of vapors emitted by groundwater while showering
- Inhalation of vapors emitted from groundwater from vapor intrusion into basements[7]

Future off-site rural resident

- Ingestion of groundwater
- Dermal contact with groundwater while showering
- Inhalation of vapors emitted by groundwater during household use and
- Inhalation of vapors emitted by groundwater while showering
- Inhalation of vapors emitted from groundwater from vapor intrusion into basements[7]

After selection of the exposure routes, CDIs were calculated using standard exposure models. Most parameters used in models were default values.

Deleted: (TCE, *cis*-1,2-DCE

Deleted: ichlorethene

Deleted: , *trans*-1,2-DCE

Deleted: ichlorethene

Deleted: and vinyl chloride only)

Formatted: Highlight

Formatted: Bulleted + Level: 1 + Aligned at: 0" + Tab after: 0.3" + Indent at: 0.3"

Formatted: Superscript

Deleted: (TCE, *cis*-1,2-DCE

Formatted: Highlight

Deleted: ichlorethene

Deleted: , *trans*-1,2-DCE

Deleted: ichlorethene

Deleted: and vinyl chloride only)

G7.3 TOXICITY ASSESSMENT

The toxicity values used in the risk assessment were taken from the Risk Methods Document. After compiling toxicity information, the determination was made that the majority of the COPCs had a toxicity value available for one or more routes of exposure.

G7.4 RISK CHARACTERIZATION

Risks were characterized by integrating the CDIs calculated during the exposure assessment and the toxicity values collected during the toxicity assessment. As a result of this characterization, it was determined that there are risks associated with exposure to groundwater. Significant results of the risk characterization are presented in the following text.

G7.4.1 Land Use Scenarios of Concern

On-site land use scenarios

It was determined that the residential use of groundwater scenario and vapor intrusion is of concern for both HI and ELCR at each source except the storm sewer, which is of concern for ELCR only.

Off-site land use scenario

Residential use of RGA groundwater containing contaminants migrating from the Southwest Plume sources was determined to be a use of concern.

[7] Vapor intrusion was modeled for residential basements for TCE, 1,2-DCE and VC only as these COCs and antimony are identified in the WAG 27 RI Report as migrating from sources at SWMU 1 and the C-720 area and result in risks above *de minimis* levels. Monitoring results document that TCE and its degradation products are the primary COCs that define the Southwest Plume. Antimony was not included in vapor intrusion modeling because it is not a volatile compound.

Formatted: Not Highlight

Deleted: 06-064(E)/041406

G7.4.2 Contaminants of Concern

On-site land uses

There are a total of 21, 9, 9, and 0, COCs for HI in groundwater drawn from the RGA across the Southwest Plume and at SWMU 1, the C-720 Building area, and the storm sewer, respectively. There are also a total of 17, 5, 5, and 2 COCs for ELCR in groundwater drawn from the RGA across the Southwest Plume and at SWMU 1, the C-720 Building area, and the storm sewer, respectively. Of these COCs, the following are “priority COCs”[2] because they have a chemical-specific HI or ELCR greater than or equal to 1 or 1×10^{-4} in one or more scenarios.

- Southwest Plume – arsenic; iron; manganese; uranium; benzene; bromomethane; carbon tetrachloride; chloroform; 1,2-DCA; 1,1-DCE; *cis*-1,2-DCE; TCE; and VC.
- SWMU 1 – arsenic; iron; manganese; chloroform; *cis*-1,2-DCE; and TCE.
- C-720 Building area – arsenic; iron; manganese; nickel; 1,1-DCE; *cis*-1,2-DCE; and TCE.
- Storm sewer – None

Off-site land uses

For the modeled POEs, the COCs for SWMU 1 are TCE; *cis*-1,2-DCE; *trans*-1,2-DCE; and VC. The COCs for the C-720 Building area are TCE; *cis*-1,2-DCE; and VC. Of these, only TCE has a HI or ELCR greater than 1 or 1×10^{-4} and is, therefore, a “priority COC”[2] for contaminant migration at SWMU 1 and the C-720 Building

G7.4.3 Pathways of Concern

Each of the exposure routes included in the BHHRA is a POC.

G7.4.4 Media of Concern

Based on the information presented in earlier in this section, RGA groundwater is a media of concern at the four sources to the Southwest Plume assessed and over the Southwest Plume.

G7.5 OBSERVATIONS

Because data collected during the SI focused on the collection of subsurface soil and groundwater data to delimit the potential sources of contamination to the Southwest Plume, the new material developed in the BHHRA and Screening Ecological Risk Assessment (SERA) is limited to risks posed by contaminants migrating from potential source areas to RGA groundwater and with direct contact with this contaminated groundwater. Risks from direct contact with other media at the potential sources (e.g., surface and subsurface soil, sediment, surface water, and McNairy Formation groundwater) are taken from the following assessment

- *Remedial Investigation Report for Waste Area Grouping 27 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1999b).

Deleted: and 15

Deleted: and SWMU 4,

Deleted: , and 11

Deleted: and SWMU 4,

Deleted: ”8

Deleted: ¶
SWMU 4 – iron; manganese; benzene; bromomethane; carbon tetrachloride; chloroform; 1,2-DCA; 1,1-DCE; *cis*-1,2-DCE; TCE; and VC.

Deleted: and SWMU 4

Deleted: 5

Deleted: For SWMU 4, TCE; *cis*-1,2-DCE; and VC are “priority COCs.”

Deleted: 5

Deleted: 2

Deleted: .

Deleted: s and studies

Deleted: ¶
Remedial Investigation Report for Waste Area Grouping 3 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky (DOE 2000a).

Deleted: 06-064(E)/041406

Consistent with regulatory guidance and agreements contained in the Risk Methods Document, the BHHRA reports risks for scenarios that encompass current use and several hypothetical future uses. The scenarios with risks discussed in the BHHRA are as follows.

- Current on-site industrial use – direct contact with surface soil (soil found 0 to 1 ft bgs), sediment, and surface water. Risk results presented in the BHHRA for this scenario were taken from assessments completed earlier.

- Future on-site industrial use – direct contact with surface soil, sediment, and surface water. Risk results presented in the BHHRA for this scenario were taken from assessments completed earlier.

- Future on-site excavation – direct contact with surface and subsurface soil (soil 0 to 16 ft bgs). Risk results presented in the BHHRA for this scenario were taken from assessments completed earlier.

- Future on-site recreational user – direct contact with sediment and surface water and consumption of game exposed to contaminated surface soil. Risk results presented in the BHHRA for this scenario were taken from assessments completed earlier.

- Future off-site recreational user – direct contact with surface water impacted by contamination migrating from sources and consumption of game exposed to this surface water. Risk results presented in the BHHRA for this scenario were taken from assessments completed earlier.

- Future on-site rural resident – direct contact with surface soil at and use of groundwater drawn from the RGA and McNairy at source areas, including consumption of vegetables that are posited to be raised in these areas. Risk results presented in the BHHRA for use of RGA groundwater in the home are newly derived. Risk results presented in the BHHRA for other media and routes of exposure were taken from assessments completed earlier.

- Future off-site rural resident – use in the home of groundwater drawn from the RGA at the DOE plant boundary, property boundary, and the Ohio River. Risk results for this receptor are newly derived in the BHHRA; however, risks estimated in earlier assessments for this receptor are also presented in the BHHRA.

The land uses and media assessed for ELCR and HI to human health for each potential source area are presented in Table G.74. Table G.74 also indicates the scenarios and media, which have their risk results taken from earlier assessments in this summary. As discussed above, only results for groundwater use by the hypothetical future on- and off-site residents were newly derived in the BHHRA.

Deleted: 85

Deleted: 85

The scenarios for which risk exceeds *de minimis* levels [i.e., a cumulative ELCR of 1×10^{-6} or a cumulative hazard index of 1 as defined in DOE 2000c] are summarized in Table G.75. This information is taken from a series of risk summary tables presented at the end of this chapter (i.e., Tables G.76 through G.79), which present cumulative risk values for each scenario, the COCs, and the POCs. Information used to prepare these summary tables came from Section 6.5 and Attachment 1 to this appendix (see Attachment 1 Tables 17 to 32).

Deleted: 86

Deleted: 87

Deleted: 91

Deleted: pathways of concern (

Deleted:)

Deleted: 46

G7.5.1 General BHHRA Observations

Observations of the current BHHRA and those completed earlier are presented here. Consistent with current and likely future land use, observations for source areas focus on risks posed under industrial land use. Similarly, observations for off-site areas focus on risks from use of groundwater at the PGDP property boundary, the first location where future residential use is possible.

Deleted: 06-064(E)/041406

Table G.74. Land uses and media assessed for each source area included in the SI for the Southwest Plume

Scenario	Location		
	SWMU 1	C-720 Building	SWMU 102
Current On-site Industrial Worker			
Surface Soil	P	NA	NA
Sediment[a]	P	NA	NA
Surface Water	NA	NA	NA
Future On-site Industrial Worker			
Soil	P	NA	NA
Sediment[a]	P	NA	NA
Surface Water	NA	NA	NA
Future On-site Excavation Worker			
Surface and Subsurface Soil	P	P	NA
Future On-site Recreational User			
Game (Soil)	P	NA	NA
Sediment[a]	P	NA	NA
Surface Water	NA	NA	NA
Future Off-site Recreational User			
Surface Water	P	NA	NA
Game	NA	NA	NA
Future On-site Rural Resident			
Soil	P	NA	NA
Groundwater[b]	X	X	X
Future Off-site Rural Resident			
Groundwater[c]	X	X	X
Future On-site Terrestrial Biota			
Soil	P	NA	NA
Sediment[a]	P	NA	NA
Surface Water	NA	NA	NA

Notes: Scenarios that were assessed in the SI BRA are marked with an X. Scenarios assessed in previous BRAs are marked with a P. Scenarios not assessed because the scenario is not applicable, or for which the medium is not present, are marked with an NA.

[a] Sediment considered in earlier assessments was in ditches surrounding the source area.

[b] The earlier BHHRAs assessed risks from use of water drawn from the RGA separately from use of water drawn from the McNairy Formation. The risks assessed in the SI BHHRA are for use of water drawn from the RGA.

[c] Modeling results were used to assess risk to the off-site rural resident. POEs are at the plant boundary, at the property boundary, and near the Ohio River.

DURING FINAL PROCESSING NEED TO ACTUALLY DELETE TABLE COLUMN

- Deleted: 85
- Deleted: SWMU 4
- Deleted: ¶ P¶ NA¶ NA
- Deleted: ¶ P¶ NA¶ NA
- Deleted: ¶ P
- Deleted: ¶ P¶ NA¶ NA
- Deleted: ¶ P¶ NA
- Deleted: ¶ P¶ X
- Deleted: ¶ X
- Deleted: ¶ P¶ NA¶ NA
- Deleted: 06-064(E)/041406

Table G.75. Scenarios for which human health risk exceeds *de minimis* levels[a]

Scenario	Location: SWMU 1	Location: C-720 Building	Location: SWMU 102
Results for ELCR:			
Current On-site Industrial Worker			
Exposure to Soil	NA	NA	NA
Exposure to Sediment	X	NA	NA
Exposure to Surface Water	NA	NA	NA
Future On-site Industrial Worker			
Exposure to Soil	NA	NA	NA
Exposure to Sediment	X	NA	NA
Exposure to Surface Water	NA	NA	NA
Future On-site Excavation Worker			
Exposure to Soil	X	X	NA
Future On-site Recreational User			
Exposure to Game	---	NA	NA
Exposure to Sediment	X	NA	NA
Exposure to Surface Water	NA	NA	NA
Future Off-site Recreational User			
Exposure to Surface Water	---	NA	NA
Exposure to Game	---	NA	NA
Future On-site Rural Resident			
Exposure to Soil	---	NA	NA
Exposure to Groundwater[b]	X	X	X
Future Off-site Rural Resident			
Exposure to Groundwater[d]	X	X	---
Results for HI[c]:			
Current On-site Industrial Worker			
Exposure to Soil	NA	NA	NA
Exposure to Sediment	X	NA	NA
Exposure to Surface Water	NA	NA	NA
Future On-site Industrial Worker			
Exposure to Soil	NA	NA	NA
Exposure to Sediment	X	NA	NA
Exposure to Surface Water	NA	NA	NA
Future On-site Excavation Worker			
Exposure to Soil	X	---	NA
Future On-site Recreational User			
Exposure to Game	---	NA	NA
Exposure to Sediment	X	NA	NA
Exposure to Surface Water	NA	NA	NA
Future Off-site Recreational User			
Exposure to Surface Water	---	NA	NA
Exposure to Game	---	NA	NA

Table G.75. Scenarios for which human health risk exceeds *de minimis* levels[a] (continued)

Deleted: 86

Scenario	Location		
	SWMU 1	C-720 Building	SWMU 102
Future On-site Rural Resident			
Exposure to Soil	---	NA	NA
Exposure to Groundwater[b]	X	X	---
Future Off-site Rural Resident			
Exposure to Groundwater[d]	X	X	---

Deleted: SWMU 4

Deleted: ¶
X¶
X

Deleted: ¶
X

Notes: Scenarios where risk exceeds *de minimis* levels are marked with an X. Scenarios where risk did not exceed *de minimis* levels are marked with a ---. NA indicates that the scenario/land use combination was not assessed because the scenario is not applicable, or the medium is not present.

[a] Consistent with the Risk Methods Document, the *de minimis* levels used are a cumulative ELCR of 1×10^{-6} and a cumulative HI of 1.

[b] The BHHRA assessed risks from use of water drawn from the RGA separately from use of water drawn from the McNairy Formation. The value reported here is for use of water from the RGA.

[c] Systemic toxicity results summarized here for the resident and recreational user are for the child.

[d] Based on results of contaminant transport modeling. X indicates that the location contains a source of unacceptable off-site contamination, and --- indicates that the location is not a source of off-site contamination. The POE considered is at the property boundary.

DURING FINAL PROCESSING NEED TO ACTUALLY DELETE TABLE COLUMN

Formatted: Not Highlight

Deleted: 06-064(E)/041406

051706

Table G.76. Summary of risk characterization for the Southwest Plume[a]

Deleted: 8

Deleted: 06-064(E)/041406

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs	% Total HI
Future child rural resident at current concentrations (RGA groundwater only)	NA	NA	NA	NA	NA	219	Aluminum Arsenic Barium Iron Manganese Molybdenum Nickel Uranium Vanadium 1,1-Dichloroethene 1,2-Dichloroethane Acetone Benzene Bromomethane Carbon tetrachloride Chloroform Chloromethane Trichloroethene Vinyl chloride *cis*-1,2-Dichloroethene *trans*1,2-Dichloroethene	<1 <1 <1 3 2 <1 <1 18 <1 <1 9 <1 2 <1 6 43 <1 14 <1 <1 <1	Ingestion of groundwater Dermal contact Inhalation while showering Inhalation household use	28 <1 9 63
Future adult rural resident at current concentrations (RGA groundwater only)	2.8×10^{-3}	Arsenic 1,2-Dichloroethene 1,1-Dichloroethene Benzene Bromodichloromethane Carbon tetrachloride Chloroform Chloromethane Dibromochloromethane Methylene chloride Tetrachloroethene Trichloroethene Vinyl chloride Neptunium-237 Technetium-99 Uranium-234 Uranium-238	4 14 22 2 <1 5 4 <1 <1 <1 <1 10 32 <1 <1 3 3	Ingestion of groundwater Dermal contact Inhalation while showering Inhalation household use	60 1 5 34	58.4	Arsenic Iron Manganese Molybdenum Nickel Uranium 1,1-Dichloroethene 1,2-Dichloroethane Benzene Bromomethane Carbon tetrachloride Chloroform Trichloroethene Vinyl chloride *cis*-1,2-Dichloroethene *trans*1,2-Dichloroethene	<1 4 3 <1 <1 27 <1 7 1 <1 6 34 14 <1 <1 <1	Ingestion of groundwater Dermal contact Inhalation while showering Inhalation household use	43 1 7 49

051706

Table G.76. Summary of risk characterization for the Southwest Plume[a] (continued)

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs	% Total HI
Future child rural resident at modeled concentrations (RGA groundwater drawn at property boundary)	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE
Future adult rural resident at modeled concentrations (RGA groundwater drawn at property boundary)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

Note: NA = ELCR not applicable to child and teen cohorts. ELCR for adult include exposure as child and teen.
NE = Land use scenario not evaluated because it is not applicable to this assessment.
[a] Total ELCR and total HI columns reflect values from BHHRAs completed as part of the Southwest Plume SI.

Deleted: 8
Deleted: 06-064(E)/041406

051706

Table G.77. Summary of risk characterization for SWMU 1[a]

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs	% Total HI
Current industrial worker at current concentrations[b] (soil)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future industrial worker at current concentrations[b] (soil)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Current industrial worker at current concentrations (sediment)	3.4×10^{-5}	Arsenic Cesium-137 Neptunium-237 Uranium Uranium-238	27 11 48 6 3	Ingestion of sediment Dermal contact External exposure	5 26 69	1.7	Chromium Iron Manganese Vanadium	16 23 25 23	Dermal contact	99
Future industrial worker at current concentrations (sediment)	3.4×10^{-5}	Arsenic Cesium-137 Neptunium-237 Uranium Uranium-235	27 11 48 6 3	Ingestion of sediment Dermal contact External exposure	5 26 69	1.7	Chromium Iron Manganese Vanadium	16 23 25 23	Dermal contact	99
Future child rural resident at current concentrations (RGA groundwater)	NA	NA	NA	NA	NA	99	Arsenic Barium Cobalt Iron Manganese Nickel Chloroform Trichloroethene *cis*-1,2-Dichloroethene	1 <1 <1 1 11 1 11 71 3	Ingestion of groundwater Dermal contact Inhalation while showering Inhalation household use Vapor intrusion	23 2 6 44 22
Future child rural resident at current concentrations[c] (McNairy groundwater)	NA	NA	NA	NA	NA	20	Aluminum Arsenic Barium Beryllium Chromium Iron Manganese Nickel Uranium Vanadium Trichloroethene	2 5 1 <1 2 58 9 <1 12 6 2	Ingestion of groundwater Dermal contact Inhalation from household use	96 2 2

Deleted: 88
Deleted: 06-064(E)/041406
Deleted: 77.1
Deleted: .1
Deleted: 30
Deleted: 2
Deleted: 2
Deleted: 8
Deleted: 59
Deleted: 15 <1
Deleted: 14
Deleted: 63
Deleted: 3

Table G.77. Summary of risk characterization for SWMU 1[a] (continued)

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs	% Total HI
Future adult rural resident at current concentrations (RGA groundwater)	6.8×10^{-4}	Arsenic 1,1-Dichloroethene Chloroform Trichloroethene Technetium-99	18 2 2 78 <1	Ingestion of groundwater Dermal contact Inhalation while showering Inhalation household use Vapor intrusion	43 4 5 36 11	26	Arsenic Barium Iron Manganese Nickel Chloroform Trichloroethene *cis*-1,2-Dichloroethene	2 <1 2 18 <1 9 64 3	Ingestion of groundwater Dermal contact Inhalation while showering Inhalation household use Vapor intrusion	37 4 5 36 18
Future adult rural resident at current concentrations[c] (McNairy groundwater)	1.4×10^{-3}	Arsenic Trichloroethene Americium-241 Cesium-137 Uranium-235 Uranium-238	9 <1 42 <1 <1 47	Ingestion of groundwater Inhalation from household use	100 <1	8.2	Aluminum Arsenic Barium Chromium Iron Manganese Uranium Vanadium Trichloroethene	2 5 1 2 58 9 12 6 1	Ingestion of groundwater Dermal contact	97 3
Future child rural resident at modeled concentrations (RGA groundwater drawn at property boundary variable degradation)	NA	NA	NA	NA	NA	0.4	Trichloroethene *cis*-1,2-Dichloroethene	56 29	NE	NE
Future child rural resident at modeled concentrations (RGA groundwater drawn at property boundary fixed degradation)	NA	NA	NA	NA	NA	1.4	Trichloroethene *cis*-1,2-Dichloroethene	83 10	NE	NE
Future adult rural resident at modeled concentrations (RGA groundwater drawn at property boundary variable degradation)	1.4×10^{-6}	Trichloroethene Vinyl chloride	39 61	Not determined	---	0.1	NE	NE	NE	NE
Future adult rural resident at modeled concentrations (RGA groundwater drawn at property boundary fixed degradation)	6.1×10^{-6}	Trichloroethene Vinyl chloride	87 14	Not determined	---	0.2	NE	NE	NE	98

Deleted: 88
Deleted: 06-064(E)/041406
Deleted: ¶
Formatted ... [109]
Deleted: 1
Deleted: .1
Deleted: 21.4
Deleted: 21¶
Deleted: 2¶
Deleted: 45¶
Deleted: 2¶
Deleted: 49¶
Deleted: <1¶
Deleted: 4¶
Deleted: 2¶
Deleted: 7
Deleted: 5¶
Deleted: 2¶
Deleted: 6¶ ... [110]
Deleted: 74¶ ... [111]
Formatted ... [112]
Deleted: 6¶ ... [113]
Deleted: 22¶
Deleted: 1
Deleted: <1¶
Deleted: ¶ ... [114]
Deleted: 11¶
Deleted: 58¶ ... [115]
Formatted ... [116]
Deleted: 3
Formatted ... [117]
Deleted: ¶ ... [118]
Deleted: ¶ ... [119]
Deleted: ¶ ... [120]
Deleted: ¶ ... [121]
Deleted: degradetion
Deleted: ¶ ... [122]
Formatted ... [123]
Deleted: ¶ ... [124]
Formatted ... [125]
Formatted ... [126]
... [127]
Formatted ... [128]
... [129]
Formatted ... [130]
... [131]

051706

Table G.77. Summary of risk characterization for SWMU 1[a] (continued)

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs	% Total HI
Future teen recreational user at current concentrations (soil)	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE
Future teen recreational user at current concentrations (sediment)	NA	NA	NA	NA	NA	2.2	Aluminum Chromium Iron Manganese Vanadium	6 19 28 10 28	Dermal contact	<99
Future adult recreational user at current concentrations (soil)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future adult recreational user at current concentrations (sediment)	1.9×10^{-5}	Arsenic Neptunium-237	78 10	Ingestion of sediment Dermal contact External exposure	9 74 13	0.5	NE	NE	NE	NE
Future excavation worker at current concentrations	1.3×10^{-4}	Arsenic PAHs Bis(2-chloroethyl)ether Dieldrin Heptachlorodibenzofuran Hexachlorobenzene N-Nitroso-di-n-propylamine PCBs Trichloroethene Vinyl chloride Cobalt-60 Uranium	18 25 1 1 3 2 12 9 2 12 1 5	Ingestion of soil Dermal contact Inhalation of VOCs and particulates External exposure	24 54 6 6	1.9	Arsenic Chromium Manganese Vanadium 2-Nitroanaline PCBs Trichloroethene *cis*-1,2-dichloroethene	7 16 14 14 12 7 6 7	Ingestion of soil Dermal contact Inhalation of VOCs and particulates	17 74 9

Note: NA = ELCR not applicable to child and teen cohorts. ELCR for adult include exposure as child and teen.
NE = Land use scenario not of concern or land use not evaluated because contact with medium is not possible.
[a] Total ELCR and total HI columns reflect values from BHHRAs completed earlier and as part of the Southwest Groundwater Plume SI.
[b] A response action for SWMU 1 has addressed PCBs and dioxins surface soil; therefore, surface soil risk is not presented. Please see the BHHRA for additional information.
[c] In the earlier guidance, ELCR and hazard from exposure to groundwater drawn from the RGA and McNairy were assessed. In the SI BHHRA, results for use of groundwater drawn from the RGA was reassessed, and the results for use of water drawn from the McNairy were recalculated.

Deleted: 88

Deleted: 06-064(E)/041406

Deleted: 2

Deleted: ¶

051706

Table G.78. Summary of risk characterization for C-720 Building[a]

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs	% Total HI
Current industrial worker at current concentrations[b] (soil)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future industrial worker at current concentrations[b] (soil)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Current industrial worker at current concentrations[b] (sediment)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future industrial worker at current concentrations [b] (sediment)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future child rural resident at current concentrations[c] (RGA groundwater)	NA	NA	NA	NA	NA	102	Arsenic Barium Iron Manganese Nickel 1,1-Dichloroethene Trichloroethene *cis*-1,2-Dichlroethene *trans*-1,2-Dichloroethene	1 <1 7 12 2 2 73 1 <1	Ingestion of groundwater Dermal contact Inhalation while showering Inhalation household use Vapor intrusion	43 2 7 48 5
Future child rural resident at current concentrations[c] (McNairy groundwater)	NA	NA	NA	NA	NA	64.4	Aluminum Arsenic Barium Beryllium Chromium Iron Manganese Nickel Uranium Vanadium 1,1-Dichloroethene Trichloroethene	9 <1 <1 <1 3 73 6 <1 <1 6 <1 <1	Ingestion of groundwater Dermal contact Inhalation during household use	97 2 <1

Deleted: 9
Deleted: 06-064(E)/041406
Deleted: ¶
Deleted: 72.8¶
Deleted: 1¶
Deleted: <1¶
Deleted: 10¶
Deleted: 17¶
Deleted: 31
Deleted: 43¶
Deleted: 2
Deleted: 2¶
Deleted: 5
Deleted: 7¶
Deleted: 34
Deleted: 48¶
Deleted: 28
Deleted: 3¶
Deleted: 3¶
Deleted: 64¶
Deleted: 2¶
Deleted: <1
Formatted: Left

051706

Table G.78. Summary of risk characterization for C-720 Building[a] (continued)

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs	% Total HI
Future adult rural resident at current concentrations[c] (RGA groundwater)	1.8×10^{-3}	Arsenic 1,1-Dichloroethene Trichloroethene Vinyl chloride Technetium-99	7 64 24 5 <1	Ingestion of groundwater Dermal contact Inhalation while showering Inhalation household use Vapor intrusion	53 2 5 38 2	23.1	Arsenic Barium Iron Manganese Nickel 1,1-Dichloroethene Trichloroethene *cis*-1,2-Dichlroethene	2 <1 12 22 4 2 53 2	Ingestion of groundwater Dermal contact Inhalation while showering Inhalation household use Vapor intrusion	56 4 4 31 3
Future adult rural resident at current concentrations[c] (McNairy groundwater)	2.2×10^{-3}	Arsenic 1,1-Dichloroethene Trichloroethene Vinyl chloride Americium-241 Cesium-137 Neptunium-237 Technetium-99 Uranium-235 Uranium-238	2 12 <1 1 24 <1 14 <1 6 40	Ingestion of groundwater Dermal contact Inhalation while showering Inhalation from household use	54 2 5 39	26.7	Aluminum Arsenic Barium Beryllium Chromium Iron Manganese Nickel Uranium Vanadium Trichloroethene	9 <1 <1 <1 3 73 6 <1 <1 6 <1	Ingestion of groundwater Dermal contact	97 3
Future child rural resident at modeled concentrations (RGA groundwater drawn at property boundary variable degradation)	NA	NA	NA	NA	NA	<0.1	NE	NE	NE	NE
Future child rural resident at modeled concentrations (RGA groundwater drawn at property boundary fixed degradation)	NA	NA	NA	NA	NA	0.3	Trichloroethene *cis*-1,2-Dichloroethene	69 30	NE	NE
Future adult rural resident at modeled concentrations (RGA groundwater drawn at property boundary variable degradation)	1.1×10^{-6}	Vinyl chloride	>95	Not determined	---	<0.1	NE	NE	NE	NE

Deleted: 9
Deleted: 06-064(E)/041406
Formatted ... [135]
Deleted: 22.1
Deleted: 2¶
Deleted: 3
Deleted: 59¶
Deleted: 3
Deleted: 65¶
Deleted: 54¶
Deleted: <1¶
Deleted: 4¶
Deleted: 24¶
Deleted: 2¶
Deleted: 13¶
Deleted: 5¶
Deleted: 3¶ ... [136]
Deleted: 23¶
Deleted: 33¶
Deleted: 5¶ ... [137]
Deleted: 4¶
Deleted: 2¶
Formatted ... [138]
Deleted: ¶ ... [139]
Deleted: 1
Formatted ... [140]
Deleted: ¶ ... [141]
Deleted: 53¶
Deleted: ¶ ... [142]
Deleted: ¶ ... [143]
Deleted: degradetion
Deleted: ¶ ... [144]
Formatted ... [145]
Formatted ... [146]
Formatted ... [147]
Deleted: degradetion
Deleted: ¶ ... [148]
Formatted ... [149]
Deleted: ¶ ... [150]
Deleted: degradetion
... [151]

Table G.78. Summary of risk characterization for C-720 Building[a] (continued)

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs	% Total HI
Future adult rural resident at modeled concentrations (RGA groundwater drawn at property boundary fixed degradation)	2.4×10^{-6}	Trichloroethene Vinyl chloride	51 48	Not determined	---	0.2	Trichloroethene *cis*-1,2-Dichloroethene	82 11	NE	NE
Future child rural resident at current concentrations[b] (soil)	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE
Future adult rural resident at current concentrations[b] (soil)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future child recreational user at current concentrations[b] (soil)	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE
Future child recreational user at current concentrations[b] (sediment)	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE
Future teen recreational user at current concentrations[b] (soil)	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE
Future teen recreational user at current concentrations[b] (sediment)	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE
Future adult recreational user at current[b] concentrations (soil)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future adult recreational user at current concentrations[b] (sediment)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future excavation worker at current concentrations	1.5×10^{-5}	Arsenic Vinyl chloride	59 33	Ingestion of soil Dermal contact Inhalation of VOCs and particulates	37 46 12	0.4	NE	NE	NE	NE

Deleted: 9
Deleted: 06-064(E)/041406
Formatted: Centered
Formatted: Centered
Formatted: Centered
Formatted: Centered
Deleted: degradetion
Formatted: Highlight
Deleted: 39
Formatted: Highlight

Note: NA = ELCR not applicable to child and teen cohorts. ELCR for adult include exposure as child and teen.
NE = Land use scenario not of concern or land use not evaluated because contact with medium is not possible.
[a] Total ELCR and total HI columns reflect values from BHHRAs completed earlier and as part of the Southwest Plume SI.
[b] The area around the C-720 Building in covered by gravel and cement; therefore, contact with surface soil is not possible. Please see the BHHRA for additional information.
[c] In the earlier assessments, ELCR and hazard from exposure to groundwater water drawn from the RGA and McNairy were assessed. In the SI BHHRA only results for use of water drawn from the RGA were reassessed, and the results for use of water from the McNairy were recalculated.

Deleted: 06-064(E)/041406

Deleted: **Table G.90. Summary of risk characterization for SWMU 4[a]¶ Receptor** ... [152]

Table G.79. Summary of risk characterization for SWMU 102[a]

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs	% Total HI
Current industrial worker at current concentrations[b] (soil)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future industrial worker at current concentrations[b] (soil)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Current industrial worker at current concentrations[b] (sediment)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future industrial worker at current concentrations [b] (sediment)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future child rural resident at current concentrations[d] (RGA groundwater)	NA	NA	NA	NA	NA	0.6	NE	NE	NE	NE
Future child rural resident at current concentrations[d] (McNairy groundwater)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future adult rural resident at current concentrations[d] (RGA groundwater)	7.9×10^{-6}	1,1-Dichloroethene Trichloroethene	27 73	Ingestion of groundwater Inhalation household use	41 48	0.2	NE	NE	NE	NE
Future adult rural resident at current concentrations[c] (McNairy groundwater)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future child rural resident at modeled concentrations[d] (RGA groundwater drawn at property boundary)	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE
Future adult rural resident at modeled concentrations[d] (RGA groundwater drawn at property boundary)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

Deleted: 9
Deleted: 1
Deleted: 06-064(E)/041406

051706

Table G.79. Summary of risk characterization for SWMU 102[a] (continued)

Deleted: 1

Deleted: 06-064(E)/041406

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs	% Total HI
Future child rural resident at current concentrations[b] (soil)	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE
Future adult rural resident at current concentrations[b] (soil)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future child recreational user at current concentrations[b] (soil)	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE
Future child recreational user at current concentrations[b] (sediment)	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE
Future teen recreational user at current concentrations[b] (soil)	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE
Future teen recreational user at current concentrations[b] (sediment)	NA	NA	NA	NA	NA	NE	NE	NE	NE	NE
Future adult recreational user at current[b] concentrations (soil)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future adult recreational user at current concentrations[b] (sediment)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Future excavation worker at current concentrations[b]	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

Note: NA = ELCR not applicable to child and teen cohorts. ELCR for adult include exposure as child and teen.
NE = Land use scenario not of concern or land use not evaluated because contact with medium is not possible.
[a] Total ELCR and total HI columns reflect values from BHHRAs completed earlier and as part of the Southwest Groundwater Plume SI.
[b] Only results for subsurface soil collected below 10 ft bgs were available for SWMU 102. Please see the BHHRA for additional information.
[c] In the SI BHHRA, only results for use of water drawn from the RGA were assessed.
[d] Information collected in the SI indicates that SWMU 102 is not a source of contamination to the Southwest Groundwater Plume.

- The current land use scenario and most plausible future use scenario, industrial use, have risks above *de minimis* levels at SWMU 1. At SWMU 1, the exposure routes driving ELCR and systemic toxicity are external exposure and dermal contact, respectively. Risks under industrial use at the C-720 area and SWMU 102 were below *de minimis* levels because ground cover prevents contact with contaminated soil.

- The dermal contact with soil exposure route poses considerable systemic toxicity, predominantly from dermal contact with metals in soil. This results from using dermal absorption factors (ABS values) in the calculation of hazard that exceed GI absorption values. This observation indicates that the hazard estimates for metals from the dermal exposure route may be unrealistic and greatly exceed the real hazard posed by this route. Although chemical-specific ABS values were used when available, default ABS values were used for most chemicals because chemical-specific values are lacking. Because of this uncertainty, response action decisions based on risks from metals in soil should include additional evaluation of the dermal exposure route.

- Risks calculated for consumption of groundwater drawn from the RGA by a hypothetical resident using data summarized over each of the four source areas and over the entire Southwest Groundwater Plume exceeded *de minimis* levels. Additionally, risks derived for the hypothetical resident using results from individual wells and borings also exceeded *de minimis* levels. The following are "priority COCs"[2] because they have a chemical-specific HI or ELCR greater than or equal to 1 or 1×10^{-4} in one or more scenarios.

  – Southwest Groundwater Plume – iron; manganese; uranium; benzene; carbon tetrachloride; chloroform; 1,2-DCA; 1,1-DCE; *cis*-1,2-DCE; TCE; and VC.

  – SWMU 1 – arsenic; iron; manganese; chloroform; *cis*-1,2-DCE; and TCE.

  – C-720 Building area – arsenic; iron; manganese; nickel; 1,1-DCE; *cis*-1,2-DCE; and TCE.

  – Storm sewer – None.

  Risks to a hypothetical resident from use of groundwater contaminated by contaminants migrating from source areas and drawn from wells completed in the RGA at the plant and property boundaries exceeded *de minimis* levels. The source with the greatest impact over the three sources modeled was SWMU 1, which was a source of TCE. The other remaining source with the next greatest impact is the C-720 Building area. For the modeled POEs, the COCs for SWMU 1 are TCE; *cis*-1,2-DCE; *trans*-1,2-DCE; and VC. The COCs for the C-720 Building area are TCE; *cis*-1,2-DCE; and VC. Of these, only TCE has a HI or ELCR greater than 1 or 1×10^{-4} and is, therefore, a "priority COC"[2] for contaminant migration at SWMU 1. The C-720 Building does not have any "priority COCs"[2]. Based on the previous and current modeling results, neither metals nor radionuclides are COCs for contaminant migration from the source the C-720 area or SWMU 1.

G.8 REMEDIAL GOAL OPTIONS

This section presents RGOs for the COCs identified in Section 5 and the methods used to calculate the RGOs. These RGOs should not be interpreted as being clean-up goals, but as risk-based values that may be used to guide the development of clean-up goals by risk managers. Clean-up goals will be determined in later decision documents.

Deleted: s
Deleted: and 4
Deleted: s
Deleted: and 4
Deleted: ”9
Deleted: <#>SWMU 4 – iron; manganese; benzene; bromomethane; carbon tetrachloride; chloroform; 1,2-DCA; 1,1-DCE; *cis*-1,2-DCE; TCE; and VC. ¶
Deleted: four
Deleted: 4
Deleted: n important
Deleted: Of t
Deleted: s
Deleted: , SWMU 1 had the
Deleted: followed by
Deleted: and SWMU 4
Deleted: 7
Deleted: 7
Deleted: For SWMU 4, TCE; *cis*-1,2-DCE; and VC are "priority COCs"
Deleted: 7
Deleted: 2.
Deleted: ; however, SWMU 4 may be a source of these contaminants.
Deleted: 06-064(E)/041406

RGOs were calculated for each COC considering use of groundwater at each source and at the property boundary POE. When calculating the HI-based RGOs, the more conservative child-based values are reported. In addition, for comparison to the RGOs, the MCLs for each COC are presented. Note, MCLs are not clean-up criteria. The National Contingency Plan notes that clean-up criteria different from MCLs may be required if multiple contaminants are present or if contaminants may reach a receptor through exposure routes different from those considered in the development of MCLs. Therefore, risks for use of contaminated groundwater must be presented in addition to a simple screen against MCLs so that risk managers can make appropriate decisions.

G8.1 CALCULATION OF RGOS

EPA guidance directs that RGOs are to be calculated for all COCs identified in a BHHRA. The COCs identified in this risk assessment, their RGOs, and MCLs are presented in Table G.80. These COCs were calculated using the following equation.

Deleted: 92

$$\frac{\textbf{Concentration}}{\textbf{Risk}} = \frac{\textbf{RGO}}{\textbf{Target Risk}}$$

where:

Concentration is the exposure concentration for the medium.
Risk is the risk posed by exposure to the contaminated medium.
RGO is the remedial goal option.
Target Risk is one of the values listed in Table G.80.

Deleted: 92

G8.2 PRESENTATION OF RGOS

The equation developed in the previous subsection was applied for each groundwater COC. (RGOs for soil COCs are in previous BHHRAs and are not repeated here.) The RGOs developed for all COCs using this equation are presented in Table G.80. In addition, these tables present the EPCs used in the BHHRA and each COC's MCL. The MCLs were taken from Appendix A of the Risk Methods Document.

Deleted: 92

RGOs also were developed for TCE found in soil sources at SWMU 1 and the C-720 Building area (Table G.81). These RGOs were calculated using the estimated loading of the COC at each source, the predicted maximum COC concentration at the property boundary POE, and a target COC concentration equal to the COC's MCL. RGOs were developed for TCE only as described below.

Deleted: , SWMU 4

Deleted: 93

Deleted: 06-064(E)/041406

051706

Table G.80. RGOs for COCs of the Southwest Plume and its sources (RGA groundwater)

Deleted: 92

Deleted: 06-064(E)/041406

COC	EPC	MCL	ELCR at EPC	HI at EPC	RGO at HI=0.1	RGO at HI=1	RGO at HI=3	RGO at ELCR= 1×10^{-6}	RGO at ELCR= 1×10^{-5}	RGO at ELCR= 1×10^{-4}	Units
Southwest Plume											
Aluminum	2.40E+00			1.59E-01	1.51E+00	1.51E+01	4.53E+01				mg/L
Arsenic	3.46E-03	1.00E-02	9.90E-05	7.66E-01	4.52E-04	4.52E-03	1.36E-02	3.49E-05	3.49E-04	3.49E-03	mg/L
Barium	1.75E-01	2.00E+00		1.69E-01	1.04E-01	1.04E+00	3.11E+00				mg/L
Iron	2.63E+01			5.85E+00	4.50E-01	4.50E+00	1.35E+01				mg/L
Manganese	1.34E+00			3.83E+00	3.50E-02	3.50E-01	1.05E+00				mg/L
Molybdenum	5.98E-02			7.94E-01	7.53E-03	7.53E-02	2.26E-01				mg/L
Nickel	1.67E-01	1.00E-01		5.56E-01	3.00E-02	3.00E-01	9.01E-01				mg/L
Uranium	3.50E-01	3.00E-02		3.86E+01	9.07E-04	9.07E-03	2.72E-02				mg/L
Vanadium	1.91E-02			2.06E-01	9.27E-03	9.27E-02	2.78E-01				mg/L
Acetone	4.90E-02			1.78E-01	2.75E-02	2.75E-01	8.26E-01				mg/L
Benzene	1.60E-02	5.00E-03	4.15E-05	3.18E+00	5.03E-04	5.03E-03	1.51E-02	3.86E-04	3.86E-03	3.86E-02	mg/L
Bromodichloromethane	1.00E-03	8.00E-02	4.63E-06	1.82E-02	5.49E-03	5.49E-02	1.65E-01	2.16E-04	2.16E-03	2.16E-02	mg/L
Bromomethane	3.87E-03			9.92E-01	3.90E-04	3.90E-03	1.17E-02				mg/L
Carbon Tetrachloride	2.45E-02	5.00E-03	1.35E-04	1.29E+01	1.90E-04	1.90E-03	5.70E-03	1.81E-04	1.81E-03	1.81E-02	mg/L
Chloroform	2.73E-02	8.00E-02	1.25E-04	9.49E+01	2.88E-05	2.88E-04	8.63E-04	2.18E-04	2.18E-03	2.18E-02	mg/L
Chloromethane	1.00E-02		5.98E-06	1.16E-01	8.62E-03	8.62E-02	2.59E-01	1.67E-03	1.67E-02	1.67E-01	mg/L
Dibromochloromethane	2.00E-03	8.00E-02	1.25E-05	3.64E-02	5.49E-03	5.49E-02	1.65E-01	1.60E-04	1.60E-03	1.60E-02	mg/L
Dichloroethane, 1,2-	9.17E-02	5.00E-03	6.23E-04	1.97E+01	4.65E-04	4.65E-03	1.40E-02	1.47E-04	1.47E-03	1.47E-02	mg/L
Dichloroethylene, 1,1-	1.86E-02	7.00E-03	3.96E-04	7.57E-01	2.46E-03	2.46E-02	7.37E-02	4.70E-05	4.70E-04	4.70E-03	mg/L
Dichloroethylene, 1,2-*cis-*	4.53E-02	7.00E-02		1.66E+00	2.73E-03	2.73E-02	8.19E-02				mg/L
Dichloroethylene, 1,2-*trans-*	4.10E-02	1.00E-01		7.48E-01	5.48E-03	5.48E-02	1.64E-01				mg/L
Methylene Chloride	6.63E-02	5.00E-03	1.56E-05	9.66E-02	6.86E-02	6.86E-01	2.06E+00	4.25E-03	4.25E-02	4.25E-01	mg/L
Tetrachloroethylene	4.00E-03	5.00E-03	6.88E-06	4.75E-02	8.42E-03	8.42E-02	2.53E-01	5.81E-04	5.81E-03	5.81E-02	mg/L
Trichloroethylene	5.01E-01	5.00E-03	2.90E-04	3.14E+01	1.60E-03	1.60E-02	4.79E-02	1.73E-03	1.73E-02	1.73E-01	mg/L
Vinyl Chloride	3.16E-02	2.00E-03	9.03E-04	1.03E+00	3.07E-03	3.07E-02	9.20E-02	3.50E-05	3.50E-04	3.50E-03	mg/L
Np-237	1.59E+00		2.77E-06					5.72E-01	5.72E+00	5.72E+01	pCi/L
Tc-99	1.70E+02	9.00E+02	1.21E-05					1.40E+01	1.40E+02	1.40E+03	pCi/L
U-234	4.08E+01	2.00E+01	7.48E-05					5.45E-01	5.45E+00	5.45E+01	pCi/L
U-238	4.21E+01	2.00E+01	9.49E-05					4.44E-01	4.44E+00	4.44E+01	pCi/L
SWMU 1											
Arsenic	4.36E-03	1.00E-02	1.25E-04	9.64E-01	4.52E-04	4.52E-03	1.36E-02	3.49E-05	3.49E-04	3.49E-03	mg/L
Barium	4.62E-01	2.00E+00		4.45E-01	1.04E-01	1.04E+00	3.11E+00				mg/L
Cobalt	2.11E-01			2.33E-01	9.06E-02	9.06E-01	2.72E+00				mg/L
Iron	5.57E+00			1.24E+00	4.49E-01	4.49E+00	1.35E+01				mg/L
Manganese	3.97E+00			1.13E+01	3.51E-02	3.51E-01	1.05E+00				mg/L
Nickel	1.47E-01	1.00E-01		4.89E-01	3.01E-02	3.01E-01	9.02E-01				mg/L
1,1-Dichloroethene	7.00E-04	7.00E-03	1.49E-05	2.84E-02	2.46E-03	2.46E-02	7.39E-02	4.70E-05	4.70E-04	4.70E-03	mg/L
Chloroform	3.20E-03	8.00E-02	1.47E-05	1.11E+01	2.88E-05	2.88E-04	8.65E-04	2.18E-04	2.18E-03	2.18E-02	mg/L

051706

Table G.80. RGOs for COCs of the Southwest Plume and its sources (RGA groundwater) (continued)

COC	EPC	MCL	ELCR at EPC	HI at EPC	RGO at HI=0.1	RGO at HI=1	RGO at HI=3	RGO at ELCR= 1×10^{-6}	RGO at ELCR= 1×10^{-5}	RGO at ELCR= 1×10^{-4}	Units
Trichloroethene	7.80E-01	5.00E-03	4.52E-04	4.88E+01	1.60E-03	1.60E-02	4.80E-02	1.73E-03	1.73E-02	1.73E-01	mg/L
cis-1,2-Dichloroethene	6.70E-02	7.00E-02		2.45E+00	2.73E-03	2.73E-02	8.20E-02				mg/L
Technetium-99	2.39E+01	9.00E+02	1.70E-06					1.41E+01	1.41E+02	1.41E+03	pCi/L
					C-720 Building Area						
Arsenic	4.26E-03	1.00E-02	1.22E-04	9.42E-01	4.52E-04	4.52E-03	1.36E-02	3.49E-05	3.49E-04	3.49E-03	mg/L
Barium	4.22E-01	2.00E+00		4.07E-01	1.04E-01	1.04E+00	3.11E+00				mg/L
Iron	3.12E+01			6.94E+00	4.50E-01	4.50E+00	1.35E+01				mg/L
Manganese	4.25E+00			1.21E+01	3.51E-02	3.51E-01	1.05E+00				mg/L
Nickel	7.01E-01	1.00E-01		2.33E+00	3.01E-02	3.01E-01	9.03E-01				mg/L
1,1-Dichloroethene	5.40E-02	7.00E-03	1.15E-03	2.19E+00	2.47E-03	2.47E-02	7.40E-02	4.70E-05	4.70E-04	4.70E-03	mg/L
Trichloroethene	7.38E-01	5.00E-03	4.28E-04	4.62E+01	1.60E-03	1.60E-02	4.79E-02	1.72E-03	1.72E-02	1.72E-01	mg/L
Vinyl chloride	2.10E-03	2.00E-03	6.00E-05	6.87E-02	3.06E-03	3.06E-02	9.17E-02	3.49E-05	3.49E-04	3.49E-03	mg/L
cis-1,2-Dichloroethene	3.10E-02	7.00E-02		1.13E+00	2.74E-03	2.74E-02	8.23E-02				mg/L
trans-1,2-Dichloroethene	1.40E-02	1.00E-01		2.55E-01	5.49E-03	5.49E-02	1.65E-01				mg/L
Technetium-99	9.34E+01	9.00E+02	6.65E-06					1.40E+01	1.40E+02	1.40E+03	pCi/L
					Storm Sewer						
1,1-Dichloroethene	1.00E-04	7.00E-03	2.13E-06	4.06E-03	2.46E-03	2.46E-02	7.39E-02	4.69E-05	4.69E-04	4.69E-03	mg/L
Trichloroethene	1.00E-02	5.00E-03	5.79E-06	6.26E-01	1.60E-03	1.60E-02	4.79E-02	1.73E-03	1.73E-02	1.73E-01	mg/L

COC = contaminant of concern
EPC = exposure point concentration
MCL = maximum contaminant level

ELCR = excess lifetime cancer risk
HI = hazard index
RGO = remedial goal option

Deleted: 06-064(E)/041406

Deleted: *SWMU 4*

Deleted: Barium ... [153]

Deleted: Iron ... [154]

Deleted: Manganese ... [155]

Deleted: Nickel ... [156]

Deleted: 1,1-Dichloroethene ... [157]

Deleted: 1,2-Dichloroethane ... [158]

Deleted: Acetone ... [159]

Deleted: Benzene ... [160]

Deleted: Bromomethane ... [161]

Deleted: Carbon tetrachloride ... [162]

Deleted: Chloroform ... [163]

Deleted: Dibromochlorometh ... [164]

Deleted: Methylene chloride ... [165]

Deleted: Tetrachloroethene ... [166]

Deleted: Trichloroethene ... [167]

Deleted: Vinyl chloride ... [168]

Deleted: *cis*-1,2-Dichloroethe ... [169]

Deleted: *trans*-1,2-Dichloroet ... [170]

DURING FINAL PROCESSING NEED TO ACTUALLY DELETE TABLE ROWS

Formatted: Left

Deleted: 06-064(E)/041406

051706

Table G.81. RGOs for source zone soil at SWMU 1 and the C-720 area

COC	Source Soil Concentration[a] (mg/kg)	POE Maximum Groundwater Concentration[b] (µg/L)	Target Groundwater Concentration at POE[c] (µg/L)	RGO for Source Zone Soils (mg/kg)
		SWMU 1		
Trichloroethene	5.8	0.95	5	30.5
		C-720 Building area		
Trichloroethene	1.67	0.073	5	114.4

[a] The soil source concentration is the maximum of the median concentration over layers included in SESOIL/AT123D probabilistic modeling. These values are taken from Table F22.1-4 in Appendix F.
[b] The maximum groundwater concentration is the peak median concentration at the property boundary in the concentration curves presented in Fig. F.47, F.50, and F.53, respectively.
[c] The target groundwater concentration is the TCE MCL.

DURING FINAL PORCESSING NEED TO ACTUALLY DELETE TABLE ROWS

With the exception of TCE, COCs modeled in the SI for SWMU 1, and the C-720 Building area sources did not have maximum predicted concentrations at the property boundary POE that exceed the MCL. An example calculation of the TCE source zone soil RGO for SWMU 1 is as follows. The maximum of the median source concentrations of TCE for SWMU 1 was 5.8 mg/kg for layer 3 (see Table F.35) and the predicted peak median TCE groundwater concentration from SWMU 1 at the property boundary was 0.95 µg/L in year 20 (see Fig. F.41). The ratio of the source soil concentration to the predicted groundwater concentration is used as the basis to determine the ratio of the source zone soil RGO to the MCL of 5 µg/L as follows:

RGO/MCL = Source Concentration/predicted GW concentration

Or

RGO = (Source Concentration/predicted GW concentration) * MCL

For TCE at SWMU 1

RGO for source zone soil TCE = (5.8 mg/kg / 0.95 µg/L) × 5 µg/L = 30.5 mg/kg

The TCE RGOs for source zone soil are calculated for each of the source areas as presented in Table G.81.

G.9 REFERENCES

Agency for Toxic Substances and Disease Registry (ATSDR) 1989. *Draft Toxicological Profile for Uranium and Compounds*, Prepared by Syracuse Research Corporation for ATSDR.

ATSDR 1990. *Draft Toxicological Profile for Cobalt,* U.S. Department of Health and Human Services, Public Health Service.

Deleted: 93
Deleted: , SWMU 4,
Deleted: *SWMU 4*
Deleted: Trichloroethene
Deleted: 5.35
Deleted: 4.3
Deleted: 5
Deleted: 6.2
Deleted: 3.
Formatted: Not Highlight
Formatted: Indent: First line: 0.3"
Deleted: For SWMU 4, although, preliminary modeling indicated that both VC and *cis*-1, 2-DCE were expected to exceed their respective MCLs at the plant boundary, and only *cis*-1, 2-DCE would exceed the MCL at the property boundary (Table F.42) they are not expected to exceed their MCLs based on probabilistic modeling for TCE (assuming TCE to be an indicator chemical). Based on preliminary modeling for TCE, the predicted maximum groundwater concentrations at the plant boundary and property boundary were 570 and 233 µg/L (Table F.42), respectively, as compared to the predicted median peak concentrations of 44 and 4.3 µg/L (Table F.53) based on probabilistic modeling. The probabilistic modeling results for TCE at SWMU 4 are more than an order of magnitude lower than the preliminary modeling results. Assuming similar predictions for *cis*-1,2-DCE and VC, the concentrations of these constituents would be significantly lower than their respective MCLs both at the plant and property boundaries; therefore calculation of RGOs for *cis*-1,2-DCE and VC are not necessary. ¶
Deleted: 47
Deleted: 47
Deleted: 93
Deleted: 06-064(E)/041406

Angerer, J., and R. Heinrich 1988. "Cobalt." In: *Handbook on Toxicity of Inorganic Compounds*, Seiler et al. eds., Marcel Dekker, Inc., New York, NY, pp. 251-264.

BJC (Bechtel Jacobs Company LLC) 2003. *Contaminant Migration from SWMU 1 and the C-720 Area at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, BJC/PAD-506.

Bonazountas, M., and J. Wagner 1884. *SESOIL: A Seasonal Soil Compartment Model*, prepared for the U.S. Environmental Protection Agency, Office of Toxic Substances, Arthur D. Little, Inc., Cambridge, MA.

Boyd, G.E. 1959. Technetium and Promethium. *J. Chem. Ed*. 36(1):3-14.

CH2M HILL 1991a. *Results of the Site Investigation, Phase I, at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, KY/ER-4, December.

CH2M HILL 1991b. *Results of the Public Health and Ecological Assessment, Phase II, at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* Volume 6 in *Results of the Site Investigation, Phase II, Paducah Gaseous Diffusion Plant*, KY/SUB/13B-97777C P-03/1991/1, April.

CH2M HILL 1992. *Results of the Site Investigation, Phase II, at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, KY/SUB/13B-97777CP-03/1991/1, April.

Clarke, M.J. and L. Podbielski 1988. In: *Handbook on Toxicity of Inorganic Compounds*, Seiler et al. eds., Marcel Dekker, Inc., New York, NY.

COE (U.S. Army Corps of Engineers) 1994. *Environmental Investigations at the Paducah Gaseous Diffusion Plant and Surrounding Area, McCracken County, Kentucky,* Prepared by: DOA Waterways Experiment Station, COE, Vicksburg, MS, prepared for DOA, Nashville District, COE, Nashville, TN, May.

DOE (U.S. Department of Energy) 1993a. *Engineering Evaluation/Cost Analysis for the Water Policy at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/06-1142&D3, U. S. Department of Energy, Paducah, KY, July.

DOE 1993b. *Record of Decision for Interim Remedial Action for the Northwest Dissolved Phase Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/OR/06-1143&D4, U. S. Department of Energy, Paducah, KY, July.

DOE 1994. *Remedial Investigation (RI) Addendum for Waste Area Grouping 23, PCB Sites, at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1147&D2, U. S. Department of Energy, Paducah, KY.

DOE 1995. *Record of Decision for Interim Remedial Action at the Northeast Plume, Paducah, Kentucky*, DOE/OR/06-1356&D2, U. S. Department of Energy, Paducah, KY, June.

DOE 1998a. *Final Remedial Action Report for Waste Area Grouping (WAG) 23 and Solid Waste Management Unit 1 of WAG 27 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1737&D0, U.S. Department of Energy, Paducah, KY, June.

Deleted: 06-064(E)/041406

DOE 1998b. *Integrated Remedial Investigation/Feasibility Study Work Plan for Waste Area Grouping 27 at Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1518&D2, U. S. Department of Energy, Paducah, KY, June.

DOE 1998c. *Work Plan for Waste Area Grouping 3 Remedial Investigation/Feasibility Study at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1649&D1, U. S. Department of Energy, Paducah, KY, November.

DOE 1999. *Remedial Investigation Report for Waste Area Grouping 27 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1777&D2, U. S. Department of Energy, Paducah, KY, June.

DOE 2000a. *Remedial Investigation Report for Waste Area Grouping 3 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1895&D1, U.S. Department of Energy, Paducah, KY.

DOE 2000b. *Methods for Conducting Human Health Risk Assessment and Risk Evaluations at the Paducah Gaseous Diffusion Plant*, DOE/OR/07-1506&D1, U. S. Department of Energy, Paducah, KY, December.

DOE 2001. *Feasibility Study for the Groundwater Operable Unit at Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1857&D2, U. S. Department of Energy, Paducah, KY, August.

DOE 2004a. *Site Management Plan, Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1207&D2, U. S. Department of Energy, Paducah, KY, April.

DOE 2004b. *Risk Assessment Information System*, Accessed on the World-Wide Web at http://risk.lsd.ornl.gov/tox/rap_toxp.htm, Developed and maintained for the U.S. Department of Energy by the Toxicology and Risk Analysis Section, Oak Ridge National Laboratory, Oak Ridge, TN.

EPA (U. S. Environmental Protection Agency) 1989. *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Part A, Baseline Risk Assessment*, OSWER Directive 9285.7-01a, Office of Emergency and Remedial Response, Washington, DC.

EPA 1998b. *Health Effects Assessment Summary Tables (HEAST), FY 1997 Update*, EPA-540-R-97-036, July.

EPA 2004. *Integrated Risk Information System (IRIS)*, Available on the World-wide Web at http://www.epa.gov/ngispgm3/iris/index.html, Maintained by the U.S. Environmental Protection Agency.

Goodman, L.S. and A. Gilman 1985. *The Pharmacologic Bases of Therapeutics*, 7th edition, Macmillan Publishing Co., New York, NY.

GSC (General Sciences Corporation) 1996. RISKPRO®'s SESOIL for Windows, GSC, Laurel, MD.

Kutegov, K.V., O.N. Pavlov, and V.P. Shvedov 1968. "Technetium," **In**: *Advan. Inorganic Chem. Radiochem*, Vol. 11, pp. 1-90.

Moskalev, Y. I., L. A. Buldakov, A. K. Zhuravleva, et al. 1979. *Toxicological and Radiobiology of Neptunium-237*, ORNL-tr-4936, Moscow Atomizdat Publishers.

Formatted: English (U.S.)

Deleted: 06-064(E)/041406

SAS® (Statistical Analysis System) 1990. *SAS® Procedures Guide, Version 6, Third Edition,* SAS Institute Inc., Cary, NC.

Sittig, M. 1985. *Handbook of Toxic and Hazardous Chemicals and Carcinogens*, Noyes Publications, Park Ridge, NJ.

Venugopal, B. and T.D. Luckey 1978. *Metal Toxicity in Mammals, Vol 2, Chemical Toxicity of Metals and Metalloids*, New York, NY, Plenum Press.

Deleted: 06-064(E)/041406

PART 2 – SCREENING ECOLOGICAL RISK ASSESSMENT

G.10 INTRODUCTION

Consistent with regulatory guidance and agreements contained in the Risk Assessment Methods Document, this BRA contains a summary of previous ecological risk assessments performed for the Southwest Plume and its sources. New work was not performed for the BRA, because all new data collected during the SI were from soil samples collected below 15 ft bgs or were groundwater samples.

Reports with earlier ecological risk assessments summarized here are as follows:

- *Remedial Investigation Report for WAG 27 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 1999a) and

This earlier ecological risk assessment reported the potential risks under both current and potential future conditions to several receptors that may come into contact with contaminated media at or migrating from potential source areas associated with the Southwest Dissolved Phase Plume. As discussed in the earlier ecological risk assessment, because the three potential source areas are located in the industrialized portion of PGDP, it would be inappropriate to derive risk estimates for impacts to nonhuman receptors under current conditions. However, an analysis to determine potential impacts to nonhuman receptors exposed to contaminants in surface soil in the future, if the industrial infrastructure were removed, and to estimate the potential impact of surface migration of contaminated media was performed in these earlier assessments. Results from this earlier Baseline Ecological Risk Assessment (BERA) are summarized in Table 1, which presents the chemicals of potential ecological concern (COPECs). As shown there, results are available for SWMU 1 only. No results are available for the storm sewer investigated during the SI or the C-720 area. Results are not available for the storm sewer because the data set for this area does not contain results for surface soil samples. Results are not available for the C-720 area because contamination in this area is restricted to subsurface soils that lie below gravel- or cement-covered areas, which makes direct contact with this contamination unlikely.

Deleted: <#>*Remedial Investigation Report for Waste Area Grouping 3 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 2000a).¶

Deleted: ese

Deleted: s

Deleted: s

Deleted: four

Deleted: ese

Deleted: s

Deleted: s

Deleted: are

Deleted: s

Deleted: and 4

G.11 OBSERVATIONS FROM ECOLOGICAL RISK ASSESSMENTS

Results from an earlier assessment presented in the WAG 27 (SWMU 1) RI report is summarized below and in Table G.81.

In the BERA for SWMU 1, two inorganic chemical COPECs, chromium and zinc, were identified. Chromium was found at a maximum concentration similar to its background concentration. Neither organic compound nor radionuclide COPECs were identified.

Deleted: s

Deleted: 1

Deleted: and WAG 3 (SWMU 4)

Deleted: s

Deleted: are

Deleted: 94

Deleted: However, c

Deleted: 06-064(E)/041406

Table G.82. Summary of hazard quotients for chemicals[a] posing potential future risks[b] to nonhuman receptors

Location	Receptor	Chemicals of Potential Ecological Concern	
		Cr	Zn
SWMU 1	Plant	16.8	1.3
Ditch soil	Worm	42.0	–
	Shrew	–	–
	Mouse	–	–
	Deer	–	–
C-720 area	Plant	NE	NE
	Worm	NE	NE
	Shrew	NE	NE
	Mouse	NE	NE
	Deer	NE	NE
SWMU 102	Plant	NE	NE
	Worm	NE	NE
	Shrew	NE	NE
	Mouse	NE	NE
	Deer	NE	NE

Notes: Cr = chromium Zn = zinc.

"–" indicates that the hazard quotient for the chemical/receptor combination did not exceed 1 or the chemical was below background in that sector.

"NE" indicates that no evaluation was done. For the C-720 area and SWMU 102, no evaluation was done because surface soil results were not available due to current ground cover and no data were available, respectively.

The table includes values for those chemicals with a maximum concentration above background (or no background available) and at least one hazard quotient > 1.0. If the hazard quotient was less than one or the maximum concentration was less than background, then the hazard quotient is not presented. Analytes for which ecological benchmarks were not available are shown in the SERA in Appendix G.

[b] Values in this table are hazard quotients estimated by dividing the dose to the receptor by the benchmark dose.

Deleted: 94

Deleted: Cu

Deleted: Ni

Deleted: V

Deleted: –¶ –¶ –¶ –¶ –

Deleted: –¶ –¶ –¶ –¶ –

Deleted: –¶ –¶ –¶ –¶ –

Deleted: NE¶ NE¶ NE¶ ... [171]

Deleted: NE¶ NE¶ ... [172]

Deleted: NE¶ NE¶ ... [173]

Deleted: NE¶ NE¶ ... [174]

Deleted: NE¶ NE¶ ... [175]

Deleted: NE¶ NE¶ ... [176]

Deleted: SWMU 4¶ Surface soil

Deleted: Plant¶ Worm¶ ... [177]

Deleted: 296¶ 740¶ ... [178]

Deleted: –¶ 1.0¶ ... [179]

Deleted: 5.1¶ –¶ ... [180]

Deleted: 23.9¶ –¶ ... [181]

Deleted: 1.45¶ –¶ ... [182]

Deleted: ; Cu = copper; Ni = nickel; V = vanadium;

Deleted: For SWMU 4, results for deer were not available in the WAG ... [183]

Deleted: [a]

Deleted: In the BERA for SWMU 4, five inorganic chemical COPEC ... [184]

Deleted: 06-064(E)/041406

ATTACHMENT G.1

TABLES

Deleted: 06-064(E)/041406

THIS PAGE INTENTIONALLY LEFT BLANK.

Deleted: 06-064(E)/041406

Table G.1.1. Summary of RGA groundwater data from SWMU 1 used in the BHHRA[a]

Analyte	Frequency of Detection[b]	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected Value	Maximum Detected Value	Units
		Inorganic Chemicals (Metals)				
Aluminum	0/1	2.00E-01	2.00E-01			mg/L
Antimony	0/3	5.00E-03	5.00E-03			mg/L
Arsenic	1/3	1.00E-02	1.00E-01	4.36E-03	4.36E-03	mg/L
Barium	3/3			8.72E-02	4.62E-01	mg/L
Beryllium	0/3	1.00E-03	1.00E-03			mg/L
Cadmium	0/3	1.00E-03	1.00E-03			mg/L
Calcium	3/3			1.59E+01	2.59E+01	mg/L
Chromium	1/3	2.00E-02	2.00E-02	2.97E-02	2.97E-02	mg/L
Cobalt	2/3	1.00E-03	1.00E-03	2.90E-02	2.11E-01	mg/L
Copper	0/3	2.00E-02	2.00E-02			mg/L
Iron	3/3			2.93E-01	5.57E+00	mg/L
Lead	0/3	5.00E-03	5.00E-03			mg/L
Magnesium	3/3			8.16E+00	1.14E+01	mg/L
Manganese	3/3			9.15E-03	3.97E+00	mg/L
Mercury	0/3	2.00E-04	2.00E-04			mg/L
Molybdenum	0/2	1.00E-03	1.00E-03			mg/L
Nickel	3/3			2.63E-02	1.47E-01	mg/L
Potassium	3/3			1.04E+00	1.31E+00	mg/L
Selenium	1/3	5.00E-03	5.00E-02	7.45E-03	7.45E-03	mg/L
Silver	0/3	1.00E-03	1.00E-03			mg/L
Sodium	1/1			1.59E+01	1.59E+01	mg/L
Thallium	0/1	2.00E-03	2.00E-03			mg/L
Uranium	0/20	1.00E-03	5.00E-03			mg/L
Vanadium	0/1	2.00E-02	2.00E-02			mg/L
Zinc	1/3	2.00E-02	2.00E-01	3.15E-02	3.15E-02	mg/L
		Organic Compounds				
1,1,1,2-Tetrachloroethane	0/3	5.00E-03	5.00E-03			mg/L
1,1,1-Trichloroethane	0/19	5.00E-03	1.00E+00			mg/L
1,1,2,2-Tetrachloroethane	0/4	5.00E-03	1.00E-02			mg/L
1,1,2-Trichloroethane	0/19	5.00E-03	1.00E+00			mg/L
1,1-Dichloroethane	0/19	5.00E-03	1.00E+00			mg/L
1,1-Dichloroethene	2/27	2.86E-03	1.00E+00	5.00E-04	7.00E-04	mg/L
1,2,3-Trichloropropane	0/3	5.00E-03	5.00E-03			mg/L
1,2-Dibromoethane	0/3	5.00E-03	5.00E-03			mg/L
1,2-Dichloroethane	0/19	5.00E-03	1.00E+00			mg/L
1,2-Dichloropropane	0/4	5.00E-03	5.00E-03			mg/L
1,2-Dimethylbenzene	0/1	5.00E-03	5.00E-03			mg/L
2-Butanone	0/4	2.50E-02	5.00E-02			mg/L
2-Chloro-1,3-butadiene	0/3	5.00E-03	5.00E-03			mg/L
2-Chloroethyl vinyl ether	0/3	5.00E-03	5.00E-03			mg/L
2-Hexanone	0/4	2.50E-02	5.00E-02			mg/L
2-Propanol	0/3	5.00E-02	5.00E-02			mg/L
4-Methyl-2-pentanone	0/4	2.50E-02	5.00E-02			mg/L
Acetone	0/4	2.50E-02	1.00E-01			mg/L
Acrolein	0/3	5.00E-02	5.00E-02			mg/L
Acrylonitrile	0/3	5.00E-02	5.00E-02			mg/L
Benzene	0/19	1.00E-03	1.00E+00			mg/L
Bromodichloromethane	0/19	5.00E-03	1.00E+00			mg/L
Bromoform	0/4	5.00E-03	1.00E-02			mg/L

Deleted: 06-064(E)/041406

Table G.1.1. Summary of RGA groundwater data from SWMU 1 used in the BHHRA[a] (continued)

Analyte	Frequency of Detection[b]	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected Value	Maximum Detected Value	Units
Bromomethane	0/4	1.00E-02	1.00E-02			mg/L
Carbon disulfide	0/4	5.00E-03	5.00E-03			mg/L
Carbon tetrachloride	0/19	5.00E-03	1.00E+00			mg/L
Chlorobenzene	0/4	5.00E-03	5.00E-03			mg/L
Chloroethane	0/4	5.00E-03	1.00E-02			mg/L
Chloroform	1/19	5.00E-03	1.00E+00	3.20E-03	3.20E-03	mg/L
Chloromethane	0/4	1.00E-02	1.00E-02			mg/L
Dibromochloromethane	0/4	5.00E-03	5.00E-03			mg/L
Dibromomethane	0/3	5.00E-03	5.00E-03			mg/L
Dichlorodifluoromethane	0/3	5.00E-03	5.00E-03			mg/L
Ethyl cyanide	0/3	1.00E-01	1.00E-01			mg/L
Ethyl methacrylate	0/3	5.00E-03	5.00E-03			mg/L
Ethylbenzene	0/19	5.00E-03	1.00E+00			mg/L
Iodomethane	0/3	5.00E-03	5.00E-03			mg/L
Methacrylonitrile	0/3	2.50E-02	2.50E-02			mg/L
Methyl methacrylate	0/3	5.00E-03	5.00E-03			mg/L
Methylene chloride	0/4	5.00E-03	5.00E-03			mg/L
Styrene	0/4	5.00E-03	5.00E-03			mg/L
Tetrachloroethene	0/19	5.00E-03	1.00E+00			mg/L
Toluene	0/19	5.00E-03	1.00E+00			mg/L
Total Xylene	0/18	5.00E-03	3.00E+00			mg/L
Trans-1,4-Dichloro-2-butene	0/3	5.00E-03	5.00E-03			mg/L
Trichloroethene	25/28	1.87E-03	2.00E-01	1.00E-04	7.80E-01	mg/L
Trichlorofluoromethane	0/3	5.00E-03	5.00E-03			mg/L
Vinyl acetate	0/3	5.00E-02	5.00E-02			mg/L
Vinyl chloride	0/27	2.00E-03	1.00E+00			mg/L
cis-1,2-Dichloroethene	2/27	4.00E-03	1.00E+00	3.00E-02	6.70E-02	mg/L
cis-1,3-Dichloropropene	0/4	5.00E-03	5.00E-03			mg/L
m,p-Xylene	0/1	1.00E-02	1.00E-02			mg/L
trans-1,2-Dichloroethene	0/27	4.00E-03	1.00E+00			mg/L
trans-1,3-Dichloropropene	0/4	5.00E-03	5.00E-03			mg/L
		Radionuclides				
Americium-241	0/2	-3.88E+01	1.16E+01			pCi/L
Cesium-134	0/2	-4.54E+00	-2.53E+00			pCi/L
Cesium-137	0/2	5.25E+00	8.02E+00			pCi/L
Cobalt-60	0/2	-1.71E+01	5.81E-01			pCi/L
Neptunium-237	0/3	-8.56E-01	-6.42E-02			pCi/L
Plutonium-238	0/2	-1.32E-01	1.05E-02			pCi/L
Plutonium-239/240	0/3	-3.39E-02	3.14E-02			pCi/L
Technetium-99	2/17	-8.65E+00	1.03E+01	2.48E+01	2.49E+01	pCi/L
Thorium-230	0/3	-3.36E-02	1.32E-03			pCi/L
Thorium-232	0/3	-3.23E-02	2.39E-02			pCi/L
Uranium-234	0/1	1.98E-01	1.98E-01			pCi/L
Uranium-235	0/3	-4.17E+00	1.27E-02			pCi/L
Uranium-238	0/2	0.00E+00	4.27E-01			pCi/L

[a] Results shown are specific to water samples collected from borings or wells at SWMU 1.
[b] Number of detected results over total number of samples used in the BHHRA.

Deleted: 06-064(E)/041406

Table G.1.2. Summary of RGA groundwater data from the C-720 area used in the BHHRA[a]

Analyte	Frequency of Detection[b]	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected Value	Maximum Detected Value	Units
		Inorganic Chemicals (Metals)				
Aluminum	0/3	2.00E-01	2.00E-01			mg/L
Antimony	0/1	5.00E-03	5.00E-03			mg/L
Arsenic	1/1			4.26E-03	4.26E-03	mg/L
Barium	1/1			4.22E-01	4.22E-01	mg/L
Beryllium	0/1	1.00E-03	1.00E-03			mg/L
Cadmium	0/3	1.00E-03	5.00E-03			mg/L
Calcium	1/1			3.52E+01	3.52E+01	mg/L
Chromium	3/3			3.08E-02	3.80E-01	mg/L
Cobalt	1/1			2.86E-02	2.86E-02	mg/L
Copper	2/3	2.00E-02	2.00E-02	3.70E-02	5.50E-02	mg/L
Iron	3/3			9.13E-01	3.12E+01	mg/L
Lead	0/3	5.00E-03	5.00E-02			mg/L
Magnesium	1/1			1.38E+01	1.38E+01	mg/L
Manganese	1/1			4.25E+00	4.25E+00	mg/L
Mercury	0/1	2.00E-04	2.00E-04			mg/L
Nickel	3/3			1.13E-01	7.01E-01	mg/L
Phosphorous	0/2	5.00E-02	5.00E-02			mg/L
Potassium	1/1			1.93E+00	1.93E+00	mg/L
Selenium	0/1	5.00E-03	5.00E-03			mg/L
Silver	0/1	1.00E-03	1.00E-03			mg/L
Sodium	1/1			5.78E+01	5.78E+01	mg/L
Thallium	0/1	2.00E-03	2.00E-03			mg/L
Uranium	0/11	1.00E-03	5.00E-03			mg/L
Vanadium	0/1	2.00E-02	2.00E-02			mg/L
Zinc	0/3	2.00E-02	1.00E-01			mg/L
		Organic Compounds				
1,1,1-Trichloroethane	0/11	1.00E-03	5.00E-02			mg/L
1,1,2,2-Tetrachloroethane	0/2	2.00E-03	5.00E-03			mg/L
1,1,2-Trichloroethane	0/11	1.00E-03	5.00E-02			mg/L
1,1-Dichloroethane	0/11	1.00E-03	5.00E-02			mg/L
1,1-Dichloroethene	8/31	1.00E-03	1.00E+00	7.00E-04	5.40E-02	mg/L
1,2-Dichloroethane	0/11	1.00E-03	5.00E-02			mg/L
1,2-Dichloropropane	0/2	1.00E-03	5.00E-03			mg/L
1,2-Dimethylbenzene	0/2	1.00E-03	5.00E-03			mg/L
2-Butanone	0/2	5.00E-03	1.00E-02			mg/L
2-Hexanone	0/2	5.00E-03	1.00E-02			mg/L
4-Methyl-2-pentanone	0/2	5.00E-03	1.00E-02			mg/L
Acetone	0/2	5.00E-03	1.00E-02			mg/L
Benzene	0/11	1.00E-03	5.00E-02			mg/L
Bromodichloromethane	0/11	1.00E-03	5.00E-02			mg/L
Bromoform	0/2	2.00E-03	5.00E-03			mg/L
Bromomethane	0/1	2.00E-03	2.00E-03			mg/L
Carbon disulfide	0/2	1.00E-03	5.00E-03			mg/L
Carbon tetrachloride	0/11	1.00E-03	5.00E-02			mg/L
Chlorobenzene	0/2	1.00E-03	5.00E-03			mg/L
Chloroethane	0/2	1.00E-03	5.00E-03			mg/L
Chloroform	0/11	1.00E-03	5.00E-02			mg/L
Chloromethane	0/2	2.00E-03	5.00E-03			mg/L
Dibromochloromethane	0/2	1.00E-03	5.00E-03			mg/L

Deleted: 06-064(E)/041406

Table G.1.2. Summary of RGA groundwater data from the C-720 area used in the BHHRA[a] (continued)

Analyte	Frequency of Detection[b]	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected Value	Maximum Detected Value	Units
Ethylbenzene	0/11	1.00E-03	5.00E-02			mg/L
Methylene chloride	0/2	1.00E-03	1.00E-02			mg/L
Styrene	0/2	1.00E-03	5.00E-03			mg/L
Tetrachloroethene	0/11	1.00E-03	5.00E-02			mg/L
Toluene	0/11	1.00E-03	5.00E-02			mg/L
Total Xylene	0/9	5.00E-03	1.50E-01			mg/L
Trichloroethene	31/31			3.80E-03	1.26E+00	mg/L
Vinyl chloride	1/31	1.00E-03	1.00E+00	2.10E-03	2.10E-03	mg/L
cis-1,2-Dichloroethene	9/31	1.00E-03	1.00E+00	3.00E-04	3.10E-02	mg/L
cis-1,3-Dichloropropene	0/2	1.00E-03	5.00E-03			mg/L
m,p-Xylene	0/2	2.00E-03	1.00E-02			mg/L
trans-1,2-Dichloroethene	8/31	1.00E-03	1.00E+00	1.00E-04	1.40E-02	mg/L
trans-1,3-Dichloropropene	0/2	1.00E-03	5.00E-03			mg/L
			Radionuclides			
Americium-241	0/3	-1.17E+01	1.89E+01			pCi/L
Cesium-134	0/3	-1.29E+01	1.83E+00			pCi/L
Cesium-137	0/3	4.50E-01	5.74E-01			pCi/L
Cobalt-60	0/3	-4.41E+00	1.34E+00			pCi/L
Neptunium-237	0/4	-6.94E-02	2.10E-01			pCi/L
Plutonium-238	0/3	-6.95E-02	1.69E-02			pCi/L
Plutonium-239/240	0/4	-1.64E-02	4.63E-02			pCi/L
Technetium-99	10/10			3.55E+01	1.29E+02	pCi/L
Thorium-230	0/4	-1.08E-01	3.96E-03			pCi/L
Thorium-232	0/4	-5.11E-02	3.67E-02			pCi/L
Uranium-234	0/1	2.35E-01	2.35E-01			pCi/L
Uranium-235	0/4	-7.80E+00	-2.98E-03			pCi/L
Uranium-238	0/2	0.00E+00	3.48E-01			pCi/L

[a] Results shown are specific to water samples collected from borings or wells at the C-720 area.
[b] Number of detected results over total number of samples used in the BHHRA.

Deleted: 06-064(E)/041406

Table G.1.3. Summary of RGA groundwater data from SWMU 4 used in the BHHRA[a]

Analyte	Frequency of Detection[b]	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected Value	Maximum Detected Value	Units
			Inorganic Chemicals (Metals)			
Aluminum	1/2	2.00E-01	2.00E-01	5.47E-01	5.47E-01	mg/L
Antimony	0/2	5.00E-03	5.00E-03			mg/L
Arsenic	0/28	1.00E-03	5.00E-03			mg/L
Barium	2/2			1.20E-01	3.14E-01	mg/L
Beryllium	0/2	1.00E-03	1.00E-03			mg/L
Cadmium	0/28	1.00E-03	5.00E-03			mg/L
Calcium	2/2			2.58E+01	2.96E+01	mg/L
Chromium	18/26	2.50E-02	1.25E-01	2.60E-02	3.81E-01	mg/L
Cobalt	2/2			1.72E-03	2.95E-03	mg/L
Copper	0/2	2.00E-02	2.00E-02			mg/L
Iron	2/2			3.14E+00	6.02E+00	mg/L
Lead	0/28	5.00E-03	5.00E-02			mg/L
Magnesium	2/2			9.38E+00	1.20E+01	mg/L
Manganese	2/2			1.44E-01	1.40E+00	mg/L
Mercury	0/28	2.00E-04	2.00E-04			mg/L
Nickel	2/2			3.45E-02	2.32E-01	mg/L
Potassium	2/2			7.06E-01	3.27E+00	mg/L
Selenium	0/28	5.00E-03	1.00E-02			mg/L
Silver	0/2	1.00E-03	1.00E-03			mg/L
Sodium	2/2			1.56E+01	1.76E+01	mg/L
Thallium	0/2	2.00E-03	2.00E-03			mg/L
Uranium	0/22	1.00E-03	1.00E+00			mg/L
Vanadium	0/2	2.00E-02	2.00E-02			mg/L
Zinc	0/2	2.00E-02	2.00E-02			mg/L
			Organic Compounds			
1,1,1,2-Tetrachloroethane	0/5	5.00E-03	5.00E-03			mg/L
1,1,1-Trichloroethane	0/58	1.00E-03	5.00E+00			mg/L
1,1,2,2-Tetrachloroethane	0/58	2.00E-03	5.00E+00			mg/L
1,1,2-Trichloroethane	0/58	1.00E-03	5.00E+00			mg/L
1,1-Dichloroethane	2/58	1.00E-03	5.00E+00	3.00E-03	1.70E-02	mg/L
1,1-Dichloroethene	47/117	1.00E-03	5.00E+00	8.00E-05	3.40E-01	mg/L
1,2,3-Trichloropropane	0/5	5.00E-03	5.00E-03			mg/L
1,2-Dibromoethane	0/5	5.00E-03	5.00E-03			mg/L
1,2-Dichloroethane	1/58	1.00E-03	5.00E+00	2.00E-01	2.00E-01	mg/L
1,2-Dichloropropane	0/58	1.00E-03	5.00E+00			mg/L
1,2-Dimethylbenzene	0/53	1.00E-03	5.00E+00			mg/L
2-Butanone	3/58	5.00E-03	1.00E+01	6.00E-03	3.50E-02	mg/L
2-Chloro-1,3-butadiene	0/5	5.00E-03	5.00E-03			mg/L
2-Chloroethyl vinyl ether	0/5	5.00E-03	5.00E-03			mg/L
2-Hexanone	0/58	5.00E-03	5.00E+00			mg/L
2-Propanol	1/5	5.00E-02	5.00E-02	5.40E-01	5.40E-01	mg/L
4-Methyl-2-pentanone	0/58	5.00E-03	5.00E+00			mg/L
Acetone	5/58	5.00E-03	1.00E+01	8.00E-03	4.90E-02	mg/L
Acrolein	0/5	5.00E-02	5.00E-02			mg/L
Acrylonitrile	0/5	5.00E-02	5.00E-02			mg/L
Benzene	1/58	1.00E-03	5.00E+00	1.60E-02	1.60E-02	mg/L
Bromodichloromethane	0/58	1.00E-03	5.00E+00			mg/L
Bromoform	0/58	2.00E-03	5.00E+00			mg/L
Bromomethane	1/51	2.00E-03	2.00E-01	4.10E-03	4.10E-03	mg/L

Deleted: 06-064(E)/041406

Table G.1.3. Summary of RGA groundwater data from SWMU 4 used in the BHHRA[a] (continued)

Analyte	Frequency of Detection[b]	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected Value	Maximum Detected Value	Units
Carbon disulfide	0/58	1.00E-03	5.00E+00			mg/L
Carbon tetrachloride	19/58	1.00E-03	5.00E+00	2.00E-03	1.20E-01	mg/L
Chlorobenzene	0/58	1.00E-03	5.00E+00			mg/L
Chloroethane	0/58	1.00E-03	5.00E+00			mg/L
Chloroform	23/58	1.00E-03	5.00E+00	1.00E-03	1.30E-01	mg/L
Chloromethane	0/58	2.00E-03	5.00E+00			mg/L
Dibromochloromethane	1/58	1.00E-03	5.00E+00	2.00E-03	2.00E-03	mg/L
Dibromomethane	0/5	5.00E-03	5.00E-03			mg/L
Dichlorodifluoromethane	0/5	5.00E-03	5.00E-03			mg/L
Ethyl cyanide	0/5	1.00E-01	1.00E-01			mg/L
Ethyl methacrylate	0/5	5.00E-03	5.00E-03			mg/L
Ethylbenzene	0/58	1.00E-03	5.00E+00			mg/L
Iodomethane	0/5	5.00E-03	5.00E-03			mg/L
Methacrylonitrile	0/5	2.50E-02	2.50E-02			mg/L
Methyl methacrylate	0/5	5.00E-03	5.00E-03			mg/L
Methylene chloride	2/58	1.00E-03	1.00E+01	1.20E-02	5.90E-01	mg/L
Styrene	0/58	1.00E-03	5.00E+00			mg/L
Tetrachloroethene	6/58	1.00E-03	5.00E+00	1.00E-03	4.00E-03	mg/L
Toluene	0/58	1.00E-03	5.00E+00			mg/L
Total Xylene	0/5	5.00E-03	5.00E-03			mg/L
Trans-1,4-Dichloro-2-butene	0/5	5.00E-03	5.00E-03			mg/L
Trichloroethene	159/169	1.00E-03	2.00E-02	1.00E-04	6.70E+01	mg/L
Trichlorofluoromethane	0/5	5.00E-03	5.00E-03			mg/L
Vinyl acetate	0/5	5.00E-02	5.00E-02			mg/L
Vinyl chloride	19/117	1.00E-03	1.00E+01	2.00E-04	4.00E-01	mg/L
cis-1,2-Dichloroethene	69/117	1.00E-03	1.00E+00	1.00E-04	1.20E+01	mg/L
cis-1,3-Dichloropropene	0/58	1.00E-03	5.00E+00			mg/L
m,p-Xylene	0/53	2.00E-03	1.00E+01			mg/L
trans-1,2-Dichloroethene	33/117	1.00E-03	5.00E+00	2.00E-04	1.10E-01	mg/L
trans-1,3-Dichloropropene	0/58	1.00E-03	5.00E+00			mg/L
		Radionuclides				
Neptunium-237	0/2	-8.16E-02	-8.07E-02			pCi/L
Plutonium-239/240	0/2	-9.26E-04	-8.76E-04			pCi/L
Technetium-99	12/20	3.82E+00	1.01E+02	2.02E+01	1.66E+02	pCi/L
Uranium-234	0/2	9.02E-02	2.84E-01			pCi/L
Uranium-235	0/2	7.06E-03	1.22E-02			pCi/L
Uranium-238	0/2	3.48E-01	4.12E-01			pCi/L

[a] Results shown are specific to water samples collected from borings or wells at SWMU 4.
[b] Number of detected results over total number of samples used in the BHHRA.

Deleted: 06-064(E)/041406

Table G.1.4. Summary of RGA groundwater data from the storm sewer used in the BHHRA[a]

Analyte	Frequency of Detection[b]	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected Value	Maximum Detected Value	Units
		Organic Compounds				
1,1,1,2-Tetrachloroethane	0/1	5.00E-03	5.00E-03			mg/L
1,1,1-Trichloroethane	0/1	5.00E-03	5.00E-03			mg/L
1,1,2,2-Tetrachloroethane	0/1	5.00E-03	5.00E-03			mg/L
1,1,2-Trichloroethane	0/1	5.00E-03	5.00E-03			mg/L
1,1-Dichloroethane	0/1	5.00E-03	5.00E-03			mg/L
1,1-Dichloroethene	2/8	4.00E-03	5.00E-03	1.00E-04	1.00E-04	mg/L
1,2,3-Trichloropropane	0/1	5.00E-03	5.00E-03			mg/L
1,2-Dibromoethane	0/1	5.00E-03	5.00E-03			mg/L
1,2-Dichloroethane	0/1	5.00E-03	5.00E-03			mg/L
1,2-Dichloropropane	0/1	5.00E-03	5.00E-03			mg/L
2-Butanone	0/1	5.00E-02	5.00E-02			mg/L
2-Chloro-1,3-butadiene	0/1	5.00E-03	5.00E-03			mg/L
2-Chloroethyl vinyl ether	0/1	5.00E-03	5.00E-03			mg/L
2-Hexanone	0/1	5.00E-02	5.00E-02			mg/L
2-Propanol	0/1	5.00E-02	5.00E-02			mg/L
4-Methyl-2-pentanone	0/1	5.00E-02	5.00E-02			mg/L
Acetone	0/1	1.00E-01	1.00E-01			mg/L
Acrolein	0/1	5.00E-02	5.00E-02			mg/L
Acrylonitrile	0/1	5.00E-02	5.00E-02			mg/L
Benzene	0/1	1.00E-03	1.00E-03			mg/L
Bromodichloromethane	0/1	5.00E-03	5.00E-03			mg/L
Bromoform	0/1	5.00E-03	5.00E-03			mg/L
Bromomethane	0/1	1.00E-02	1.00E-02			mg/L
Carbon disulfide	0/1	5.00E-03	5.00E-03			mg/L
Carbon tetrachloride	0/1	5.00E-03	5.00E-03			mg/L
Chlorobenzene	0/1	5.00E-03	5.00E-03			mg/L
Chloroethane	0/1	1.00E-02	1.00E-02			mg/L
Chloroform	0/1	5.00E-03	5.00E-03			mg/L
Chloromethane	0/1	1.00E-02	1.00E-02			mg/L
Dibromochloromethane	0/1	5.00E-03	5.00E-03			mg/L
Dibromomethane	0/1	5.00E-03	5.00E-03			mg/L
Dichlorodifluoromethane	0/1	5.00E-03	5.00E-03			mg/L
Ethyl cyanide	0/1	1.00E-01	1.00E-01			mg/L
Ethyl methacrylate	0/1	5.00E-03	5.00E-03			mg/L
Ethylbenzene	0/1	5.00E-03	5.00E-03			mg/L
Iodomethane	0/1	5.00E-03	5.00E-03			mg/L
Methacrylonitrile	0/1	2.50E-02	2.50E-02			mg/L
Methyl methacrylate	0/1	5.00E-03	5.00E-03			mg/L
Methylene chloride	0/1	5.00E-03	5.00E-03			mg/L
Styrene	0/1	5.00E-03	5.00E-03			mg/L
Tetrachloroethene	0/1	5.00E-03	5.00E-03			mg/L
Toluene	0/1	5.00E-03	5.00E-03			mg/L
Total Xylene	0/1	5.00E-03	5.00E-03			mg/L
Trans-1,4-Dichloro-2-butene	0/1	5.00E-03	5.00E-03			mg/L
Trichloroethene	8/8			9.00E-05	1.00E-02	mg/L
Trichlorofluoromethane	0/1	5.00E-03	5.00E-03			mg/L
Vinyl acetate	0/1	5.00E-02	5.00E-02			mg/L

Deleted: 06-064(E)/041406

Table G.1.4. Summary of RGA groundwater data from the storm sewer used in the BHHRA[a] (continued)

Analyte	Frequency of Detection[b]	Minimum Nondetected Value	Maximum Nondetected Value	Minimum Detected Value	Maximum Detected Value	Units
Vinyl chloride	0/8	4.00E-03	4.00E-03			mg/L
cis-1,2-Dichloroethene	0/8	4.00E-03	5.00E-03			mg/L
cis-1,3-Dichloropropene	0/1	5.00E-03	5.00E-03			mg/L
trans-1,2-Dichloroethene	3/8	4.00E-03	5.00E-03	8.00E-04	4.00E-03	mg/L
trans-1,3-Dichloropropene	0/1	5.00E-03	5.00E-03			mg/L

[a] Results shown are specific to water samples collected from borings or wells at the storm sewer.
[b] Number of detected results over total number of samples used in the BHHRA.

Deleted: 06-064(E)/041406

Table G.1.5. Comparison between undetected analyte's maximum sample quantitation limits (SQLs) and residential use no action screening value for water use – Results for SWMU 1[a]

Analyte	Frequency of Detection[b]	Maximum SQL[b]	HI-based No Action Screening Value[c]	ELCR-based No Action Screening Value[c]	HI Screening Value Exceeded?	ELCR Screening Value Exceeded?	Units
Inorganic Chemicals (Metals)							
Aluminum	0/1	2.00E-01	1.49E+00		No		mg/L
Antimony	0/3	5.00E-03	5.64E-04		Yes		mg/L
Beryllium	0/3	1.00E-03	2.64E-03		No		mg/L
Cadmium	0/3	1.00E-03	6.61E-04		Yes		mg/L
Copper	0/3	2.00E-02	5.57E-02		No		mg/L
Lead	0/3	5.00E-03	1.50E-02		No		mg/L
Mercury	0/3	2.00E-04	4.44E-04		No		mg/L
Molybdenum	0/2	1.00E-03	7.53E-03		No		mg/L
Silver	0/3	1.00E-03	7.50E-03		No		mg/L
Thallium	0/1	2.00E-03					mg/L
Uranium	0/20	5.00E-03	9.06E-04		Yes		mg/L
Vanadium	0/1	2.00E-02	9.25E-03		Yes		mg/L
Organic Compounds							
1,1,1,2-Tetrachloroethane	0/3	5.00E-03	8.18E-03	5.10E-04	No	Yes	mg/L
1,1,1-Trichloroethane	0/19	1.00E+00	3.35E-02		Yes		mg/L
1,1,2,2-Tetrachloroethane	0/4	1.00E-02	1.64E-02	6.61E-05	No	Yes	mg/L
1,1,2-Trichloroethane	0/19	1.00E+00	1.10E-03	2.38E-04	Yes	Yes	mg/L
1,1-Dichloroethane	0/19	1.00E+00	3.63E-02		Yes		mg/L
1,2,3-Trichloropropane	0/3	5.00E-03	1.26E-03	1.55E-06	Yes	Yes	mg/L
1,2-Dibromoethane	0/3	5.00E-03	1.57E-05	6.00E-07	Yes	Yes	mg/L
1,2-Dichloroethane	0/19	1.00E+00	4.65E-04	1.47E-04	Yes	Yes	mg/L
1,2-Dichloropropane	0/4	5.00E-03	3.13E-04	1.96E-04	Yes	Yes	mg/L
1,2-Dimethylbenzene	0/1	5.00E-03	4.39E-01		No		mg/L
2-Butanone	0/4	5.00E-02	8.68E-02		No		mg/L
2-Chloro-1,3-butadiene	0/3	5.00E-03	6.57E-04		Yes		mg/L
2-Chloroethyl vinyl ether	0/3	5.00E-03					mg/L
2-Hexanone	0/4	5.00E-02					mg/L
2-Propanol	0/3	5.00E-02					mg/L
4-Methyl-2-pentanone	0/4	5.00E-02	7.22E-03		Yes		mg/L
Acetone	0/4	1.00E-01	2.75E-02		Yes		mg/L
Acrolein	0/3	5.00E-02	1.92E-06		Yes		mg/L
Acrylonitrile	0/3	5.00E-02	1.70E-04	4.26E-05	Yes	Yes	mg/L
Benzene	0/19	1.00E+00	5.04E-04	3.85E-04	Yes	Yes	mg/L
Bromodichloromethane	0/19	1.00E+00	5.49E-03	2.16E-04	Yes	Yes	mg/L
Bromoform	0/4	1.00E-02	3.01E-02	6.62E-03	No	Yes	mg/L
Bromomethane	0/4	1.00E-02	3.91E-04		Yes		mg/L
Carbon disulfide	0/4	5.00E-03	4.57E-02		No		mg/L
Carbon tetrachloride	0/19	1.00E+00	1.90E-04	1.81E-04	Yes	Yes	mg/L
Chlorobenzene	0/4	5.00E-03	4.66E-03		Yes		mg/L
Chloroethane	0/4	1.00E-02	3.68E-01	4.61E-03	No	Yes	mg/L
Chloromethane	0/4	1.00E-02	8.64E-03	1.67E-03	Yes	Yes	mg/L
Dibromochloromethane	0/4	5.00E-03	5.49E-03	1.59E-04	No	Yes	mg/L
Dibromomethane	0/3	5.00E-03	2.75E-03		Yes		mg/L
Dichlorodifluoromethane	0/3	5.00E-03	1.80E-02		No		mg/L
Ethyl cyanide	0/3	1.00E-01					mg/L
Ethyl methacrylate	0/3	5.00E-03	2.47E-02		No		mg/L

Deleted: 06-064(E)/041406

Table G.1.5. Comparison between undetected analyte's maximum sample quantitation limits (SQLs) and residential use no action screening value for water use – Results for SWMU 1[a] (continued)

Analyte	Frequency of Detection[b]	Maximum SQL[b]	HI-based No Action Screening Value[c]	ELCR-based No Action Screening Value[c]	HI Screening Value Exceeded?	ELCR Screening Value Exceeded?	Units
Ethylbenzene	0/19	1.00E+00	5.63E-02	4.68E-03	Yes	Yes	mg/L
Iodomethane	0/3	5.00E-03					mg/L
Methacrylonitrile	0/3	2.50E-02	4.65E-05		Yes		mg/L
Methyl methacrylate	0/3	5.00E-03	6.51E-02		No		mg/L
Methylene chloride	0/4	5.00E-03	6.86E-02	4.26E-03	No	Yes	mg/L
Styrene	0/4	5.00E-03	5.65E-02		No		mg/L
Tetrachloroethene	0/19	1.00E+00	8.42E-03	5.82E-04	Yes	Yes	mg/L
Toluene	0/19	1.00E+00	3.38E-02		Yes		mg/L
Total Xylene	0/18	3.00E+00	6.53E-02		Yes		mg/L
Trans-1,4-Dichloro-2-butene	0/3	5.00E-03					mg/L
Trichlorofluoromethane	0/3	5.00E-03	5.77E-02		No		mg/L
Vinyl acetate	0/3	5.00E-02	1.89E-02		Yes		mg/L
Vinyl chloride	0/27	1.00E+00	3.06E-03	3.50E-05	Yes	Yes	mg/L
cis-1,3-Dichloropropene	0/4	5.00E-03					mg/L
m,p-Xylene	0/1	1.00E-02					mg/L
trans-1,2-Dichloroethene	0/27	1.00E+00	5.48E-03		Yes		mg/L
trans-1,3-Dichloropropene	0/4	5.00E-03					mg/L
			Radionuclides				
Americium-241	0/2	1.16E+01		3.71E-01		Yes	pCi/L
Cesium-134	0/2	-2.53E+00		9.15E-01		No	pCi/L
Cesium-137	0/2	8.02E+00		1.27E+00		Yes	pCi/L
Cobalt-60	0/2	5.81E-01		2.46E+00		No	pCi/L
Neptunium-237	0/3	-6.42E-02		5.73E-01		No	pCi/L
Plutonium-238	0/2	1.05E-02		2.95E-01		No	pCi/L
Plutonium-239/240	0/3	3.14E-02					pCi/L
Thorium-230	0/3	1.32E-03		4.24E-01		No	pCi/L
Thorium-232	0/3	2.39E-02		3.82E-01		No	pCi/L
Uranium-234	0/1	1.98E-01		5.46E-01		No	pCi/L
Uranium-235	0/3	1.27E-02		5.38E-01		No	pCi/L
Uranium-238	0/2	4.27E-01		4.43E-01		No	pCi/L

[a] Results shown are for water samples collected from borings or wells at SWMU 1.
[b] Number of detected results over total number of samples used in the BHHRA.
[c] Risk-based screening values are taken from Appendix A of the Risk Methods Document. The HI-based value is that for the child resident. The ELCR-based value is that for lifetime exposure. HI and ELCR target values used for the screening values are 0.1 and 1×10^{-6}, respectively.

Deleted: 06-064(E)/041406

Table G.1.6. Comparison between undetected analyte's maximum sample quantitation limits (SQLs) and residential use no action screening value for water use – Results for the C-720 area[a]

Analyte	Frequency of Detection[b]	Maximum SQL[b]	HI-based No Action Screening Value[c]	ELCR-based No Action Screening Value[c]	HI Screening Value Exceeded?	ELCR Screening Value Exceeded?	Units
Inorganic Chemicals (Metals)							
Aluminum	0/3	2.00E-01	1.49E+00		No		mg/L
Antimony	0/1	5.00E-03	5.64E-04		Yes		mg/L
Beryllium	0/1	1.00E-03	2.64E-03		No		mg/L
Cadmium	0/3	5.00E-03	6.61E-04		Yes		mg/L
Lead	0/3	5.00E-02	1.50E-02		Yes		mg/L
Mercury	0/1	2.00E-04	4.44E-04		No		mg/L
Phosphorous	0/2	5.00E-02	3.00E-05		Yes		mg/L
Selenium	0/1	5.00E-03	7.54E-03		No		mg/L
Silver	0/1	1.00E-03	7.50E-03		No		mg/L
Thallium	0/1	2.00E-03					mg/L
Uranium	0/11	5.00E-03	9.06E-04		Yes		mg/L
Vanadium	0/1	2.00E-02	9.25E-03		Yes		mg/L
Zinc	0/3	1.00E-01	4.50E-01		No		mg/L
Organic Compounds							
1,1,1-Trichloroethane	0/11	5.00E-02	3.35E-02		Yes		mg/L
1,1,2,2-Tetrachloroethane	0/2	5.00E-03	1.64E-02	6.61E-05	No	Yes	mg/L
1,1,2-Trichloroethane	0/11	5.00E-02	1.10E-03	2.38E-04	Yes	Yes	mg/L
1,1-Dichloroethane	0/11	5.00E-02	3.63E-02		Yes		mg/L
1,2-Dichloroethane	0/11	5.00E-02	4.65E-04	1.47E-04	Yes	Yes	mg/L
1,2-Dichloropropane	0/2	5.00E-03	3.13E-04	1.96E-04	Yes	Yes	mg/L
1,2-Dimethylbenzene	0/2	5.00E-03	4.39E-01		No		mg/L
2-Butanone	0/2	1.00E-02	8.68E-02		No		mg/L
2-Hexanone	0/2	1.00E-02					mg/L
4-Methyl-2-pentanone	0/2	1.00E-02	7.22E-03		Yes		mg/L
Acetone	0/2	1.00E-02	2.75E-02		No		mg/L
Benzene	0/11	5.00E-02	5.04E-04	3.85E-04	Yes	Yes	mg/L
Bromodichloromethane	0/11	5.00E-02	5.49E-03	2.16E-04	Yes	Yes	mg/L
Bromoform	0/2	5.00E-03	3.01E-02	6.62E-03	No	No	mg/L
Bromomethane	0/1	2.00E-03	3.91E-04		Yes		mg/L
Carbon disulfide	0/2	5.00E-03	4.57E-02		No		mg/L
Carbon tetrachloride	0/11	5.00E-02	1.90E-04	1.81E-04	Yes	Yes	mg/L
Chlorobenzene	0/2	5.00E-03	4.66E-03		Yes		mg/L
Chloroethane	0/2	5.00E-03	3.68E-01	4.61E-03	No	Yes	mg/L
Chloroform	0/11	5.00E-02	2.87E-05	2.18E-04	Yes	Yes	mg/L
Chloromethane	0/2	5.00E-03	8.64E-03	1.67E-03	No	Yes	mg/L
Dibromochloromethane	0/2	5.00E-03	5.49E-03	1.59E-04	No	Yes	mg/L
Ethylbenzene	0/11	5.00E-02	5.63E-02	4.68E-03	No	Yes	mg/L
Methylene chloride	0/2	1.00E-02	6.86E-02	4.26E-03	No	Yes	mg/L
Styrene	0/2	5.00E-03	5.65E-02		No		mg/L
Tetrachloroethene	0/11	5.00E-02	8.42E-03	5.82E-04	Yes	Yes	mg/L
Toluene	0/11	5.00E-02	3.38E-02		Yes		mg/L
Total Xylene	0/9	1.50E-01	6.53E-02		Yes		mg/L
cis-1,3-Dichloropropene	0/2	5.00E-03					mg/L
m,p-Xylene	0/2	1.00E-02					mg/L
trans-1,3-Dichloropropene	0/2	5.00E-03					mg/L

Deleted: 06-064(E)/041406

Table G.1.6. Comparison between undetected analyte's maximum sample quantitation limits (SQLs) and residential use no action screening value for water use – Results for the C-720 area[a] (continued)

Analyte	Frequency of Detection[b]	Maximum SQL[b]	HI-based No Action Screening Value[c]	ELCR-based No Action Screening Value[c]	HI Screening Value Exceeded?	ELCR Screening Value Exceeded?	Units
			Radionuclides				
Americium-241	0/3	1.89E+01		3.71E-01		Yes	pCi/L
Cesium-134	0/3	1.83E+00		9.15E-01		Yes	pCi/L
Cesium-137	0/3	5.74E-01		1.27E+00		No	pCi/L
Cobalt-60	0/3	1.34E+00		2.46E+00		No	pCi/L
Neptunium-237	0/4	2.10E-01		5.73E-01		No	pCi/L
Plutonium-238	0/3	1.69E-02		2.95E-01		No	pCi/L
Plutonium-239/240	0/4	4.63E-02					pCi/L
Potassium-40	0/4	1.78E+02		1.56E+00		No	pCi/L
Thorium-230	0/4	3.96E-03		4.24E-01		No	pCi/L
Thorium-232	0/4	3.67E-02		3.82E-01		No	pCi/L
Uranium-234	0/1	2.35E-01		5.46E-01		No	pCi/L
Uranium-235	0/4	-2.98E-03		5.38E-01		No	pCi/L
Uranium-238	0/2	3.48E-01		4.43E-01		No	pCi/L

[a] Results shown are for water samples collected from borings or wells at the C-720 area.
[b] Number of detected results over total number of samples used in the BHHRA.
[c] Risk-based screening values are taken from Appendix A of the Risk Methods Document. The HI-based value is that for the child resident. The ELCR-based value is that for lifetime exposure. HI and ELCR target values used for the screening values are 0.1 and 1×10^{-6}, respectively.

Deleted: 06-064(E)/041406

Table G.1.7. Comparison between undetected analyte's maximum sample quantitation limits (SQLs) and residential use no action screening value for water use – Results for SWMU 4[a]

Analyte	Frequency of Detection[b]	Maximum SQL[b]	HI-based No Action Screening Value[c]	ELCR-based No Action Screening Value[c]	HI Screening Value Exceeded?	ELCR Screening Value Exceeded?	Units
Inorganic Chemicals (Metals)							
Antimony	0/2	5.00E-03	5.64E-04		Yes		mg/L
Arsenic	0/28	5.00E-03	4.52E-04	3.50E-05	Yes	Yes	mg/L
Beryllium	0/2	1.00E-03	2.64E-03		No		mg/L
Cadmium	0/28	5.00E-03	6.61E-04		Yes		mg/L
Copper	0/2	2.00E-02	5.57E-02		No		mg/L
Lead	0/28	5.00E-02	1.50E-02		Yes		mg/L
Mercury	0/28	2.00E-04	4.44E-04		No		mg/L
Selenium	0/28	1.00E-02	7.54E-03		Yes		mg/L
Silver	0/2	1.00E-03	7.50E-03		No		mg/L
Thallium	0/2	2.00E-03					mg/L
Uranium	0/22	1.00E+00	9.06E-04		Yes		mg/L
Vanadium	0/2	2.00E-02	9.25E-03		Yes		mg/L
Zinc	0/2	2.00E-02	4.50E-01		No		mg/L
Organic Compounds							
1,1,1,2-Tetrachloroethane	0/5	5.00E-03	8.18E-03	5.10E-04	No	Yes	mg/L
1,1,1-Trichloroethane	0/58	5.00E+00	3.35E-02		Yes		mg/L
1,1,2,2-Tetrachloroethane	0/58	5.00E+00	1.64E-02	6.61E-05	Yes	Yes	mg/L
1,1,2-Trichloroethane	0/58	5.00E+00	1.10E-03	2.38E-04	Yes	Yes	mg/L
1,2,3-Trichloropropane	0/5	5.00E-03	1.26E-03	1.55E-06	Yes	Yes	mg/L
1,2-Dibromoethane	0/5	5.00E-03	1.57E-05	6.00E-07	Yes	Yes	mg/L
1,2-Dichloropropane	0/58	5.00E+00	3.13E-04	1.96E-04	Yes	Yes	mg/L
1,2-Dimethylbenzene	0/53	5.00E+00	4.39E-01		Yes		mg/L
2-Chloro-1,3-butadiene	0/5	5.00E-03	6.57E-04		Yes		mg/L
2-Chloroethyl vinyl ether	0/5	5.00E-03					mg/L
2-Hexanone	0/58	5.00E+00					mg/L
4-Methyl-2-pentanone	0/58	5.00E+00	7.22E-03		Yes		mg/L
Acrolein	0/5	5.00E-02	1.92E-06		Yes		mg/L
Acrylonitrile	0/5	5.00E-02	1.70E-04	4.26E-05	Yes	Yes	mg/L
Bromodichloromethane	0/58	5.00E+00	5.49E-03	2.16E-04	Yes	Yes	mg/L
Bromoform	0/58	5.00E+00	3.01E-02	6.62E-03	Yes	Yes	mg/L
Carbon disulfide	0/58	5.00E+00	4.57E-02		Yes		mg/L
Chlorobenzene	0/58	5.00E+00	4.66E-03		Yes		mg/L
Chloroethane	0/58	5.00E+00	3.68E-01	4.61E-03	Yes	Yes	mg/L
Chloromethane	0/58	5.00E+00	8.64E-03	1.67E-03	Yes	Yes	mg/L
Dibromomethane	0/5	5.00E-03	2.75E-03		Yes		mg/L
Dichlorodifluoromethane	0/5	5.00E-03	1.80E-02		No		mg/L
Ethyl cyanide	0/5	1.00E-01					mg/L
Ethyl methacrylate	0/5	5.00E-03	2.47E-02		No		mg/L
Ethylbenzene	0/58	5.00E+00	5.63E-02	4.68E-03	Yes	Yes	mg/L
Iodomethane	0/5	5.00E-03					mg/L
Methacrylonitrile	0/5	2.50E-02	4.65E-05		Yes		mg/L
Methyl methacrylate	0/5	5.00E-03	6.51E-02		No		mg/L
Styrene	0/58	5.00E+00	5.65E-02		Yes		mg/L
Toluene	0/58	5.00E+00	3.38E-02		Yes		mg/L

Deleted: 06-064(E)/041406

Table G.1.7. Comparison between undetected analyte's maximum sample quantitation limits (SQLs) and residential use no action screening value for water use – Results for SWMU 4[a] (continued)

Analyte	Frequency of Detection[b]	Maximum SQL[b]	HI-based No Action Screening Value[c]	ELCR-based No Action Screening Value[c]	HI Screening Value Exceeded?	ELCR Screening Value Exceeded?	Units
Total Xylene	0/5	5.00E-03	6.53E-02		No		mg/L
Trans-1,4-Dichloro-2-butene	0/5	5.00E-03					mg/L
Trichlorofluoromethane	0/5	5.00E-03	5.77E-02		No		mg/L
Vinyl acetate	0/5	5.00E-02	1.89E-02		Yes		mg/L
cis-1,3-Dichloropropene	0/58	5.00E+00					mg/L
m,p-Xylene	0/53	1.00E+01					mg/L
trans-1,3-Dichloropropene	0/58	5.00E+00					mg/L
Radionuclides							
Neptunium-237	0/2	-8.07E-02		5.73E-01		No	pCi/L
Plutonium-239/240	0/2	-8.76E-04					pCi/L
Uranium-234	0/2	2.84E-01		5.46E-01		No	pCi/L
Uranium-235	0/2	1.22E-02		5.38E-01		No	pCi/L
Uranium-238	0/2	4.12E-01		4.43E-01		No	pCi/L

[a] Results shown are for water samples collected from borings or wells at SWMU 4.
[b] Number of detected results over total number of samples used in the BHHRA.
[c] Risk-based screening values are taken from Appendix A of the Risk Methods Document. The HI-based value is that for the child resident. The ELCR-based value is that for lifetime exposure. HI and ELCR target values used for the screening values are 0.1 and 1×10^{-6}, respectively.

Deleted: 06-064(E)/041406

Table G.1.8. Comparison between undetected analyte's maximum sample quantitation limits (SQLs) and residential use no action screening value for water use – Results for the storm sewer[a]

Analyte	Frequency of Detection[b]	Maximum SQL[b]	HI-based No Action Screening Value[c]	ELCR-based No Action Screening Value[c]	HI Screening Value Exceeded?	ELCR Screening Value Exceeded?	Units
Organic Compounds							
1,1,1,2-Tetrachloroethane	0/1	5.00E-03	8.18E-03	5.10E-04	No	Yes	mg/L
1,1,1-Trichloroethane	0/1	5.00E-03	3.35E-02		No		mg/L
1,1,2,2-Tetrachloroethane	0/1	5.00E-03	1.64E-02	6.61E-05	No	Yes	mg/L
1,1,2-Trichloroethane	0/1	5.00E-03	1.10E-03	2.38E-04	Yes	Yes	mg/L
1,1-Dichloroethane	0/1	5.00E-03	3.63E-02		No		mg/L
1,2,3-Trichloropropane	0/1	5.00E-03	1.26E-03	1.55E-06	Yes	Yes	mg/L
1,2-Dibromoethane	0/1	5.00E-03	1.57E-05	6.00E-07	Yes	Yes	mg/L
1,2-Dichloroethane	0/1	5.00E-03	4.65E-04	1.47E-04	Yes	Yes	mg/L
1,2-Dichloropropane	0/1	5.00E-03	3.13E-04	1.96E-04	Yes	Yes	mg/L
2-Butanone	0/1	5.00E-02	8.68E-02		No		mg/L
2-Chloro-1,3-butadiene	0/1	5.00E-03	6.57E-04		Yes		mg/L
2-Chloroethyl vinyl ether	0/1	5.00E-03					mg/L
2-Hexanone	0/1	5.00E-02					mg/L
2-Propanol	0/1	5.00E-02					mg/L
4-Methyl-2-pentanone	0/1	5.00E-02	7.22E-03		Yes		mg/L
Acetone	0/1	1.00E-01	2.75E-02		Yes		mg/L
Acrolein	0/1	5.00E-02	1.92E-06		Yes		mg/L
Acrylonitrile	0/1	5.00E-02	1.70E-04	4.26E-05	Yes	Yes	mg/L
Benzene	0/1	1.00E-03	5.04E-04	3.85E-04	No	Yes	mg/L
Bromodichloromethane	0/1	5.00E-03	5.49E-03	2.16E-04	No	Yes	mg/L
Bromoform	0/1	5.00E-03	3.01E-02	6.62E-03	No	No	mg/L
Bromomethane	0/1	1.00E-02	3.91E-04		Yes		mg/L
Carbon disulfide	0/1	5.00E-03	4.57E-02		No		mg/L
Carbon tetrachloride	0/1	5.00E-03	1.90E-04	1.81E-04	Yes	Yes	mg/L
Chlorobenzene	0/1	5.00E-03	4.66E-03		Yes		mg/L
Chloroethane	0/1	1.00E-02	3.68E-01	4.61E-03	No	Yes	mg/L
Chloroform	0/1	5.00E-03	2.87E-05	2.18E-04	Yes	Yes	mg/L
Chloromethane	0/1	1.00E-02	8.64E-03	1.67E-03	Yes	Yes	mg/L
Dibromochloromethane	0/1	5.00E-03	5.49E-03	1.59E-04	No	Yes	mg/L
Dibromomethane	0/1	5.00E-03	2.75E-03		Yes		mg/L
Dichlorodifluoromethane	0/1	5.00E-03	1.80E-02		No		mg/L
Ethyl cyanide	0/1	1.00E-01					mg/L
Ethyl methacrylate	0/1	5.00E-03	2.47E-02		No		mg/L
Ethylbenzene	0/1	5.00E-03	5.63E-02	4.68E-03	No	Yes	mg/L
Iodomethane	0/1	5.00E-03					mg/L
Methacrylonitrile	0/1	2.50E-02	4.65E-05		Yes		mg/L
Methyl methacrylate	0/1	5.00E-03	6.51E-02		No		mg/L
Methylene chloride	0/1	5.00E-03	6.86E-02	4.26E-03	No	Yes	mg/L
Styrene	0/1	5.00E-03	5.65E-02		No		mg/L
Tetrachloroethene	0/1	5.00E-03	8.42E-03	5.82E-04	No	Yes	mg/L
Toluene	0/1	5.00E-03	3.38E-02		No		mg/L
Total Xylene	0/1	5.00E-03	6.53E-02		No		mg/L
Trans-1,4-Dichloro-2-butene	0/1	5.00E-03					mg/L

Deleted: 06-064(E)/041406

Table G.1.8. Comparison between undetected analyte's maximum sample quantitation limits (SQLs) and residential use no action screening value for water use – Results for the storm sewer[a] (continued)

Analyte	Frequency of Detection[b]	Maximum SQL[b]	HI-based No Action Screening Value[c]	ELCR-based No Action Screening Value[c]	HI Screening Value Exceeded?	ELCR Screening Value Exceeded?	Units
Trichlorofluoromethane	0/1	5.00E-03	5.77E-02		No		mg/L
Vinyl acetate	0/1	5.00E-02	1.89E-02		Yes		mg/L
Vinyl chloride	0/8	4.00E-03	3.06E-03	3.50E-05	Yes	Yes	mg/L
cis-1,2-Dichloroethene	0/8	5.00E-03	2.73E-03		Yes		mg/L
cis-1,3-Dichloropropene	0/1	5.00E-03					mg/L
trans-1,3-Dichloropropene	0/1	5.00E-03					mg/L

[a] Results shown are for water samples collected from borings or wells at the storm sewer.
[b] Number of detected results over total number of samples used in the BHHRA.
[c] Risk-based screening values are taken from Appendix A of the Risk Methods Document. The HI-based value is that for the child resident. The ELCR-based value is that for lifetime exposure. HI and ELCR target values used for the screening values are 0.1 and 1×10^{-6}, respectively.

Deleted: 06-064(E)/041406

Table G.1.9. Comparison between maximum detected concentrations and provisional groundwater background concentrations – SWMU 1[a]

Analyte	Frequency of Detection[b]	Maximum Detected Value	Background Concentration[c]	Background Concentration Exceeded?	Units
		Inorganic Chemicals (Metals)			
Arsenic	1/3	4.36E-03	5.00E-03	No	mg/L
Barium	3/3	4.62E-01	2.35E-01	Yes	mg/L
Calcium	3/3	2.59E+01	4.12E+01	No	mg/L
Chromium	1/3	2.97E-02	1.44E-01	No	mg/L
Cobalt	2/3	2.11E-01	4.50E-02	Yes	mg/L
Iron	3/3	5.57E+00	5.03E+00	Yes	mg/L
Magnesium	3/3	1.14E+01	1.63E+01	No	mg/L
Manganese	3/3	3.97E+00	1.19E-01	Yes	mg/L
Nickel	3/3	1.47E-01	6.82E-01	No	mg/L
Potassium	3/3	1.31E+00	5.20E+00	No	mg/L
Selenium	1/3	7.45E-03	5.00E-03	Yes	mg/L
Sodium	1/1	1.59E+01	5.95E+01	No	mg/L
Zinc	1/3	3.15E-02	5.40E-02	No	mg/L
		Organic Compounds			
1,1-Dichloroethene	2/27	7.00E-04			mg/L
Chloroform	1/19	3.20E-03			mg/L
Trichloroethene	25/28	7.80E-01			mg/L
cis-1,2-Dichloroethene	2/27	6.70E-02			mg/L
		Radionuclides			
Technetium-99	2/17	2.49E+01	2.23E+01	Yes	pCi/L

[a] Results shown are for water samples collected from borings or wells at SWMU 1.

[b] Number of detected results over total number of samples used in the BHHRA.

[c] Provisional background concentrations are taken from Appendix A of the Risk Methods Document. Blank cells indicate that a background concentration for the analyte does not exist.

Deleted: 06-064(E)/041406

Table G.1.10. Comparison between maximum detected concentrations and provisional groundwater background concentrations – C-720 area[a]

Analyte	Frequency of Detection[b]	Maximum Detected Value	Background Concentration[c]	Background Concentration Exceeded?	Units
Inorganic Chemicals (Metals)					
Arsenic	1/1	4.26E-03	5.00E-03	No	mg/L
Barium	1/1	4.22E-01	2.35E-01	Yes	mg/L
Calcium	1/1	3.52E+01	4.12E+01	No	mg/L
Chromium	3/3	3.80E-01	1.44E-01	Yes	mg/L
Cobalt	1/1	2.86E-02	4.50E-02	No	mg/L
Copper	2/3	5.50E-02	3.60E-02	Yes	mg/L
Iron	3/3	3.12E+01	5.03E+00	Yes	mg/L
Magnesium	1/1	1.38E+01	1.63E+01	No	mg/L
Manganese	1/1	4.25E+00	1.19E-01	Yes	mg/L
Nickel	3/3	7.01E-01	6.82E-01	Yes	mg/L
Potassium	1/1	1.93E+00	5.20E+00	No	mg/L
Sodium	1/1	5.78E+01	5.95E+01	No	mg/L
Organic Compounds					
1,1-Dichloroethene	8/31	5.40E-02			mg/L
Trichloroethene	31/31	1.26E+00			mg/L
Vinyl chloride	1/31	2.10E-03			mg/L
cis-1,2-Dichloroethene	9/31	3.10E-02			mg/L
trans-1,2-Dichloroethene	8/31	1.40E-02			mg/L
Radionuclides					
Technetium-99	10/10	1.29E+02	2.23E+01	Yes	pCi/L

[a] Results shown are for water samples collected from borings or wells at the C-720 area.
[b] Number of detected results over total number of samples used in the BHHRA.
[c] Provisional background concentrations are taken from Appendix A of the Risk Methods Document. Blank cells indicate that a background concentration for the analyte does not exist.

Deleted: 06-064(E)/041406

Table G.1.11. Comparison between maximum detected concentrations and provisional groundwater background concentrations – SWMU 4[a]

Analyte	Frequency of Detection[b]	Maximum Detected Value	Background Concentration[c]	Background Concentration Exceeded?	Units
Inorganic Chemicals (Metals)					
Aluminum	1/2	5.47E-01	2.19E+00	No	mg/L
Barium	2/2	3.14E-01	2.35E-01	Yes	mg/L
Calcium	2/2	2.96E+01	4.12E+01	No	mg/L
Chromium	18/26	3.81E-01	1.44E-01	Yes	mg/L
Cobalt	2/2	2.95E-03	4.50E-02	No	mg/L
Iron	2/2	6.02E+00	5.03E+00	Yes	mg/L
Magnesium	2/2	1.20E+01	1.63E+01	No	mg/L
Manganese	2/2	1.40E+00	1.19E-01	Yes	mg/L
Nickel	2/2	2.32E-01	6.82E-01	No	mg/L
Potassium	2/2	3.27E+00	5.20E+00	No	mg/L
Sodium	2/2	1.76E+01	5.95E+01	No	mg/L
Organic Compounds					
1,1-Dichloroethane	2/58	1.70E-02			mg/L
1,1-Dichloroethene	47/117	3.40E-01			mg/L
1,2-Dichloroethane	1/58	2.00E-01			mg/L
2-Butanone	3/58	3.50E-02			mg/L
2-Propanol	1/5	5.40E-01			mg/L
Acetone	5/58	4.90E-02			mg/L
Benzene	1/58	1.60E-02			mg/L
Bromomethane	1/51	4.10E-03			mg/L
Carbon tetrachloride	19/58	1.20E-01			mg/L
Chloroform	23/58	1.30E-01			mg/L
Dibromochloromethane	1/58	2.00E-03			mg/L
Methylene chloride	2/58	5.90E-01			mg/L
Tetrachloroethene	6/58	4.00E-03			mg/L
Trichloroethene	159/169	6.70E+01			mg/L
Vinyl chloride	19/117	4.00E-01			mg/L
cis-1,2-Dichloroethene	69/117	1.20E+01			mg/L
trans-1,2-Dichloroethene	33/117	1.10E-01			mg/L
Radionuclides					
Technetium-99	12/20	1.66E+02	2.23E+01	Yes	pCi/L

[a] Results shown are for water samples collected from borings or wells at SWMU 4.
[b] Number of detected results over total number of samples used in the BHHRA.
[c] Provisional background concentrations are taken from Appendix A of the Risk Methods Document. Blank cells indicate that a background concentration for the analyte does not exist.

Deleted: 06-064(E)/041406

Table G.1.12. Comparison between maximum detected concentrations and provisional groundwater background concentrations – storm sewer[a]

Analyte	Frequency of Detection[b]	Maximum Detected Value	Background Concentration[c]	Background Concentration Exceeded?	Units
		Organic Compounds			
1,1-Dichloroethene	2/8	1.00E-04			mg/L
Trichloroethene	8/8	1.00E-02			mg/L
trans-1,2-Dichloroethene	3/8	4.00E-03			mg/L

[a] Results shown are for water samples collected from borings or wells at the storm sewer.
[b] Number of detected results over total number of samples used in the BHHRA.
[c] Provisional background concentrations are taken from Appendix A of the Risk Methods Document. Blank cells indicate that a background concentration for the analyte does not exist.

Table G.1.13. Comparison of maximum detected concentrations in groundwater to residential use no action screening values for water – SWMU 1[a]

Analyte	Frequency of Detection[b]	Maximum Detected Value	HI-based No Action Screening Value[c]	ELCR-based No Action Screening Value[c]	HI Screening Value Exceeded?	ELCR Screening Value Exceeded?	Units
			Inorganic Chemicals (Metals)				
Arsenic	1/3	4.36E-03	4.52E-04	3.50E-05	Yes	Yes	mg/L
Barium	3/3	4.62E-01	1.04E-01		Yes		mg/L
Calcium	3/3	2.59E+01					mg/L
Chromium	1/3	2.97E-02	1.76E+00		No		mg/L
Cobalt	2/3	2.11E-01	9.06E-02		Yes		mg/L
Iron	3/3	5.57E+00	4.49E-01		Yes		mg/L
Magnesium	3/3	1.14E+01					mg/L
Manganese	3/3	3.97E+00	3.50E-02		Yes		mg/L
Nickel	3/3	1.47E-01	3.01E-02		Yes		mg/L
Potassium	3/3	1.31E+00					mg/L
Selenium	1/3	7.45E-03	7.54E-03		No		mg/L
Sodium	1/1	1.59E+01					mg/L
Zinc	1/3	3.15E-02	4.50E-01		No		mg/L
			Organic Compounds				
1,1-Dichloroethene	2/27	7.00E-04	2.46E-03	4.70E-05	No	Yes	mg/L
Chloroform	1/19	3.20E-03	2.87E-05	2.18E-04	Yes	Yes	mg/L
Trichloroethene	25/28	7.80E-01	1.60E-03	1.73E-03	Yes	Yes	mg/L
cis-1,2-Dichloroethene	2/27	6.70E-02	2.73E-03		Yes		mg/L
			Radionuclides				
Technetium-99	2/17	2.49E+01		1.40E+01		Yes	pCi/L

[a] Results shown are for RGA water samples collected from borings or wells at SWMU 1.
[b] Number of detected results over total number of samples used in the BHHRA.
[c] Risk-based screening values are taken from Appendix A of the Risk Methods Document. The HI-based value is that for the child resident. The ELCR-based value is that for lifetime exposure. HI and ELCR target values used for the screening values are 0.1 and 1×10^{-6}, respectively.

Deleted: 06-064(E)/041406

Table G.1.14. Comparison of maximum detected concentrations in groundwater to residential use no action screening values for water – C-720 area[a]

Analyte	Frequency of Detection[b]	Maximum Detected Value	HI-based No Action Screening Value[c]	ELCR-based No Action Screening Value[c]	HI Screening Value Exceeded?	ELCR Screening Value Exceeded?	Units
			Inorganic Chemicals (Metals)				
Arsenic	1/1	4.26E-03	4.52E-04	3.50E-05	Yes	Yes	mg/L
Barium	1/1	4.22E-01	1.04E-01		Yes		mg/L
Calcium	1/1	3.52E+01					mg/L
Chromium	3/3	3.80E-01	1.76E+00		No		mg/L
Cobalt	1/1	2.86E-02	9.06E-02		No		mg/L
Copper	2/3	5.50E-02	5.57E-02		No		mg/L
Iron	3/3	3.12E+01	4.49E-01		Yes		mg/L
Magnesium	1/1	1.38E+01					mg/L
Manganese	1/1	4.25E+00	3.50E-02		Yes		mg/L
Nickel	3/3	7.01E-01	3.01E-02		Yes		mg/L
Potassium	1/1	1.93E+00					mg/L
Sodium	1/1	5.78E+01					mg/L
			Organic Compounds				
1,1-Dichloroethene	8/31	5.40E-02	2.46E-03	4.70E-05	Yes	Yes	mg/L
Trichloroethene	31/31	1.26E+00	1.60E-03	1.73E-03	Yes	Yes	mg/L
Vinyl chloride	1/31	2.10E-03	3.06E-03	3.50E-05	No	Yes	mg/L
cis-1,2-Dichloroethene	9/31	3.10E-02	2.73E-03		Yes		mg/L
trans-1,2-Dichloroethene	8/31	1.40E-02	5.48E-03		Yes		mg/L
			Radionuclides				
Technetium-99	10/10	1.29E+02		1.40E+01		Yes	pCi/L

[a] Results shown are for RGA water samples collected from borings or wells at the C-720 area.
[b] Number of detected results over total number of samples used in the BHHRA.
[c] Risk-based screening values are taken from Appendix A of the Risk Methods Document. The HI-based value is that for the child resident. The ELCR-based value is that for lifetime exposure. HI and ELCR target values used for the screening values are 0.1 and 1×10^{-6}, respectively.

Deleted: 06-064(E)/041406

Table G.1.15. Comparison of maximum detected concentrations in groundwater to residential use no action screening values for water – SWMU 4[a]

Analyte	Frequency of Detection[b]	Maximum Detected Value	HI-based No Action Screening Value[c]	ELCR-based No Action Screening Value[c]	HI Screening Value Exceeded?	ELCR Screening Value Exceeded?	Units
Inorganic Chemicals (Metals)							
Aluminum	1/2	5.47E-01	1.49E+00		No		mg/L
Barium	2/2	3.14E-01	1.04E-01		Yes		mg/L
Calcium	2/2	2.96E+01					mg/L
Chromium	18/26	3.81E-01	1.76E+00		No		mg/L
Cobalt	2/2	2.95E-03	9.06E-02		No		mg/L
Iron	2/2	6.02E+00	4.49E-01		Yes		mg/L
Magnesium	2/2	1.20E+01					mg/L
Manganese	2/2	1.40E+00	3.50E-02		Yes		mg/L
Nickel	2/2	2.32E-01	3.01E-02		Yes		mg/L
Potassium	2/2	3.27E+00					mg/L
Sodium	2/2	1.76E+01					mg/L
Organic Compounds							
1,1-Dichloroethane	2/58	1.70E-02	3.63E-02		No		mg/L
1,1-Dichloroethene	47/117	3.40E-01	2.46E-03	4.70E-05	Yes	Yes	mg/L
1,2-Dichloroethane	1/58	2.00E-01	4.65E-04	1.47E-04	Yes	Yes	mg/L
2-Butanone	3/58	3.50E-02	8.68E-02		No		mg/L
2-Propanol	1/5	5.40E-01					mg/L
Acetone	5/58	4.90E-02	2.75E-02		Yes		mg/L
Benzene	1/58	1.60E-02	5.04E-04	3.85E-04	Yes	Yes	mg/L
Bromomethane	1/51	4.10E-03	3.91E-04		Yes		mg/L
Carbon tetrachloride	19/58	1.20E-01	1.90E-04	1.81E-04	Yes	Yes	mg/L
Chloroform	23/58	1.30E-01	2.87E-05	2.18E-04	Yes	Yes	mg/L
Dibromochloromethane	1/58	2.00E-03	5.49E-03	1.59E-04	No	Yes	mg/L
Methylene chloride	2/58	5.90E-01	6.86E-02	4.26E-03	Yes	Yes	mg/L
Tetrachloroethene	6/58	4.00E-03	8.42E-03	5.82E-04	No	Yes	mg/L
Trichloroethene	159/169	6.70E+01	1.60E-03	1.73E-03	Yes	Yes	mg/L
Vinyl chloride	19/117	4.00E-01	3.06E-03	3.50E-05	Yes	Yes	mg/L
cis-1,2-Dichloroethene	69/117	1.20E+01	2.73E-03		Yes		mg/L
trans-1,2-Dichloroethene	33/117	1.10E-01	5.48E-03		Yes		mg/L
Radionuclides							
Technetium-99	12/20	1.66E+02		1.40E+01		Yes	pCi/L

[a] Results shown are for RGA water samples collected from borings or wells at SWMU 4.
[b] Number of detected results over total number of samples used in the BHHRA.
[c] Risk-based screening values are taken from Appendix A of the Risk Methods Document. The HI-based value is that for the child resident. The ELCR-based value is that for lifetime exposure. HI and ELCR target values used for the screening values are 0.1 and 1×10^{-6}, respectively.

Deleted: 06-064(E)/041406

Table G.1.16. Comparison of maximum detected concentrations in groundwater to residential use no action screening values for water – storm sewer[a]

Analyte	Frequency of Detection[b]	Maximum Detected Value	HI-based No Action Screening Value[c]	ELCR-based No Action Screening Value[c]	HI Screening Value Exceeded?	ELCR Screening Value Exceeded?	Units
			Organic Compounds (Metals)				
1,1-Dichloroethene	2/8	1.00E-04	2.46E-03	4.70E-05	No	Yes	mg/L
Trichloroethene	8/8	1.00E-02	1.60E-03	1.73E-03	Yes	Yes	mg/L
trans-1,2-Dichloroethene	3/8	4.00E-03	5.48E-03		No		mg/L

[a] Results shown are for RGA water samples collected from borings or wells at the storm sewer.
[b] Number of detected results over total number of samples used in the BHHRA.
[c] Risk-based screening values are taken from Appendix A of the Risk Methods Document. The HI-based value is that for the child resident. The ELCR-based value is that for lifetime exposure. HI and ELCR target values used for the screening values are 0.1 and 1×10^{-6}, respectively.

Table G.1.17. SWMU 1 Sediment – Revised Hazard Estimates for the Current and Future Industrial Worker[a]

Chemical of Potential Concern[b]	Incidental Ingestion	***Dermal Contact***[c]	Inhalation of Particulates and Vapors	Total	Percent
Aluminum	6.82E-04	9.02E-02		9.09E-02	5.3
Arsenic	1.68E-03	5.42E-02		5.59E-02	3.3
Barium	1.31E-04	2.47E-02	7.99E-07	2.48E-02	1.5
Beryllium	2.35E-05	3.11E-02	1.03E-10	3.11E-02	1.8
Chromium	4.05E-04	2.68E-01	5.30E-07	2.68E-01	15.7
Cobalt	9.86E-06	1.63E-04	1.29E-06	1.74E-04	0.0
Iron	4.43E-03	3.91E-01		3.95E-01	23.2
Manganese	1.31E-03	4.32E-01	5.65E-08	4.33E-01	25.4
Mercury	2.60E-05	4.91E-03	5.24E-05	4.99E-03	0.3
Vanadium	3.02E-04	4.00E-01	1.04E-03	4.01E-01	23.5
Zinc	1.71E-05	1.13E-03		1.15E-03	0.1
Am-241				0.00E+00	0.0
Cs-137				0.00E+00	0.0
Np-237				0.00E+00	0.0
Pu-239/240				0.00E+00	0.0
Th-230				0.00E+00	0.0
U				0.00E+00	0.0
U-235				0.00E+00	0.0
U-238				0.00E+00	0.0
Total	9.02E-03	1.70E+00	1.10E-03	1.71E+00	
Percent	0.5	99.4	0.1		100

[a] Results modified from Tables 1.94 and 1.96 in the WAG 27 RI Report. Blank cells indicate that a result is not available for the contaminant-endpoint combination.
[b] Chemicals of potential concern presented in bold, italic font are contaminants of concern for the scenario because they have a hazard index across all routes of exposure greater than 1.00E-01.
[c] Exposure routes presented in bold, italic font are pathways of concern for the scenario because they have a hazard index across all chemicals of potential concern greater than 1.00E-01.

Deleted: 06-064(E)/041406

Table G.1.18. SWMU 1 McNairy Groundwater – Revised Hazard Estimates for the Future Adult Rural Resident[a]

Chemical of Potential Concern[b]	*Ingestion*[c]	*Dermal Contact while Showering*[c]	Inhalation of Vapors while Showering	Inhalation of Vapors During Household Use	Total	Percent
Aluminum	1.96E-01	3.57E-03			2.00E-01	2.4
Arsenic	4.27E-01	1.89E-03			4.29E-01	5.2
Barium	1.13E-01	2.93E-03			1.16E-01	1.4
Beryllium	3.88E-02	7.05E-03			4.59E-02	0.6
Cadmium	1.81E-02	3.28E-03			2.14E-02	0.3
Chromium	1.45E-01	1.32E-02			1.58E-01	1.9
Cobalt	1.75E-02	3.98E-05			1.75E-02	0.2
Iron	4.73E+00	5.73E-02			4.79E+00	58.2
Manganese	7.11E-01	3.23E-02			7.43E-01	9.0
Mercury	1.50E-02	3.88E-04			1.54E-02	0.2
Nickel	5.38E-02	3.62E-04			5.42E-02	0.7
Sulfate					0.00E+00	0.0
Uranium	1.00E+00	2.14E-03			1.00E+00	12.2
Vanadium	4.33E-01	7.86E-02			5.12E-01	6.2
Zinc	1.58E-02	1.44E-04			1.59E-02	0.2
2-Propanol					0.00E+00	0.0
TCE	2.55E-02	4.93E-03	6.95E-03	7.55E-02	1.13E-01	1.4
Am-241					0.00E+00	0.0
Cs-137					0.00E+00	0.0
Tc-99					0.00E+00	0.0
U-235					0.00E+00	0.0
U-238					0.00E+00	0.0
Total	7.94E+00	2.08E-01	6.95E-03	7.55E-02	8.23E+00	
Percent	96.5	2.5	0.1	0.9		100

[a] Results modified from Tables 1.97a in the WAG 27 RI Report. Blank cells indicate that a result is not available for the contaminant-endpoint combination.

[b] Chemicals of potential concern presented in bold, italic font are contaminants of concern for the scenario because they have a hazard index across all routes of exposure greater than 1.00E-01.

[c] Exposure routes presented in bold, italic font are pathways of concern for the scenario because they have a hazard index across all chemicals of potential concern greater than 1.00E-01.

Deleted: 06-064(E)/041406

Table G.1.19. SWMU 1 McNairy Groundwater – Revised Hazard Estimates for the Future Child Rural Resident[a]

Chemical of Potential Concern[b]	*Ingestion*[c]	***Dermal Contact while Showering***[c]	Inhalation of Vapors while Showering	Inhalation of Vapors During Household Use	Total	Percent
Aluminum	4.74E-01	6.83E-03			4.81E-01	2.4
Arsenic	1.03E+00	3.62E-03			1.03E+00	5.2
Barium	2.73E-01	5.62E-03			2.79E-01	1.4
Beryllium	9.37E-02	1.35E-02			1.07E-01	0.5
Cadmium	4.36E-02	6.28E-03			4.99E-02	0.2
Chromium	3.51E-01	2.53E-02			3.76E-01	1.9
Cobalt	4.23E-02	7.62E-05			4.24E-02	0.2
Iron	1.14E+01	1.10E-01			1.15E+01	57.7
Manganese	1.72E+00	6.18E-02			1.78E+00	8.9
Mercury	3.62E-02	7.44E-04			3.69E-02	0.2
Nickel	1.30E-01	6.93E-04			1.31E-01	0.7
Sulfate					0.00E+00	0.0
Uranium	2.42E+00	4.10E-03			2.42E+00	12.1
Vanadium	1.05E+00	1.51E-01			1.20E+00	6.0
Zinc	3.82E-02	2.75E-04			3.85E-02	0.2
2-Propanol					0.00E+00	0.0
TCE	6.14E-02	9.44E-03	3.35E-02	3.64E-01	4.68E-01	2.3
Am-241					0.00E+00	0.0
Cs-137					0.00E+00	0.0
Tc-99					0.00E+00	0.0
U-235					0.00E+00	0.0
U-238					0.00E+00	0.0
Total	1.92E+01	3.99E-01	3.35E-02	3.64E-01	2.00E+01	
Percent	96.0	2.0	0.2	1.8		100

[a] Results modified from Tables 1.97b in the WAG 27 RI Report. Blank cells indicate that a result is not available for the contaminant-endpoint combination.

[b] Chemicals of potential concern presented in bold, italic font are contaminants of concern for the scenario because they have a hazard index across all routes of exposure greater than 1.00E-01.

[c] Exposure routes presented in bold, italic font are pathways of concern for the scenario because they have a hazard index across all chemicals of potential concern greater than 1.00E-01.

Deleted: 06-064(E)/041406

Table G.1.20. SWMU 1 Sediment – Revised Hazard Estimates for the Adult Recreational User[a]

Chemical of Potential Concern	Incidental Ingestion	Dermal Contact	Inhalation of Particulates and Vapors	Total	Percent
Aluminum	3.64E-04	3.05E-02		3.09E-02	6.4
Arsenic	8.96E-04	1.84E-02		1.93E-02	4.0
Barium	6.98E-05	8.38E-03	2.13E-07	8.45E-03	1.8
Beryllium	1.25E-05	1.05E-02	2.74E-11	1.05E-02	2.2
Chromium	2.16E-04	9.08E-02	1.41E-07	9.10E-02	18.9
Cobalt	5.26E-06	5.52E-05	3.45E-07	6.08E-05	0.0
Iron	2.36E-03	1.32E-01		1.34E-01	28.0
Manganese	2.29E-04	4.81E-02	1.40E-05	4.83E-02	10.1
Mercury	1.39E-05	1.66E-03	2.77E-04	1.95E-03	0.4
Vanadium	1.61E-04	1.35E-01		1.35E-01	28.1
Zinc	9.10E-06	3.82E-04		3.91E-04	0.1
Am-241				0.00E+00	0.0
Cs-137				0.00E+00	0.0
Np-237				0.00E+00	0.0
Pu-239/240				0.00E+00	0.0
Th-230				0.00E+00	0.0
U				0.00E+00	0.0
U-235				0.00E+00	0.0
U-238				0.00E+00	0.0
Total	4.34E-03	4.76E-01	2.92E-04	4.80E-01	
Percent	0.9	99.0	0.1		100

[a] Results modified from Tables 1.98a in the WAG 27 RI Report. Blank cells indicate that a result is not available for the contaminant-endpoint combination. No contaminants or pathways of concern are identified because the total hazard index for the scenario is less than 1.

Deleted: 06-064(E)/041406

Table G.1.21. SWMU 1 Sediment – Revised Hazard Estimates for the Child Recreational User[a]

Chemical of Potential Concern[b]	Incidental Ingestion	*Dermal Contact*[c]	Inhalation of Particulates and Vapors	Total	Percent
Aluminum	4.73E-03	2.12E-01		2.17E-01	6.5
Arsenic	1.16E-02	1.27E-01		1.39E-01	4.1
Barium	9.08E-04	5.80E-02	2.87E-07	5.89E-02	1.8
Beryllium	1.63E-04	7.30E-02	3.68E-11	7.32E-02	2.2
Chromium	2.81E-03	6.29E-01	1.90E-07	6.32E-01	18.8
Cobalt	6.84E-05	3.83E-04	4.64E-07	4.52E-04	0.0
Iron	3.07E-02	9.17E-01		9.48E-01	28.2
Manganese	2.97E-03	3.33E-01	1.88E-05	3.36E-01	10.0
Mercury	1.80E-04	1.15E-02	3.73E-04	1.21E-02	0.4
Vanadium	2.09E-03	9.37E-01		9.39E-01	28.0
Zinc	1.18E-04	2.65E-03		2.77E-03	0.1
Am-241				0.00E+00	0.0
Cs-137				0.00E+00	0.0
Np-237				0.00E+00	0.0
Pu-239/240				0.00E+00	0.0
Th-230				0.00E+00	0.0
U				0.00E+00	0.0
U-235				0.00E+00	0.0
U-238				0.00E+00	0.0
Total	5.63E-02	3.30E+00	3.93E-04	3.36E+00	
Percent	1.7	98.3	0.0		100

[a] Results modified from Tables 1.98b in the WAG 27 RI Report. Blank cells indicate that a result is not available for the contaminant-endpoint combination.

[b] Chemicals of potential concern presented in bold, italic font are contaminants of concern for the scenario because they have a hazard index across all routes of exposure greater than 1.00E-01.

[c] Exposure routes presented in bold, italic font are pathways of concern for the scenario because they have a hazard index across all chemicals of potential concern greater than 1.00E-01.

Deleted: 06-064(E)/041406

Table G.1.22. SWMU 1 Sediment – Revised Hazard Estimates for the Teen Recreational User[a]

Chemical of Potential Concern[b]	Incidental Ingestion	*Dermal Contact*[c]	Inhalation of Particulates and Vapors	Total	Percent
Aluminum	7.97E-04	1.42E-01		1.43E-01	6.4
Arsenic	1.96E-03	8.50E-02		8.70E-02	3.9
Barium	1.53E-04	3.88E-02	2.87E-07	3.90E-02	1.8
Beryllium	2.75E-05	4.88E-02	3.68E-11	4.88E-02	2.2
Chromium	4.74E-04	4.21E-01	1.90E-07	4.21E-01	19.0
Cobalt	1.15E-05	2.56E-04	4.64E-07	2.68E-04	0.0
Iron	5.18E-03	6.13E-01		6.18E-01	27.9
Manganese	5.01E-04	2.23E-01	1.88E-05	2.24E-01	10.1
Mercury	3.04E-05	7.71E-03	3.73E-04	8.11E-03	0.4
Vanadium	3.53E-04	6.27E-01		6.27E-01	28.3
Zinc	1.99E-05	1.77E-03		1.79E-03	0.1
Am-241				0.00E+00	0.0
Cs-137				0.00E+00	0.0
Np-237				0.00E+00	0.0
Pu-239/240				0.00E+00	0.0
Th-230				0.00E+00	0.0
U				0.00E+00	0.0
U-235				0.00E+00	0.0
U-238				0.00E+00	0.0
Total	9.51E-03	2.21E+00	3.93E-04	2.22E+00	
Percent	0.4	99.6	0.0		100

[a] Results modified from Tables 1.98c in the WAG 27 RI Report. Blank cells indicate that a result is not available for the contaminant-endpoint combination.

[b] Chemicals of potential concern presented in bold, italic font are contaminants of concern for the scenario because they have a hazard index across all routes of exposure greater than 1.00E-01.

[c] Exposure routes presented in bold, italic font are pathways of concern for the scenario because they have a hazard index across all chemicals of potential concern greater than 1.00E-01.

Deleted: 06-064(E)/041406

Table G.1.23. SWMU 1 Soil – Revised Hazard Estimates for the Future Excavation Worker[a]

Chemical of Potential Concern[b]	Incidental Ingestion[c]	Dermal Contact[c]	Inhalation of Particulates and Vapors[c]	Total	Percent
Aluminum	1.43E-02	6.40E-02		7.83E-02	4.1
Antimony	2.64E-03	5.82E-02		6.08E-02	3.2
Arsenic	6.81E-02	7.44E-02		1.43E-01	7.4
Barium	2.94E-03	1.88E-02	6.24E-07	2.17E-02	1.1
Beryllium	7.76E-04	3.48E-02	1.17E-10	3.56E-02	1.9
Cadmium	4.45E-03	3.99E-02	3.37E-08	4.44E-02	2.3
Chromium	1.34E-02	2.99E-01	6.07E-07	3.12E-01	16.3
Cobalt	1.85E-04	1.03E-04	8.41E-07	2.89E-04	0.0
Manganese	2.21E-02	2.48E-01	3.08E-05	2.70E-01	14.1
Mercury	7.03E-04	4.50E-03	9.75E-04	6.18E-03	0.3
Nickel	3.64E-03	6.04E-03		9.68E-03	0.5
Silver	3.65E-05	9.09E-05		1.27E-04	0.0
Thallium				0.00E+00	0.0
Vanadium	5.76E-03	2.58E-01		2.64E-01	13.7
Zinc	3.06E-04	6.85E-04		9.91E-04	0.1
1,1-DCE	2.32E-06	5.19E-06	2.12E-05	2.87E-05	0.0
1,2,4-TCB	1.30E-04	1.20E-04	6.91E-06	2.57E-04	0.0
1,2-DCB	1.51E-05	4.22E-05	2.13E-05	7.86E-05	0.0
1,3-DCB	4.28E-05	1.20E-04	2.42E-10	1.63E-04	0.0
1,4-DCB			6.02E-06	6.02E-06	0.0
1-Methyl-2-PCHex				0.00E+00	0.0
2,3,4-TMH				0.00E+00	0.0
2,4,5-TCP	2.48E-05	4.45E-05	4.68E-07	6.98E-05	0.0
2,4,6-TCP				0.00E+00	0.0
2,4-DMD				0.00E+00	0.0
2,4-DNT	6.78E-04	7.14E-04	2.51E-05	1.42E-03	0.1
2,5-DMH				0.00E+00	0.0
2,6-DNT	1.30E-03	1.37E-03	5.91E-05	2.73E-03	0.1
2-Chloronaphthalene	1.62E-05	2.91E-05	7.59E-06	5.29E-05	0.0
2-Hexanone				0.00E+00	0.0
2-Methyl-4,6-DNP				0.00E+00	0.0
2-Methylnaphthalene				0.00E+00	0.0
2-Nitroaniline	5.63E-02	1.01E-01	6.58E-02	2.23E-01	11.6
2-Nitrophenol				0.00E+00	0.0
3,3'-Dichlorobenzidine				0.00E+00	0.0
2-Hexene-2-5, Dione				0.00E+00	0.0
3-Nitroaniline				0.00E+00	0.0
4,4'-DDD				0.00E+00	0.0
4,4'-DDE				0.00E+00	0.0
4,4'-DDT	2.83E-04	3.62E-04	1.22E-07	6.45E-04	0.0
4-Bromophenyl-phenylether				0.00E+00	0.0
4-Chloro3-methylphenol				0.00E+00	0.0
4-Chlorophenyl-phenylether				0.00E+00	0.0
4-Methyl-3-penten-2-one				0.00E+00	0.0
4-Nitroanliline				0.00E+00	0.0
Acenaphthene	2.16E-05	6.25E-05	1.30E-06	8.54E-05	0.0
Acenaphthylene				0.00E+00	0.0
Aldrin	1.41E-03	2.52E-03	2.67E-06	3.93E-03	0.2
Anthracene	4.33E-06	5.10E-06	7.27E-08	9.50E-06	0.0
Benz(a)anthracene				0.00E+00	0.0

Deleted: 06-064(E)/041406

Table G.1.23. SWMU 1 Soil – Revised Hazard Estimates for the Future Excavation Worker[a] (continued)

Chemical of Potential Concern[b]	Incidental Ingestion[c]	Dermal Contact[c]	Inhalation of Particulates and Vapors[c]	Total	Percent
Benzo(a)pyrene				0.00E+00	0.0
Benzo(b)fluoranthene				0.00E+00	0.0
Benzo(g,h,i)perylene				0.00E+00	0.0
Benzo(k)fluoranthene				0.00E+00	0.0
Bis(2-chloroethoxy)methane				0.00E+00	0.0
Bis(2-chloroethyl)ether				0.00E+00	0.0
Bis(2-chloroisopropyl)ether				0.00E+00	0.0
Bis(2-ethylhexyl)phthalate	4.09E-05	1.93E-04	2.50E-09	2.34E-04	0.0
Butyl benzyl phthalate	6.48E-06	9.51E-06	1.01E-08	1.60E-05	0.0
Chrysene				0.00E+00	0.0
Decane				0.00E+00	0.0
Decane, 6-Ethyl-2-Methyl				0.00E+00	0.0
D-n-butylphthalate	2.58E-05	2.31E-05	4.19E-08	4.89E-05	0.0
Di-n-octylphthalate	6.49E-05	6.46E-05	1.42E-08	1.30E-04	0.0
Dibenz(a,h)anthracene				0.00E+00	0.0
Dibenzofuran	3.25E-04	5.82E-04	1.05E-05	9.18E-04	0.0
Dieldrin	1.70E-03	3.04E-03	1.03E-05	4.75E-03	0.2
Endosulfan I				0.00E+00	0.0
Endosulfan II				0.00E+00	0.0
Endosulfan Sulfate				0.00E+00	0.0
Endrin	2.83E-04	1.27E-02	1.66E-06	1.30E-02	0.7
Endrin Ketone				0.00E+00	0.0
Ethylbenzene	2.01E-07	4.63E-07	1.71E-07	8.35E-07	0.0
Fluoranthene	3.23E-05	9.34E-05	1.39E-07	1.26E-04	0.0
Fluorene	3.24E-05	5.81E-05	8.34E-07	9.13E-05	0.0
Heptachlor	8.44E-05	1.05E-04	4.91E-07	1.90E-04	0.0
Heptachlor Epoxide	3.25E-03	4.04E-03	8.26E-06	7.30E-03	0.4
Heptachlorodibenzofuran				0.00E+00	0.0
Hexachlorobenzene	1.69E-03	3.04E-03	1.21E-04	4.85E-03	0.3
Hexachlorobutadiene	6.78E-03	1.21E-02	1.24E-03	2.01E-02	1.0
Hexachlorocyclopentadiene	1.85E-04	3.32E-04	5.99E-03	6.51E-03	0.3
Hexachloroethane	1.36E-03	2.43E-03	1.97E-04	3.99E-03	0.2
Hexadecane				0.00E+00	0.0
Indeno(1,2,3-cd)pyrene				0.00E+00	0.0
Methoxychlor	8.51E-05	1.53E-04	2.74E-07	2.38E-04	0.0
N-Nitroso-di-n-propylamine				0.00E+00	0.0
N-Nitrosodiphenylamine				0.00E+00	0.0
Naphthalene	6.46E-05	7.23E-05	3.54E-04	4.91E-04	0.0
Nonane, 2,3-Dimethyl-				0.00E+00	0.0
Octachlorodibenzo-p-Dioxin				0.00E+00	0.0
Octachlorodibenzofuran				0.00E+00	0.0
Octacosane				0.00E+00	0.0
Octadecene				0.00E+00	0.0
PCB-1016	1.24E-02	7.40E-03	3.42E-04	2.01E-02	1.0
PCB-1221				0.00E+00	0.0
PCB-1232				0.00E+00	0.0
PCB-1242				0.00E+00	0.0
PCB-1248				0.00E+00	0.0
PCB-1254	6.88E-02	4.11E-02	1.70E-03	1.12E-01	5.8
PCB-1260				0.00E+00	0.0
PCB-1268				0.00E+00	0.0

Deleted: 06-064(E)/041406

Table G.1.23. SWMU 1 Soil – Revised Hazard Estimates for the Future Excavation Worker[a] (continued)

Chemical of Potential Concern[b]	Incidental Ingestion[c]	Dermal Contact[c]	Inhalation of Particulates and Vapors[c]	Total	Percent
Pentachloro-1,1'-Biphenyl Iso				0.00E+00	0.0
Pentachlorophenol	1.15E-04	1.03E-04	1.28E-06	2.19E-04	0.0
Phenanthrene				0.00E+00	0.0
PCB				0.00E+00	0.0
Pyrene	4.32E-05	1.25E-04	1.49E-07	1.68E-04	0.0
Tetrachloro-1,1' -Biphenyl Iso				0.00E+00	0.0
Total Cresols				0.00E+00	0.0
Toxaphene				0.00E+00	0.0
TCE	5.28E-03	7.89E-02	2.13E-02	1.05E-01	5.5
VC				0.00E+00	0.0
Xylene	9.53E-09	2.32E-08	1.83E-08	5.10E-08	0.0
alpha-BHC				0.00E+00	0.0
alpha-Chlordane				0.00E+00	0.0
beta-BHC				0.00E+00	0.0
cis-1,2-DCE	1.77E-02	3.97E-02	8.01E-02	1.38E-01	7.2
cis-1,3-DCP				0.00E+00	0.0
delta-BHC				0.00E+00	0.0
gamma-BHC (Lindane)	1.41E-04	1.30E-04	3.96E-06	2.75E-04	0.0
gamma-Chlordane				0.00E+00	0.0
trans-1,2-DCE	2.58E-04	5.78E-04	1.46E-03	2.30E-03	0.1
trans-1,3-DCP				0.00E+00	0.0
Cs-137				0.00E+00	0.0
Co-60				0.00E+00	0.0
Np-237				0.00E+00	0.0
Pu-239/240				0.00E+00	0.0
Tc-99				0.00E+00	0.0
Th-230				0.00E+00	0.0
U				0.00E+00	0.0
U-234				0.00E+00	0.0
U-235				0.00E+00	0.0
U-238				0.00E+00	0.0
Total	3.20E-01	1.42E+00	1.80E-01	1.92E+00	
Percent	16.7	74.0	9.4		100

[a] Results modified from Tables 1.99 in the WAG 27 RI Report. Blank cells indicate that a result is not available for the contaminant-endpoint combination.

[b] Chemicals of potential concern presented in bold, italic font are contaminants of concern for the scenario because they have a hazard index across all routes of exposure greater than 1.00E-01.

[c] Exposure routes presented in bold, italic font are pathways of concern for the scenario because they have a hazard index across all chemicals of potential concern greater than 1.00E-01.

Deleted: 06-064(E)/041406

Table G.1.24. SWMU 1 Sediment – Revised Excess Cancer Risk Estimates for the Current and Future Industrial Worker[a]

Chemical of Potential Concern[b]	Incidental Ingestion[c]	Dermal Contact[c]	Inhalation of Particulates and Vapors	External Exposure[c]	Total	Percent
Aluminum					0.00E+00	0.0
Arsenic	2.70E-07	8.70E-06	3.40E-11		8.97E-06	26.7
Barium					0.00E+00	0.0
Beryllium					0.00E+00	0.0
Chromium			2.30E-10		2.30E-10	0.0
Cobalt					0.00E+00	0.0
Iron					0.00E+00	0.0
Manganese					0.00E+00	0.0
Mercury					0.00E+00	0.0
Vanadium					0.00E+00	0.0
Zinc					0.00E+00	0.0
Am-241	2.40E-07		1.10E-09	1.50E-07	3.91E-07	1.2
Cs-137	1.30E-09		3.00E-14	3.80E-06	3.80E-06	11.3
Np-237	2.30E-07		1.00E-09	1.60E-05	1.62E-05	48.2
Pu-239/240	5.40E-07		1.80E-09	9.50E-10	5.43E-07	1.6
Th-230	4.50E-07		7.70E-09	2.30E-08	4.81E-07	1.4
U	4.10E-08		3.10E-10	1.90E-06	1.94E-06	5.8
U-235	6.90E-10		7.10E-12	1.70E-07	1.71E-07	0.5
U-238	2.30E-08		1.70E-10	1.10E-06	1.12E-06	3.3
Total	1.53E-06	8.70E-06	1.24E-08	2.31E-05	3.37E-05	
Percent	4.5	25.9	0.0	68.8		100

[a] Results modified from Tables 1.95 in the WAG 27 RI Report. Blank cells indicate that a result is not available for the contaminant-endpoint combination.

[b] Chemicals of potential concern presented in bold, italic font are contaminants of concern for the scenario because they have an excess lifetime cancer risk across all routes of exposure greater than 1.00E-06.

[c] Exposure routes presented in bold, italic font are pathways of concern for the scenario because they have an excess lifetime cancer risk across all chemicals of potential concern greater than 1.00E-06.

Deleted: 06-064(E)/041406

Table G.1.25. SWMU 1 McNairy Groundwater – Revised Excess Cancer Risk Estimates for the Rural Resident[a]

Chemical of Potential Concern[b]	Ingestion[c]	Dermal Contact while Showering[c]	Inhalation of Vapors while Showering	Inhalation of Vapors During Household Use[c]	Total	Percent
Aluminum					0.00E+00	0.0
Arsenic	1.30E-04	5.50E-07			1.31E-04	9.2
Barium					0.00E+00	0.0
Beryllium					0.00E+00	0.0
Cadmium					0.00E+00	0.0
Chromium					0.00E+00	0.0
Cobalt					0.00E+00	0.0
Iron					0.00E+00	0.0
Manganese					0.00E+00	0.0
Mercury					0.00E+00	0.0
Nickel					0.00E+00	0.0
Sulfate					0.00E+00	0.0
Uranium					0.00E+00	0.0
Vanadium					0.00E+00	0.0
Zinc					0.00E+00	0.0
2-Propanol					0.00E+00	0.0
TCE	1.20E-06	2.10E-07	2.30E-07	2.40E-06	4.04E-06	0.3
Am-241	5.90E-04				5.90E-04	41.7
Cs-137	8.20E-06				8.20E-06	0.6
Tc-99	7.20E-07				7.20E-07	0.1
U-235	1.20E-05				1.20E-05	0.8
U-238	6.70E-04				6.70E-04	47.3
Total	1.41E-03	7.60E-07	2.30E-07	2.40E-06	1.42E-03	
Percent	99.8	0.1	0.0	0.2		100

[a] Results modified from Tables 1.101 in the WAG 27 RI Report. Blank cells indicate that a result is not available for the contaminant-endpoint combination.

[b] Chemicals of potential concern presented in bold, italic font are contaminants of concern for the scenario because they have an excess lifetime cancer risk across all routes of exposure greater than 1.00E-06.

[c] Exposure routes presented in bold, italic font are pathways of concern for the scenario because they have an excess lifetime cancer risk across all chemicals of potential concern greater than 1.00E-06.

Deleted: 06-064(E)/041406

Table G.1.26. SWMU 1 Sediment – Revised Excess Cancer Risk Estimates for the Recreational User[a]

Chemical of Potential Concern[b]	Incidental Ingestion[c]	Dermal Contact[c]	Inhalation of Particulates and Vapors	External Exposure[c]	Total	Percent
Aluminum					0.00E+00	0.0
Arsenic	7.30E-07	1.40E-05	1.70E-11		1.47E-05	77.7
Barium					0.00E+00	0.0
Beryllium					0.00E+00	0.0
Chromium			1.10E-10		1.10E-10	0.0
Cobalt					0.00E+00	0.0
Iron					0.00E+00	0.0
Manganese					0.00E+00	0.0
Mercury					0.00E+00	0.0
Vanadium					0.00E+00	0.0
Zinc					0.00E+00	0.0
Am-241	2.80E-07		5.20E-10	1.60E-08	2.97E-07	1.6
Cs-137	1.50E-09		1.50E-14	4.10E-07	4.12E-07	2.2
Np-237	2.70E-07		4.90E-10	1.70E-06	1.97E-06	10.4
Pu-239/240	6.30E-07		8.80E-10	1.00E-10	6.31E-07	3.3
Th-230	5.20E-07		3.80E-09	2.50E-09	5.26E-07	2.8
U	4.80E-08		1.50E-10	2.00E-07	2.48E-07	1.3
U-235	8.00E-10		3.50E-12	1.80E-08	1.88E-08	0.1
U-238	2.60E-08		8.40E-11	1.10E-07	1.36E-07	0.7
Total	1.78E-06	1.40E-05	6.05E-09	2.46E-06	1.90E-05	
Percent	9.4	73.8	0.0	13.0		100

[a] Results modified from Tables 1.102 in the WAG 27 RI Report. Blank cells indicate that a result is not available for the contaminant-endpoint combination.

[b] Chemicals of potential concern presented in bold, italic font are contaminants of concern for the scenario because they have an excess lifetime cancer risk across all routes of exposure greater than 1.00E-06.

[c] Exposure routes presented in bold, italic font are pathways of concern for the scenario because they have an excess lifetime cancer risk across all chemicals of potential concern greater than 1.00E-06.

Deleted: 06-064(E)/041406

Table G.1.27. SWMU 1 Soil – Revised Excess Cancer Risk Estimates for the Future Excavation Worker[a]

Chemical of Potential Concern[b]	Incidental Ingestion[c]	Dermal Contact[c]	Inhalation of Particulates and Vapors[c]	External Exposure[c]	Total	Percent
Aluminum					0.00E+00	0.0
Antimony					0.00E+00	0.0
Arsenic	1.10E-05	1.20E-05	4.80E-11		2.30E-05	17.8
Barium					0.00E+00	0.0
Beryllium					0.00E+00	0.0
Cadmium			4.30E-12		4.30E-12	0.0
Chromium			2.60E-10		2.60E-10	0.0
Cobalt					0.00E+00	0.0
Manganese					0.00E+00	0.0
Mercury					0.00E+00	0.0
Nickel					0.00E+00	0.0
Silver					0.00E+00	0.0
Thallium					0.00E+00	0.0
Vanadium					0.00E+00	0.0
Zinc					0.00E+00	0.0
1,1-DCE	4.50E-09	1.00E-08	1.20E-08		2.65E-08	0.0
1,2,4-TCB					0.00E+00	0.0
1,2-DCB					0.00E+00	0.0
1,3-DCB					0.00E+00	0.0
1,4-DCB	1.20E-08	2.90E-08			4.10E-08	0.0
1-Methyl-2-PCHex					0.00E+00	0.0
2,3,4-TMH					0.00E+00	0.0
2,4,5-TCP					0.00E+00	0.0
2,4,6-TCP	5.30E-09	9.50E-09	2.70E-10		1.51E-08	0.0
2,4-DMD					0.00E+00	0.0
2,4-DNT	3.30E-07	3.50E-07			6.80E-07	0.5
2,5-DMH					0.00E+00	0.0
2,6-DNT	3.20E-07	3.30E-07			6.50E-07	0.5
2-Chloronaphthalene					0.00E+00	0.0
2-Hexanone					0.00E+00	0.0
2-Methyl-4,6-DNP					0.00E+00	0.0
2-Methylnaphthalene					0.00E+00	0.0
2-Nitroaniline					0.00E+00	0.0
2-Nitrophenol					0.00E+00	0.0
3,3'-Dichlorobenzidine	2.50E-07	4.40E-07			6.90E-07	0.5
2-Hexene-2-5, Dione					0.00E+00	0.0
3-Nitroaniline					0.00E+00	0.0
4,4'-DDD	7.30E-09	9.30E-09			1.66E-08	0.0
4,4'-DDE	1.00E-08	1.30E-08			2.30E-08	0.0
4,4'-DDT	1.70E-08	2.20E-08	7.40E-12		3.90E-08	0.0
4-Bromophenyl-phenylether					0.00E+00	0.0
4-Chloro3-methylphenol					0.00E+00	0.0
4-Chlorophenyl-phenylether					0.00E+00	0.0
4-Methyl-3-penten-2-one					0.00E+00	0.0
4-Nitroanliline					0.00E+00	0.0
Acenaphthene					0.00E+00	0.0
Acenaphthylene					0.00E+00	0.0
Aldrin	2.60E-07	4.60E-07	4.90E-10		7.20E-07	0.6
Anthracene					0.00E+00	0.0

Deleted: 06-064(E)/041406

Table G.1.27. SWMU 1 Soil – Revised Excess Cancer Risk Estimates for the Future Excavation Worker[a] (continued)

Chemical of Potential Concern[b]	Incidental Ingestion[c]	Dermal Contact[c]	Inhalation of Particulates and Vapors[c]	External Exposure[c]	Total	Percent
Benz(a)anthracene	3.40E-07	9.70E-07	2.00E-07		1.51E-06	1.2
Benzo(a)pyrene	3.40E-06	9.70E-06	7.60E-07		1.39E-05	10.7
Benzo(b)fluoranthene	3.40E-07	9.70E-07	4.00E-07		1.71E-06	1.3
Benzo(g,h,i)perylene					0.00E+00	0.0
Benzo(k)fluoranthene	3.40E-08	9.70E-08	4.70E-09		1.36E-07	0.1
Bis(2-chloroethoxy)methane					0.00E+00	0.0
Bis(2-chloroethyl)ether	5.10E-07	9.10E-07	2.10E-07		1.63E-06	1.3
Bis(2-chloroisopropyl)ether	3.20E-08	5.80E-08	7.30E-09		9.73E-08	0.1
Bis(2-ethylhexyl)phthalate	4.10E-09	1.90E-08			2.31E-08	0.0
Butyl benzyl phthalate					0.00E+00	0.0
Chrysene	3.40E-09	9.70E-09	6.90E-09		2.00E-08	0.0
Decane					0.00E+00	0.0
Decane, 6-Ethyl-2-Methyl					0.00E+00	0.0
D-n-butylphthalate					0.00E+00	0.0
Di-n-octylphthalate					0.00E+00	0.0
Dibenz(a,h)anthracene	3.40E-06	9.80E-06	1.80E-07		1.34E-05	10.3
Dibenzofuran					0.00E+00	0.0
Dieldrin	4.90E-07	8.70E-07	3.00E-09		1.36E-06	1.1
Endosulfan I					0.00E+00	0.0
Endosulfan II					0.00E+00	0.0
Endosulfan Sulfate					0.00E+00	0.0
Endrin					0.00E+00	0.0
Endrin Ketone					0.00E+00	0.0
Ethylbenzene					0.00E+00	0.0
Fluoranthene					0.00E+00	0.0
Fluorene					0.00E+00	0.0
Heptachlor	6.80E-08	8.40E-08	4.00E-10		1.52E-07	0.1
Heptachlor Epoxide	1.40E-07	1.70E-07	3.50E-10		3.10E-07	0.2
Heptachlorodibenzofuran	1.50E-06	2.60E-06	4.80E-19		4.10E-06	3.2
Hexachlorobenzene	7.70E-07	1.40E-06	5.60E-08		2.23E-06	1.7
Hexachlorobutadiene	3.80E-08	6.80E-08	6.80E-09		1.13E-07	0.1
Hexachlorocyclopentadiene					0.00E+00	0.0
Hexachloroethane	6.80E-09	1.20E-08	9.80E-10		1.98E-08	0.0
Hexadecane					0.00E+00	0.0
Indeno(1,2,3-cd)pyrene	3.40E-07	9.80E-07	3.30E-08		1.35E-06	1.0
Methoxychlor					0.00E+00	0.0
N-Nitroso-di-n-propylamine	3.20E-06	1.20E-05			1.52E-05	11.8
N-Nitrosodiphenylamine	2.20E-09	8.00E-09			1.02E-08	0.0
Naphthalene					0.00E+00	0.0
Nonane, 2,3-Dimethyl-					0.00E+00	0.0
Octachlorodibenzo-p-Dioxin	3.50E-07	6.30E-07	1.20E-19		9.80E-07	0.8
Octachlorodibenzofuran	2.30E-07	4.10E-07	7.70E-20		6.40E-07	0.5
Octacosane					0.00E+00	0.0
Octadecene					0.00E+00	0.0
PCB-1016	6.20E-07	3.70E-07	1.70E-08		1.01E-06	0.8
PCB-1221	6.20E-07	3.70E-07	2.70E-13		9.90E-07	0.8
PCB-1232	6.20E-07	3.70E-07	2.70E-13		9.90E-07	0.8
PCB-1242	6.50E-07	3.90E-07	2.40E-08		1.06E-06	0.8
PCB-1248	2.70E-06	1.60E-06	1.20E-12		4.30E-06	3.3
PCB-1254	9.80E-07	5.90E-07	2.40E-08		1.59E-06	1.2

Deleted: 06-064(E)/041406

Table G.1.27. SWMU 1 Soil – Revised Excess Cancer Risk Estimates for the Future Excavation Worker[a] (continued)

Chemical of Potential Concern[b]	Incidental Ingestion[c]	Dermal Contact[c]	Inhalation of Particulates and Vapors[c]	External Exposure[c]	Total	Percent
PCB-1260	1.40E-06	8.20E-07	4.00E-08		2.26E-06	1.7
PCB-1268					0.00E+00	0.0
Pentachloro-1,1'-Biphenyl Iso					0.00E+00	0.0
Pentachlorophenol	1.50E-07	1.30E-07			2.80E-07	0.2
Phenanthrene					0.00E+00	0.0
PCB	1.60E-06	9.70E-07	2.20E-08		2.59E-06	2.0
Pyrene					0.00E+00	0.0
Tetrachloro-1,1' -Biphenyl Iso					0.00E+00	0.0
Total Cresols					0.00E+00	0.0
Toxaphene	3.30E-07	6.00E-07	3.80E-10		9.30E-07	0.7
TCE	1.20E-07	1.90E-06	2.70E-07		2.29E-06	1.8
VC	2.90E-06	6.50E-06	5.60E-06		1.50E-05	11.6
Xylene					0.00E+00	0.0
alpha-BHC	9.50E-08	8.80E-08	2.20E-09		1.85E-07	0.1
alpha-Chlordane					0.00E+00	0.0
beta-BHC	2.70E-08	2.70E-08	2.80E-10		5.43E-08	0.0
cis-1,2-DCE					0.00E+00	0.0
cis-1,3-DCP					0.00E+00	0.0
delta-BHC					0.00E+00	0.0
gamma-BHC (Lindane)	2.00E-08	1.80E-08			3.80E-08	0.0
gamma-Chlordane					0.00E+00	0.0
trans-1,2-DCE					0.00E+00	0.0
trans-1,3-DCP					0.00E+00	0.0
Cs-137	3.90E-09		3.00E-15	3.90E-07	3.94E-07	0.3
Co-60	2.00E-09		9.40E-15	1.60E-06	1.60E-06	1.2
Np-237	2.00E-07		2.90E-11	4.60E-07	6.60E-07	0.5
Pu-239/240	8.80E-08		1.00E-11	5.40E-12	8.80E-08	0.1
Tc-99	1.10E-07		2.90E-13	7.40E-11	1.10E-07	0.1
Th-230	8.90E-08		5.30E-11	1.60E-10	8.92E-08	0.1
U	2.40E-06		6.20E-10	3.90E-06	6.30E-06	4.9
U-234	6.80E-07		2.80E-10	5.00E-10	6.81E-07	0.5
U-235	1.40E-08		5.20E-12	1.20E-07	1.34E-07	0.1
U-238	3.80E-07		9.80E-11	6.10E-07	9.90E-07	0.8
Total	3.23E-05	7.02E-05	7.88E-06	7.08E-06	1.29E-04	
Percent	24.9	54.3	6.1	5.5		100

[a] Results modified from Tables 1.103 in the WAG 27 RI Report. Blank cells indicate that a result is not available for the contaminant-endpoint combination.

[b] Chemicals of potential concern presented in bold, italic font are contaminants of concern for the scenario because they have an excess cancer risk across all routes of exposure greater than 1.00E-06.

[c] Exposure routes presented in bold, italic font are pathways of concern for the scenario because they have an excess cancer risk across all chemicals of potential concern greater than 1.00E-06.

Deleted: 06-064(E)/041406

Table G.1.28. C-720 Building McNairy Groundwater – Revised Hazard Estimates for the Future Adult Rural Resident[a]

Chemical of Potential Concern[b]	Ingestion[c]	Dermal Contact while Showering[c]	Inhalation of Vapors while Showering	Inhalation of Vapors During Household Use	Total	Percent
Aluminum	2.42E+00	4.39E-02			2.46E+00	9.2
Arsenic	1.05E-01	4.64E-04			1.05E-01	0.4
Barium	1.21E-01	3.14E-03			1.24E-01	0.5
Beryllium	1.30E-01	2.36E-02			1.54E-01	0.6
Bromide					0.00E+00	0.0
Cadmium	3.36E-02	6.10E-03			3.97E-02	0.1
Chromium	7.08E-01	6.43E-02			7.72E-01	2.9
Cobalt	2.14E-02	4.86E-05			2.14E-02	0.1
Iron	1.93E+01	2.34E-01			1.95E+01	73.1
Manganese	1.42E+00	6.44E-02			1.48E+00	5.6
Mercury	1.13E-02	2.94E-04			1.16E-02	0.0
Nickel	1.19E-01	8.00E-04			1.20E-01	0.4
Sulfate					0.00E+00	0.0
Uranium	1.51E-01	3.23E-04			1.51E-01	0.6
Vanadium	1.32E+00	2.40E-01			1.56E+00	5.8
Zinc	3.28E-02	2.98E-04			3.31E-02	0.1
1,1-DCE	7.15E-03	1.16E-04	1.95E-03	2.12E-02	3.04E-02	0.1
TCE	2.59E-02	5.01E-03	7.06E-03	7.67E-02	1.15E-01	0.4
VC					0.00E+00	0.0
Am-241					0.00E+00	0.0
Cs-137					0.00E+00	0.0
Np-237					0.00E+00	0.0
Tc-99					0.00E+00	0.0
U-235					0.00E+00	0.0
U-238					0.00E+00	0.0
Total	2.59E+01	6.87E-01	9.01E-03	9.79E-02	2.67E+01	
Percent	97.0	2.6	0.0	0.4		100

[a] Results modified from Tables 1.97a in the WAG 27 RI Report. Blank cells indicate that a result is not available for the contaminant-endpoint combination.

[b] Chemicals of potential concern presented in bold, italic font are contaminants of concern for the scenario because they have a hazard index across all routes of exposure greater than 1.00E-01.

[c] Exposure routes presented in bold, italic font are pathways of concern for the scenario because they have a hazard index across all chemicals of potential concern greater than 1.00E-01.

Deleted: 06-064(E)/041406

Table G.1.29. C-720 Building McNairy Groundwater – Revised Hazard Estimates for the Future Child Rural Resident[a]

Chemical of Potential Concern[b]	Ingestion[c]	Dermal Contact while Showering[c]	Inhalation of Vapors while Showering	Inhalation of Vapors During Household Use	Total	Percent
Aluminum	5.84E+00	8.41E-02			5.92E+00	9.2
Arsenic	2.53E-01	8.89E-04			2.54E-01	0.4
Barium	2.92E-01	6.00E-03			2.98E-01	0.5
Beryllium	3.13E-01	4.51E-02			3.58E-01	0.6
Bromide					0.00E+00	0.0
Cadmium	8.11E-02	1.17E-02			9.28E-02	0.1
Chromium	1.71E+00	1.23E-01			1.83E+00	2.8
Cobalt	5.18E-02	9.32E-05			5.19E-02	0.1
Iron	4.66E+01	4.47E-01			4.70E+01	73.0
Manganese	3.42E+00	1.23E-01			3.54E+00	5.5
Mercury	2.73E-02	5.63E-04			2.79E-02	0.0
Nickel	2.87E-01	1.53E-03			2.89E-01	0.4
Sulfate					0.00E+00	0.0
Uranium	3.66E-01	6.19E-04			3.67E-01	0.6
Vanadium	3.19E+00	4.59E-01			3.65E+00	5.7
Zinc	7.92E-02	5.70E-04			7.98E-02	0.1
1,1-DCE	1.73E-02	2.21E-04	9.43E-03	1.02E-01	1.29E-01	0.2
TCE	6.24E-02	9.59E-03	3.41E-02	3.70E-01	4.76E-01	0.7
VC					0.00E+00	0.0
Am-241					0.00E+00	0.0
Cs-137					0.00E+00	0.0
Np-237					0.00E+00	0.0
Tc-99					0.00E+00	0.0
U-235					0.00E+00	0.0
U-238					0.00E+00	0.0
Total	6.26E+01	1.31E+00	4.35E-02	4.72E-01	6.44E+01	
Percent	97.2	2.0	0.1	0.7		100

[a] Results modified from Tables 1.97b in the WAG 27 RI Report. Blank cells indicate that a result is not available for the contaminant-endpoint combination.

[b] Chemicals of potential concern presented in bold, italic font are contaminants of concern for the scenario because they have a hazard index across all routes of exposure greater than 1.00E-01.

[c] Exposure routes presented in bold, italic font are pathways of concern for the scenario because they have a hazard index across all chemicals of potential concern greater than 1.00E-01.

Deleted: 06-064(E)/041406

Table G.1.30. C-720 Building Soil – Revised Hazard Estimates for the Future Excavation Worker[a]

Chemical of Potential Concern	Incidental Ingestion	Dermal Contact	Inhalation of Particulates and Vapors	Total	Percent
Antimony	2.27E-03	5.08E-02		5.31E-02	13.7
Arsenic	2.55E-02	2.78E-02		5.33E-02	13.7
Barium	2.60E-03	1.66E-02	5.51E-07	1.92E-02	4.9
Beryllium	4.60E-04	2.06E-02	6.96E-11	2.11E-02	5.4
Chromium	1.02E-02	2.28E-01	4.62E-07	2.38E-01	61.3
Cobalt	2.32E-04	1.30E-04	1.06E-06	3.63E-04	0.1
Bis(2-ethylhexyl)phthalate	1.39E-05	6.55E-05	8.49E-10	7.94E-05	0.0
TCE	1.62E-04	2.41E-03	6.51E-04	3.22E-03	0.8
VC				0.00E+00	0.0
U				0.00E+00	0.0
U-238				0.00E+00	0.0
Total	4.14E-02	3.46E-01	6.53E-04	3.88E-01	
Percent	10.7	89.2	0.2		100

[a] Results modified from Tables 1.99 in the WAG 27 RI Report. Blank cells indicate that a result is not available for the contaminant-endpoint combination. Blank cells indicate that a result is not available for the contaminant-endpoint combination. No contaminants or pathways of concern are identified because the total hazard index for the scenario is less than 1.

Deleted: 06-064(E)/041406

Table G.1.31. C-720 Building McNairy Groundwater – Revised Excess Cancer Risk Estimates for the Rural Resident[a]

Chemical of Potential Concern[b]	Ingestion[c]	Dermal Contact while Showering	Inhalation of Vapors while Showering[c]	Inhalation of Vapors During Household Use[c]	Total	Percent
Aluminum					0.00E+00	0.0
Arsenic	3.30E-05	1.40E-07			3.31E-05	1.5
Barium					0.00E+00	0.0
Beryllium					0.00E+00	0.0
Bromide					0.00E+00	0.0
Cadmium					0.00E+00	0.0
Chromium					0.00E+00	0.0
Cobalt					0.00E+00	0.0
Iron					0.00E+00	0.0
Manganese					0.00E+00	0.0
Mercury					0.00E+00	0.0
Nickel					0.00E+00	0.0
Sulfate					0.00E+00	0.0
Uranium					0.00E+00	0.0
Vanadium					0.00E+00	0.0
Zinc					0.00E+00	0.0
1,1-DCE	2.70E-05	4.10E-07	1.90E-05	2.10E-04	2.56E-04	11.9
TCE	1.20E-06	2.10E-07	2.30E-07	2.50E-06	4.14E-06	0.2
VC	1.80E-05	2.20E-07	1.00E-06	1.10E-05	3.02E-05	1.4
Am-241	5.10E-04				5.10E-04	23.7
Cs-137	1.60E-05				1.60E-05	0.7
Np-237	3.10E-04				3.10E-04	14.4
Tc-99	1.00E-06				1.00E-06	0.0
U-235	1.20E-04				1.20E-04	5.6
U-238	8.70E-04				8.70E-04	40.4
Total	1.91E-03	9.80E-07	2.02E-05	2.24E-04	2.15E-03	
Percent	88.6	0.0	0.9	10.4		100

[a] Results modified from Tables 1.101 in the WAG 27 RI Report. Blank cells indicate that a result is not available for the contaminant-endpoint combination.

[b] Chemicals of potential concern presented in bold, italic font are contaminants of concern for the scenario because they have an excess lifetime cancer risk across all routes of exposure greater than 1.00E-06.

[c] Exposure routes presented in bold, italic font are pathways of concern for the scenario because they have an excess lifetime cancer risk across all chemicals of potential concern greater than 1.00E-06.

Deleted: 06-064(E)/041406

Table G.1.32. C-720 Building Soil – Revised Excess Cancer Risk Estimates for the Future Excavation Worker[a]

Chemical of Potential Concern[b]	Incidental Ingestion[c]	Dermal Contact[c]	Inhalation of Particulates and Vapors[c]	External Exposure	Total	Percent
Antimony					0.00E+00	0.0
Arsenic	4.10E-06	4.50E-06	1.80E-11		8.60E-06	59.0
Barium					0.00E+00	0.0
Beryllium					0.00E+00	0.0
Chromium			2.00E-10		2.00E-10	0.0
Cobalt					0.00E+00	0.0
Bis(2-ethylhexyl)phthalate	1.40E-09	6.60E-09			8.00E-09	0.1
TCE	3.80E-09	5.70E-08	8.30E-09		6.91E-08	0.5
VC	9.40E-07	2.10E-06	1.80E-06		4.84E-06	33.2
U	2.60E-07		6.70E-11	4.10E-07	6.70E-07	4.6
U-238	1.50E-07		3.80E-11	2.40E-07	3.90E-07	2.7
Total	5.46E-06	6.66E-06	1.81E-06	6.50E-07	1.46E-05	
Percent	37.4	45.7	12.4	4.5		100

[a] Results modified from Tables 1.103 in the WAG 27 RI Report. Blank cells indicate that a result is not available for the contaminant-endpoint combination.

[b] Chemicals of potential concern presented in bold, italic font are contaminants of concern for the scenario because they have an excess cancer risk across all routes of exposure greater than 1.00E-06.

[c] Exposure routes presented in bold, italic font are pathways of concern for the scenario because they have an excess cancer risk across all chemicals of potential concern greater than 1.00E-06.

Deleted: Table G.1.33. SWMU 4 Soil – Revised Hazard Estimates for the Current and Future Industrial Worker[a] Chemical of Potential Concern[b] ... [185]

Deleted: Table G.1.34. SWMU 4 McNairy Groundwater – Revised Hazard Estimates for the Future Adult Rural Resident[a] Chemical of Potential Concern[b] ... [186]

Deleted: Table G.1.35. SWMU 4 McNairy Groundwater – Revised Hazard Estimates for the Future Child Rural Resident[a] Chemical of Potential Concern[b] ... [187]

Deleted: Table G.1.36. SWMU 4 Soil – Revised Hazard Estimates for the Adult Rural Resident[a] Chemical of Potential Concern ... [188]

Deleted: Table G.1.37. SWMU 4 Soil – Revised Hazard Estimates for the Child Rural Resident[a] Chemical of Potential Concern ... [189]

Deleted: Barium ... [190]

Deleted: Table G.1.40. SWMU 4 Soil – Revised Hazard Estimates for the Teen Recreational User[a] Chemical of Potential Concern ... [191]

Deleted: Table G.1.41. SWMU 4 Soil – Revised Hazard Estimates for the Future Excavation Worker[a] Chemical of Potential Concern[b] ... [192]

Deleted: Table G.1.42. SWMU 4 Soil – Revised Excess Cancer Risk Estimates for the Current and Future Industrial Worker[a] Chemical of Potential Concern[b] ... [193]

Deleted: Table G.1.43. SWMU 4 McNairy Groundwater – Revised Excess Cancer Risk Estimates for the Rural Resident[a] Chemical of ... [194]

Deleted: Barium ... [195]

Deleted: Table G.1.45. SWMU 4 Soil – Revised Excess Cancer Risk Estimates for the Recreational User[a] Chemical of ... [196]

Deleted: Table G.1.46. SWMU 4 Soil – Revised Excess Cancer Risk Estimates for the Future Excavation Wo ... [197]

Deleted: 06-064(E)/041406

ATTACHMENT G.2

WASTE AREA GROUP 27 TABLES

THIS PAGE INTENTIONALLY LEFT BLANK.

Table G.2.1. WAG 27 Hazard Estimates for the Industrial Worker SMWU 001

Chemical of Potential Concern	Direct Ingestion	Dermal contact	Inhalation of Particulates and Vapors	Total	Percent
Aluminum	6.82E-04	9.02E-02		9.09E-02	0.01%
Arsenic	1.68E-03	5.42E-02		5.59E-02	0.00%
Barium	1.31E-04	2.47E-02	7.99E-07	2.48E-02	0.00%
Beryllium	2.35E-05	3.11E-02	1.03E-10	3.11E-02	0.00%
Chromium	4.05E-04	2.68E-01	5.30E-07	2.68E-01	0.02%
Cobalt	9.86E-06	1.63E-04	1.29E-06	1.74E-04	0.00%
Iron	4.43E-03	3.91E-01		3.95E-01	0.03%
Lead	1.30E+01	1.14E+03	5.65E-08	1.15E+03	99.85%
Manganese	1.31E-03	4.32E-01	5.65E-08	4.33E-01	0.04%
Mercury	2.60E-05	4.91E-03	5.24E-05	4.99E-03	0.00%
Vanadium	3.02E-04	4.00E-01	1.04E-03	4.01E-01	0.03%
Zinc	1.71E-05	1.13E-03		1.15E-03	0.00%
Am-241				0.00E+00	0.00%
Cs-137				0.00E+00	0.00%
Np-237				0.00E+00	0.00%
Pu-239/240				0.00E+00	0.00%
Th-230				0.00E+00	0.00%
U				0.00E+00	0.00%
U-235				0.00E+00	0.00%
U-238				0.00E+00	0.00%
Total	1.30E+01	1.14E+03	1.10E-03	1.15E+03	
Percent	1.13%	98.87%	0.00%		100.00%

Table G.2.2. Hazard Estimates for Adult Resident McNairy Groundwater SMWU-001

Chemical of Potential Concern	*Ingestion*	*Dermal* Contact while Showering	Ingestion of Vegetables	Inhalation of Vapors While Showering	Inhalation of Vapors During Household Use	Total	Percent
Aluminum	1.96E-01	3.57E-03	1.02E-01			3.02E-01	0.00%
Arsenic	4.27E-01	1.89E-03	2.27E-01			6.56E-01	0.01%
Barium	1.13E-01	2.93E-03	5.89E-02			1.75E-01	0.00%
Beryllium	3.88E-02	7.05E-03	2.02E-02			6.61E-02	0.00%
Cadmium	1.81E-02	3.28E-03	6.43E-03			2.78E-02	0.00%
Chromium	1.45E-01	1.32E-02	7.51E-02			2.33E-01	0.00%
Cobalt	1.75E-02	3.98E-05	9.63E+00			9.65E+00	0.09%
Iron	4.73E+00	5.73E-02	2.45E+00			7.24E+00	0.07%
Lead	1.03E+04	1.24E+02	5.31E+00			1.04E+04	99.79%
Manganese	7.11E-01	3.23E-02	1.44E-01			8.87E-01	0.01%
Mercury	1.50E-02	3.88E-04	1.41E-02			2.95E-02	0.00%
Nickel	5.38E-02	3.62E-04	3.16E-02			8.58E-02	0.00%
Sulfate						0.00E+00	0.00%
Uranium	1.00E+00	2.14E-03	5.19E-01			1.52E+00	0.01%
Vanadium	4.33E-01	7.86E-02	2.24E-01			7.36E-01	0.01%
Zinc	1.58E-02	1.44E-04	1.41E-02			3.00E-02	0.00%
2-Propanol						0.00E+00	0.00%
TCE	2.55E-02	4.93E-03	2.45E-02	0.00695	0.00755	6.94E-02	0.00%
Am-241						0.00E+00	0.00%
Cs-137						0.00E+00	0.00%
Tc-99						0.00E+00	0.00%
U-235						0.00E+00	0.00%
U-238						0.00E+00	0.00%
Total	1.03E+04	1.24E+02	1.89E+01	6.95E-03	7.55E-03	1.05E+04	
Percent	98.63%	1.19%	0.18%	0.00%	0.00%		100

Table G.2.3. WAG 27 Hazard Estimates for the Child Residental User SMWU 001

Chemical of Potential Concern	*Ingestion*	*Dermal* Contact while Showering	Ingestion of Vegetables	Inhalation of Vapors While Showering	Inhalation of Vapors During Household Use	Total	Percent
Aluminum	4.74E-01	6.83E-03	3.20E-01			8.01E-01	1.92E-05
Arsenic	1.03E+00	3.62E-03	7.13E-01			1.75E+00	0.00%
Barium	2.73E-01	5.62E-03	1.85E-01			4.64E-01	0.00%
Beryllium	9.37E-02	1.35E-02	6.35E-02			1.71E-01	0.00%
Cadmium	4.36E-02	6.28E-03	2.02E-02			7.01E-02	0.00%
Chromium	3.51E-01	2.53E-02	2.36E-02			4.00E-01	0.00%
Cobalt	4.23E-02	7.62E-05	3.03E-02			7.27E-02	0.00%
Iron	1.14E+01	1.10E-01	7.70E+00			1.92E+01	0.05%
Lead	2.48E+04	2.38E+02	1.67E+04			4.17E+04	99.92%
Manganese	1.72E+00	6.18E-02	4.52E-01			2.23E+00	0.01%
Mercury	3.62E-02	7.44E-04	4.45E-02			8.14E-02	0.00%
Nickel	1.30E-01	6.93E-04	9.95E-02			2.30E-01	0.00%
Sulfate						0.00E+00	0.00%
Uranium	2.42E+00	4.10E-03	1.63E+00			4.05E+00	0.01%
Vanadium	1.05E+00	1.51E-01	7.06E-01			1.91E+00	0.00%
Zinc	3.82E-02	2.75E-04	4.44E-03			4.29E-02	0.00%
2-Propanol						0.00E+00	0.00%
TCE	6.14E-02	9.44E-03	7.70E-02	3.50E-02	3.64E-02	2.19E-01	0.00%
Am-241						0.00E+00	0.00%
Cs-137						0.00E+00	0.00%
Tc-99						0.00E+00	0.00%
U-235						0.00E+00	0.00%
U-238						0.00E+00	0.00%
Total	2.48E+04	2.38E+02	1.67E+04	3.50E-02	3.64E-02	4.18E+04	
Percent	59.42%	0.57%	40.01%	0.00%	0.00%		100.00%

Table G.2.4. WAG 27 Hazard Estimates for the Adult Recreational User SMWU 001

Chemical of Potential Concern	Direct Ingestion	Dermal contact	Inhalation of Particulates and Vapors	Total	Percent
Aluminum	3.64E-04	3.05E-02		3.09E-02	0.01%
Arsenic	8.96E-04	1.84E-02		1.93E-02	0.00%
Barium	6.98E-05	8.38E-03	7.99E-07	8.45E-03	0.00%
Beryllium	1.25E-05	1.05E-02	1.03E-10	1.05E-02	0.00%
Chromium	2.16E-04	9.08E-02	5.30E-07	9.10E-02	0.02%
Cobalt	5.26E-06	5.52E-05	1.29E-06	6.18E-05	0.00%
Iron	2.36E-03	1.32E-01		1.34E-01	0.03%
Lead	6.92E+00	3.97E+02	1.51E-08	4.04E+02	99.88%
Manganese	2.29E-04	4.81E-02	1.40E-05	4.83E-02	0.01%
Mercury	1.39E-05	1.66E-03	2.77E-04	1.95E-03	0.00%
Vanadium	1.61E-04	1.35E-01		1.35E-01	0.03%
Zinc	9.10E-06	3.82E-04		3.91E-04	0.00%
Am-241				0.00E+00	0.00%
Cs-137				0.00E+00	0.00%
Np-237				0.00E+00	0.00%
Pu-239/240				0.00E+00	0.00%
Th-230				0.00E+00	0.00%
U				0.00E+00	0.00%
U-235				0.00E+00	0.00%
U-238				0.00E+00	0.00%
Total	6.92E+00	3.97E+02	2.91E-04	4.04E+02	
Percent	1.71%	98.22%	0.00%		100.00%

Table G.2.5. WAG 27 Hazard Estimates for the Child Recreational User SMWU 001

Chemical of Potential Concern	Direct Ingestion	Dermal contact	Inhalation of Particulates and Vapors	Total	Percent
Arsenic	1.16E-02	1.27E-01		1.39E-01	0.00%
Barium	9.08E-04	5.80E-02	2.87E-07	5.89E-02	0.00%
Beryllium	1.63E-04	7.30E-02	3.68E-11	7.32E-02	0.00%
Chromium	2.81E-03	6.29E-01	1.90E-07	6.32E-01	0.02%
Cobalt	6.84E-05	3.83E-04	4.64E-07	4.52E-04	0.00%
Iron	3.07E-02	9.17E-01		9.48E-01	0.03%
Lead	8.99E+01	2.68E+03	2.03E-08	2.77E+03	99.89%
Manganese	2.97E-03	3.33E-01	1.88E-05	1.21E-02	0.00%
Mercury	1.80E-04	1.15E-02	3.73E-04	9.39E-01	0.03%
Vanadium	2.09E-03	9.37E-01		2.77E-03	0.00%
Zinc	1.18E-04	2.65E-03		0.00E+00	0.00%
Am-241				0.00E+00	0.00%
Cs-137				0.00E+00	0.00%
Np-237				0.00E+00	0.00%
Pu-239/240				0.00E+00	0.00%
Th-230				0.00E+00	0.00%
U				0.00E+00	0.00%
U-235				0.00E+00	0.00%
U-238				0.00E+00	0.00%
Total	9.00E+01	2.68E+03	3.93E-04	2.77E+03	
Percent	3.24%	96.77%	0.00%		100.00%

Table G.2.6. WAG 27 Hazard Estimates for the Teen Recreational User SMWU 001

Chemical of Potential Concern	Direct Ingestion	Dermal contact	Inhalation of Particulates and Vapors	Total	Percent
Aluminum	7.97E-04	1.42E-01		1.43E-01	0.01%
Arsenic	1.96E-03	8.50E-02		8.70E-02	0.00%
Barium	1.53E-04	3.88E-02	2.87E-07	3.90E-02	0.00%
Beryllium	2.75E-05	4.88E-02	3.68E-11	4.88E-02	0.00%
Chromium	4.74E-04	4.21E-01	1.90E-07	4.21E-01	0.02%
Cobalt	1.15E-05	2.56E-04	4.64E-07	2.68E-04	0.00%
Iron	5.18E-03	6.13E-01		6.18E-01	0.03%
Lead	1.52E+01	1.79E+03	2.03E-08	1.81E+03	99.88%
Manganese	5.01E-04	2.23E-01	1.88E-05	2.24E-01	0.01%
Mercury	3.04E-05	7.71E-03	3.73E-04	8.11E-03	0.00%
Vanadium	3.53E-04	6.27E-01		6.27E-01	0.03%
Zinc	1.99E-05	1.77E-03		1.79E-03	0.00%
Am-241				0.00E+00	0.00%
Cs-137				0.00E+00	0.00%
Np-237				0.00E+00	0.00%
Pu-239/240				0.00E+00	0.00%
Th-230				0.00E+00	0.00%
U				0.00E+00	0.00%
U-235				0.00E+00	0.00%
U-238				0.00E+00	0.00%
Total	1.52E+01	1.79E+03	3.93E-04	1.81E+03	
Percent	0.84%	99.16%	0.00%		100.00%

Table G.2.7. WAG 27 Hazard Estimates for the Future Excavation Worker SMWU 001

Chemical of Potential Concern	Direct Ingestion	Dermal contact	Inhalation of Particulates and Vapors	Total	Percent
Aluminum	1.43E-02	6.40E-02		7.83E-02	0.00%
Antimony	2.64E-03	5.82E-02		6.08E-02	0.00%
Arsenic	6.81E-02	7.44E-02		1.43E-01	0.01%
Barium	2.94E-03	1.88E-02	6.24E-07	2.17E-02	0.00%
Beryllium	7.76E-04	3.48E-02	1.17E-10	3.56E-02	0.00%
Cadmium	4.45E-03	3.99E-02	3.37E-08	4.44E-02	0.00%
Chromium	1.34E-02	2.99E-01	6.07E-07	3.12E-01	0.02%
Cobalt	1.85E-04	1.03E-04	8.41E-07	2.89E-04	0.00%
Lead	4.83E+02	1.44E+03	7.31E-08	1.92E+03	99.90%
Manganese	2.21E-02	2.48E-01	3.08E-05	2.70E-01	0.01%
Mercury	7.03E-04	4.50E-03	9.75E-04	6.18E-03	0.00%
Nickel	3.64E-03	6.04E-03		9.68E-03	0.00%
Silver	3.65E-05	9.09E-05		1.27E-04	0.00%
Thallium				0.00E+00	0.00%
Vanadium	5.76E-03	2.58E-01		2.64E-01	0.01%
Zinc	3.06E-04	6.85E-04		9.91E-04	0.00%
1,1-DCE	2.32E-06	5.19E-06	2.12E-05	2.87E-05	0.00%
1,2,4-TCB	1.30E-04	1.20E-04	6.91E-06	2.57E-04	0.00%
1,2-DCB	1.51E-05	4.22E-05	2.13E-05	7.86E-05	0.00%
1,3-DCB	4.28E-05	1.20E-04	2.42E-10	1.63E-04	0.00%
1,4-DCB			6.02E-06	6.02E-06	0.00%
1-Methyl-2-PCHex				0.00E+00	0.00%
2,3,4-TMH				0.00E+00	0.00%
2,4,5-TCP	2.48E-05	4.45E-05	4.68E-07	6.98E-05	0.00%
2,4,6-TCP				0.00E+00	0.00%
2,4-DMD				0.00E+00	0.00%
2,4-DNT	6.78E-04	7.14E-04	2.51E-05	1.42E-03	0.00%
2,5-DMH				0.00E+00	0.00%
2,6-DNT	1.30E-03	1.37E-03	5.91E-05	2.73E-03	0.00%
2-Chloronaphthalene	1.62E-05	2.91E-05	7.59E-06	5.29E-05	0.00%
2-Hexanone				0.00E+00	0.00%
2-Methyl-4,6-DNP				0.00E+00	0.00%
2-Methylnaphthalene				0.00E+00	0.00%
2-Nitroaniline	5.63E-02	1.01E-01	6.58E-02	2.23E-01	0.01%
2-Nitrophenol				0.00E+00	0.00%
3,3'-Dichlorobenzidine				0.00E+00	0.00%
2-Hexene-2-5, Dione				0.00E+00	0.00%
3-Nitroaniline				0.00E+00	0.00%
4,4'-DDD				0.00E+00	0.00%
4,4'-DDE				0.00E+00	0.00%
4,4'-DDT	2.83E-04	3.62E-04	1.22E-07	6.45E-04	0.00%
4-Bromophenyl-phenylether				0.00E+00	0.00%

Table G.2.7. WAG 27 Hazard Estimates for the Future Excavation Worker SMWU 001 (Continued)

Chemical of Potential Concern	Direct Ingestion	Dermal contact	Inhalation of Particulates and Vapors	Total	Percent
4-Chloro3-methylphenol				0.00E+00	0.00%
4-Chlorophenyl-phenylether				0.00E+00	0.00%
4-Methyl-3-penten-2-one				0.00E+00	0.00%
4-Nitroanliline				0.00E+00	0.00%
Acenaphthene	2.16E-05	6.25E-05	1.30E-06	8.54E-05	0.00%
Acenaphthylene				0.00E+00	0.00%
Aldrin	1.41E-03	2.52E-03	2.67E-06	3.93E-03	0.00%
Anthracene	4.33E-06	5.10E-06	7.27E-08	9.50E-06	0.00%
Benz(a)anthracene				0.00E+00	0.00%
Benzo(a)pyrene				0.00E+00	0.00%
Benzo(b)fluoranthene				0.00E+00	0.00%
Benzo(g,h,i)perylene				0.00E+00	0.00%
Benzo(k)fluoranthene				0.00E+00	0.00%
Bis(2-chloroethoxy)methane				0.00E+00	0.00%
Bis(2-chloroethyl)ether				0.00E+00	0.00%
Bis(2-chloroisopropyl)ether				0.00E+00	0.00%
Bis(2-ethylhexyl)phthalate	4.09E-05	1.93E-04	2.50E-09	2.34E-04	0.00%
Butyl benzyl phthalate	6.48E-06	9.51E-06	1.01E-08	1.60E-05	0.00%
Chrysene				0.00E+00	0.00%
Decane				0.00E+00	0.00%
Decane, 6-Ethyl-2-Methyl				0.00E+00	0.00%
D-n-butylphthalate	2.58E-05	2.31E-05	4.19E-08	4.89E-05	0.00%
Di-n-octylphthalate	6.49E-05	6.46E-05	1.42E-08	1.30E-04	0.00%
Dibenz(a,h)anthracene				0.00E+00	0.00%
Dibenzofuran	3.25E-04	5.82E-04	1.05E-05	9.18E-04	0.00%
Dieldrin	1.70E-03	3.04E-03	1.03E-05	4.75E-03	0.00%
Endosulfan I				0.00E+00	0.00%
Endosulfan II				0.00E+00	0.00%
Endosulfan Sulfate				0.00E+00	0.00%
Endrin	2.83E-04	1.27E-02	1.66E-06	1.30E-02	0.00%
Endrin Ketone				0.00E+00	0.00%
Ethylbenzene	2.01E-07	4.63E-07	1.71E-07	8.35E-07	0.00%
Fluoranthene	3.23E-05	9.34E-05	1.39E-07	1.26E-04	0.00%
Fluorene	3.24E-05	5.81E-05	8.34E-07	9.13E-05	0.00%
Heptachlor	8.44E-05	1.05E-04	4.91E-07	1.90E-04	0.00%
Heptachlor Epoxide	3.25E-03	4.04E-03	8.26E-06	7.30E-03	0.00%
Heptachlorodibenzofuran				0.00E+00	0.00%
Hexachlorobenzene	1.69E-03	3.04E-03	1.21E-04	4.85E-03	0.00%

Table G.2.7. WAG 27 Hazard Estimates for the Future Excavation Worker SMWU 001 (Continued)

Chemical of Potential Concern	Direct Ingestion	Dermal contact	Inhalation of Particulates and Vapors	Total	Percent
Hexachlorobutadiene	6.78E-03	1.21E-02	1.24E-03	2.01E-02	0.00%
Hexachlorocyclopentadiene	1.85E-04	3.32E-04	5.99E-03	6.51E-03	0.00%
Hexachloroethane	1.36E-03	2.43E-03	1.97E-04	3.99E-03	0.00%
Hexadecane				0.00E+00	0.00%
Indeno(1,2,3-cd)pyrene				0.00E+00	0.00%
Methoxychlor	8.51E-05	1.53E-04	2.74E-07	2.38E-04	0.00%
N-Nitroso-di-n-propylamine				0.00E+00	0.00%
N-Nitrosodiphenylamine				0.00E+00	0.00%
Naphthalene	6.46E-05	7.23E-05	3.54E-04	4.91E-04	0.00%
Nonane, 2,3-Dimethyl-				0.00E+00	0.00%
Octachlorodibenzo-p-Dioxin				0.00E+00	0.00%
Octachlorodibenzofuran				0.00E+00	0.00%
Octacosane				0.00E+00	0.00%
Octadecene				0.00E+00	0.00%
PCB-1016	1.24E-02	7.40E-03	3.42E-04	2.01E-02	0.00%
PCB-1221				0.00E+00	0.00%
PCB-1232				0.00E+00	0.00%
PCB-1242				0.00E+00	0.00%
PCB-1248				0.00E+00	0.00%
PCB-1254	6.88E-02	4.11E-02	1.70E-03	1.12E-01	0.01%
PCB-1260				0.00E+00	0.00%
PCB-1268				0.00E+00	0.00%
Pentachloro-1,1'-Biphenyl Iso				0.00E+00	0.00%
Pentachlorophenol	1.15E-04	1.03E-04	1.28E-06	2.19E-04	0.00%
Phenanthrene				0.00E+00	0.00%
PCB				0.00E+00	0.00%
Pyrene	4.32E-05	1.25E-04	1.49E-07	1.68E-04	0.00%
Tetrachloro-1,1'-Biphenyl Iso				0.00E+00	0.00%
Total Cresols				0.00E+00	0.00%
Toxaphene				0.00E+00	0.00%
TCE	5.28E-03	7.89E-02	2.13E-02	1.05E-01	0.01%
VC				0.00E+00	0.00%
Xylene	9.53E-09	2.32E-08	1.83E-08	5.10E-08	0.00%
alpha-BHC				0.00E+00	0.00%
alpha-Chlordane				0.00E+00	0.00%
beta-BHC				0.00E+00	0.00%
cis-1,2-DCE	1.77E-02	3.97E-02	8.01E-02	1.38E-01	0.01%

Table G.2.7. WAG 27 Hazard Estimates for the Future Excavation Worker SMWU 001 (Continued)

Chemical of Potential Concern	Direct Ingestion	Dermal contact	Inhalation of Particulates and Vapors	Total	Percent
cis-1,3-DCP				0.00E+00	0.00%
delta-BHC				0.00E+00	0.00%
gamma-BHC (Lindane)	1.41E-04	1.30E-04	3.96E-06	2.75E-04	0.00%
gamma-Chlordane				0.00E+00	0.00%
trans-1,2-DCE	2.58E-04	5.78E-04	1.46E-03	2.30E-03	0.00%
trans-1,3-DCP				0.00E+00	0.00%
Cs-137				0.00E+00	0.00%
Co-60				0.00E+00	0.00%
Np-237				0.00E+00	0.00%
Pu-239/240				0.00E+00	0.00%
Tc-99				0.00E+00	0.00%
Th-230				0.00E+00	0.00%
U				0.00E+00	0.00%
U-234				0.00E+00	0.00%
U-235				0.00E+00	0.00%
U-238				0.00E+00	0.00%
Total	4.83E+02	1.44E+03	1.80E-01	1.92E+03	
Percent	25.11%	74.88%	0.01%		99.99%

Table G.2.8. WAG 27 Excess Cancer Risk for the Industrial Worker SMWU 001

Chemical of Potential Concern	Direct Ingestion	Dermal contact	Inhalation of Particulates and Vapors	External Exposure	Total	Percent
Aluminum					0.00E+00	0.00%
Arsenic	2.70E-07	8.70E-06	3.40E-11		8.97E-06	6.91%
Barium					0.00E+00	0.00%
Beryllium	7.20E-08	9.60E-05	1.80E-12		9.61E-05	74.06%
Chromium			2.30E-10		2.30E-10	0.00%
Cobalt					0.00E+00	0.00%
Iron					0.00E+00	0.00%
Manganese					0.00E+00	0.00%
Mercury					0.00E+00	0.00%
Vanadium					0.00E+00	0.00%
Zinc					0.00E+00	0.00%
Am-241	2.40E-07		1.10E-09	1.50E-07	3.91E-07	0.30%
Cs-137	1.30E-09		3.00E-14	3.80E-06	3.80E-06	2.93%
Np-237	2.30E-07		1.00E-09	1.60E-05	1.62E-05	12.51%
Pu-239/240	5.40E-07		1.80E-09	9.50E-10	5.43E-07	0.42%
Th-230	4.50E-07		7.70E-09	2.30E-08	4.81E-07	0.37%
U	4.10E-08		3.10E-10	1.90E-06	1.94E-06	1.50%
U-235	6.90E-10		7.10E-12	1.70E-07	1.71E-07	0.13%
U-238	2.30E-08		1.70E-10	1.10E-06	1.12E-06	0.87%
Total	1.87E-06	1.05E-04	1.24E-08	2.31E-05	1.30E-04	100.00%
Percent	1.44%	80.71%	0.01%	17.84%		

Table G.2.9. WAG 27 Excess Cancer Risk for the Rural Resident NcNairy Groundwater SMWU 001

Chemical of Potential Concern	Ingestion	Dermal Contact while Showering[c]	Inhalation of Vapors while Showering	Inhalation of Vapors During Household Use[c]	Ingestion of Vegetables	External Exposure	Total	Percent
Aluminum								
Arsenic	1.30E-04	5.50E-07			7.70E-05		2.08E-04	8.53%
Barium								
Beryllium	2.30E-04	3.90E-05			1.30E-04		3.99E-04	16.40%
Cadmium								
Chromium								
Cobalt								
Iron								
Manganese								
Mercury								
Nickel								
Sulfate								
Uranium								
Vanadium								
Zinc								
2-Propanol								
TCE	1.20E-06	2.10E-07	2.30E-07	2.40E-06	1.20E-06		5.24E-06	0.22%
Am-241	5.90E-04				3.10E-04		9.00E-04	36.99%
Cs-137	8.20E-06				3.60E-06		1.18E-05	0.48%
Tc-99	7.20E-07				2.20E-04		2.21E-04	9.07%
U-235	1.20E-05		2.30E-07		6.50E-06		1.87E-05	0.77%
U-238	6.70E-04				3.60E-04		6.70E-04	27.54%
Pathway Total	1.64E-03	3.98E-05	4.60E-07	2.40E-06	1.11E-03		2.43E-03	100.00%
Fraction of Total	67.49%	1.63%	0.02%	0.10%	45.55%			

Table G.2.10. WAG 27 Excess Cancer Risk for the Recreational User SMWU 001

Chemical of Potential Concern	Ingestion	Dermal Contact while Showering	Inhalation of Paticles and Vapors	External Exposure	Total	Percent
Aluminum						
Arsenic	7.30E-07	1.40E-05	1.70E-11		1.47E-05	8.71%
Barium						
Beryllium	1.90E-07	1.50E-04	8.70E-13		1.50E-04	88.79%
Chromium			1.10E-10		1.10E-10	0.00%
Cobalt						
Iron						
Lead						
Manganese						
Mercury						
Vanadium						
Zinc						
Am-241	2.80E-07		5.20E-10	1.60E-08	2.97E-07	0.18%
Cs-137	1.50E-09		1.50E-14	4.10E-07	4.12E-07	0.24%
Neptunium-237	2.70E-07		4.90E-10	1.70E-06	1.97E-06	1.16%
Plutonium-239/240	6.30E-07		8.80E-10	1.00E-10	6.31E-07	0.37%
Thorium-230	5.20E-07		3.80E-09	2.50E-09	5.26E-07	0.31%
Uranium	4.80E-08		1.50E-10	2.00E-07	2.48E-07	0.15%
U-235	8.00E-10		3.50E-12	1.80E-08	1.88E-08	0.01%
U-238	2.60E-08		8.40E-11	1.10E-07	1.36E-07	0.08%
Pathway Total	2.70E-06	1.64E-04	6.06E-09	2.46E-06	1.69E-04	99.92%
Fraction of Total	1.59%	96.95%	0.00%	1.45%	100.00%	

Table G.2.11. WAG 27 ELCR for the Future Excavation Worker SMWU 001

Chemical of Potential Concern	Direct Ingestion	Dermal contact	Inhalation of Particulates and Vapors	Total	Percent
Aluminum				0.00E+00	0.00%
Antimony				0.00E+00	0.00%
Arsenic	1.10E-05	1.20E-05	4.80E-11	2.30E-05	9.80%
Barium				0.00E+00	0.00%
Beryllium	2.40E-06	1.10E-04	2.00E-12	1.12E-04	47.90%
Cadmium			4.30E-12	4.30E-12	0.00%
Chromium			2.60E-10	2.60E-10	0.00%
Cobalt				0.00E+00	0.00%
Manganese				0.00E+00	0.00%
Mercury				0.00E+00	0.00%
Nickel				0.00E+00	0.00%
Silver				0.00E+00	0.00%
Thallium				0.00E+00	0.00%
Vanadium				0.00E+00	0.00%
Zinc				0.00E+00	0.00%
1,1-DCE	4.50E-09	1.00E-08	1.20E-08	2.65E-08	0.01%
1,2,4-TCB				0.00E+00	0.00%
1,2-DCB				0.00E+00	0.00%
1,3-DCB				0.00E+00	0.00%
1,4-DCB	1.20E-08	2.90E-08		4.10E-08	0.02%
1-Methyl-2-PCHex				0.00E+00	0.00%
2,3,4-TMH				0.00E+00	0.00%
2,4,5-TCP				0.00E+00	0.00%
2,4,6-TCP	5.30E-09	9.50E-09	2.70E-10	1.51E-08	0.01%
2,4-DMD				0.00E+00	0.00%
2,4-DNT	3.30E-07	3.50E-07		6.80E-07	0.29%
2,5-DMH				0.00E+00	0.00%
2,6-DNT	3.20E-07	3.30E-07		6.50E-07	0.28%
2-Chloronaphthalene				0.00E+00	0.00%
2-Hexanone				0.00E+00	0.00%
2-Methylnaphthalene				0.00E+00	0.00%
2-Nitroaniline				0.00E+00	0.00%
2-Nitrophenol				0.00E+00	0.00%
3,3'-Dichlorobenzidine	2.50E-07	4.40E-07		6.90E-07	0.29%
2-Hexene-2-5, Dione				0.00E+00	0.00%
3-Nitroaniline				0.00E+00	0.00%
4,4'-DDD	7.30E-09	9.30E-09		1.66E-08	0.01%
4,4'-DDE	1.00E-08	1.30E-08		2.30E-08	0.01%
4,4'-DDT	1.70E-08	2.20E-08	7.40E-12	3.90E-08	0.02%
4-Bromophenyl-phenylether				0.00E+00	0.00%
4-Chloro3-methylphenol				0.00E+00	0.00%

Table G.2.11. WAG 27 ELCR for the Future Excavation Worker SMWU 001 (Continued)

Chemical of Potential Concern	Direct Ingestion	Dermal contact	Inhalation of Particulates and Vapors	Total	Percent
4-Chlorophenyl-phenylether				0.00E+00	0.00%
4-Methyl-3-penten-2-one				0.00E+00	0.00%
4-Nitroanliline				0.00E+00	0.00%
Acenaphthene				0.00E+00	0.00%
Acenaphthylene				0.00E+00	0.00%
Aldrin	2.60E-07	4.60E-07	4.90E-10	7.20E-07	0.31%
Anthracene				0.00E+00	0.00%
Benz(a)anthracene	3.40E-07	9.70E-07	2.00E-07	1.51E-06	0.64%
Benzo(a)pyrene	3.40E-06	9.70E-06	7.60E-07	1.39E-05	5.91%
Benzo(b)fluoranthene	3.40E-07	9.70E-07	4.00E-07	1.71E-06	0.73%
Benzo(g,h,i)perylene				0.00E+00	0.00%
Benzo(k)fluoranthene	3.40E-08	9.70E-08	4.70E-09	1.36E-07	0.06%
Bis(2-chloroethoxy)methane				0.00E+00	0.00%
Bis(2-chloroethyl)ether	5.10E-07	9.10E-07	2.10E-07	1.63E-06	0.69%
Bis(2-chloroisopropyl)ether	3.20E-08	5.80E-08	7.30E-09	9.73E-08	0.04%
Bis(2-ethylhexyl)phthalate	4.10E-09	1.90E-08		2.31E-08	0.01%
Butyl benzyl phthalate				0.00E+00	0.00%
Chrysene	3.40E-09	9.70E-09	6.90E-09	2.00E-08	0.01%
Decane				0.00E+00	0.00%
Decane, 6-Ethyl-2-Methyl				0.00E+00	0.00%
D-n-butylphthalate				0.00E+00	0.00%
Di-n-octylphthalate				0.00E+00	0.00%
Dibenz(a,h)anthracene	3.40E-06	9.80E-06	1.80E-07	1.34E-05	5.70%
Dibenzofuran				0.00E+00	0.00%
Dieldrin	4.90E-07	8.70E-07	3.00E-09	1.36E-06	0.58%
Endosulfan I				0.00E+00	0.00%
Endosulfan II				0.00E+00	0.00%
Endosulfan Sulfate				0.00E+00	0.00%
Endrin				0.00E+00	0.00%
Endrin Ketone				0.00E+00	0.00%
Ethylbenzene				0.00E+00	0.00%
Fluoranthene				0.00E+00	0.00%
Fluorene				0.00E+00	0.00%
Heptachlor	6.80E-08	8.40E-08	4.00E-10	1.52E-07	0.06%
Heptachlor Epoxide	1.40E-07	1.70E-07	3.50E-10	3.10E-07	0.13%
Heptachlorodibenzofuran	1.50E-06	2.60E-06	4.80E-19	4.10E-06	1.75%
Hexachlorobenzene	7.70E-07	1.40E-06	5.60E-08	2.23E-06	0.95%
Hexachlorobutadiene	3.80E-08	6.80E-08	6.80E-09	1.13E-07	0.05%

Table G.2.11 WAG 27 ELCR for the Future Excavation Worker SMWU 001 (Continued)

Chemical of Potential Concern	Direct Ingestion	Dermal contact	Inhalation of Particulates and Vapors	Total	Percent
Hexachlorocyclopentadiene				0.00E+00	0.00%
Hexachloroethane	6.80E-09	1.20E-08	9.80E-10	1.98E-08	0.01%
Hexadecane				0.00E+00	0.00%
Indeno(1,2,3-cd)pyrene	3.40E-07	9.80E-07	3.30E-08	1.35E-06	0.58%
Methoxychlor				0.00E+00	0.00%
N-Nitroso-di-n-propylamine	3.20E-06	1.20E-05		1.52E-05	6.48%
N-Nitrosodiphenylamine	2.20E-09	8.00E-09		1.02E-08	0.00%
Naphthalene				0.00E+00	0.00%
Nonane, 2,3-Dimethyl-				0.00E+00	0.00%
Octachlorodibenzo-p-Dioxin	3.50E-07	6.30E-07	1.20E-19	9.80E-07	0.42%
Octachlorodibenzofuran	2.30E-07	4.10E-07	7.70E-20	6.40E-07	0.27%
Octacosane				0.00E+00	0.00%
Octadecene				0.00E+00	0.00%
PCB-1016	6.20E-07	3.70E-07	1.70E-08	1.01E-06	0.43%
PCB-1221	6.20E-07	3.70E-07	2.70E-13	9.90E-07	0.42%
PCB-1232	6.20E-07	3.70E-07	2.70E-13	9.90E-07	0.42%
PCB-1242	6.50E-07	3.90E-07	2.40E-08	1.06E-06	0.45%
PCB-1248	2.70E-06	1.60E-06	1.20E-12	4.30E-06	1.83%
PCB-1254	9.80E-07	5.90E-07	2.40E-08	1.59E-06	0.68%
PCB-1260	1.40E-06	8.20E-07	4.00E-08	2.26E-06	0.96%
PCB-1268				0.00E+00	0.00%
Pentachloro-1,1'-Biphenyl Iso				0.00E+00	0.00%
Pentachlorophenol	1.50E-07	1.30E-07		2.80E-07	0.12%
Phenanthrene				0.00E+00	0.00%

Table G.2.11 WAG 27 ELCR for the Future Excavation Worker SMWU 001 (Continued)

Chemical of Potential Concern	Direct Ingestion	Dermal contact	Inhalation of Particulates and Vapors	Total	Percent
PCB	1.60E-06	9.70E-07	2.20E-08	2.59E-06	1.10%
Pyrene				0.00E+00	0.00%
Tetrachloro-1,1' -Biphenyl Iso				0.00E+00	0.00%
Total Cresols				0.00E+00	0.00%
Toxaphene	3.30E-07	6.00E-07	3.80E-10	9.30E-07	0.40%
TCE	1.20E-07	1.90E-06	2.70E-07	2.29E-06	0.98%
VC	2.90E-06	6.50E-06	5.60E-06	1.50E-05	6.39%
Xylene				0.00E+00	0.00%
alpha-BHC	9.50E-08	8.80E-08	2.20E-09	1.85E-07	0.08%
alpha-Chlordane				0.00E+00	0.00%
beta-BHC	2.70E-08	2.70E-08	2.80E-10	5.43E-08	0.02%
cis-1,2-DCE				0.00E+00	0.00%
cis-1,3-DCP				0.00E+00	0.00%
delta-BHC				0.00E+00	0.00%
gamma-BHC (Lindane)	2.00E-08	1.80E-08		3.80E-08	0.02%
gamma-Chlordane				0.00E+00	0.00%
trans-1,2-DCE				0.00E+00	0.00%
trans-1,3-DCP				0.00E+00	0.00%
Cs-137	3.90E-09		3.00E-15	3.90E-09	0.00%
Co-60	2.00E-09		9.40E-15	2.00E-09	0.00%
Np-237	2.00E-07		2.90E-11	2.00E-07	0.09%
Pu-239/240	8.80E-08		1.00E-11	8.80E-08	0.04%
Tc-99	1.10E-07		2.90E-13	1.10E-07	0.05%
Th-230	8.90E-08		5.30E-11	8.91E-08	0.04%
U	2.40E-06		6.20E-10	2.40E-06	1.02%
U-234	6.80E-07		2.80E-10	6.80E-07	0.29%
U-235	1.40E-08		5.20E-12	1.40E-08	0.01%
U-238	3.80E-07		9.80E-11	3.80E-07	0.16%
Total	4.66E-05	1.80E-04	7.88E-06	2.35E-04	
Percent	19.86%	76.78%	3.36%		100.00%

Table G.2.12 Adult Resident McNairy Ground Water C-720

Chemical of Potential Concern	*Ingestion*	*Dermal* Contact while Showering	Ingestion of Vegetables	Inhalation of Vapors While Showering	Inhalation of Vapors During Household Use	Total	Percent
Aluminum	2.42E+00	4.39E-02	1.25E+00			3.71E+00	0.04%
Arsenic	1.05E-01	4.64E-04	5.56E-02			1.61E-01	0.00%
Barium	1.21E-01	3.14E-03	6.29E-02			1.87E-01	0.00%
Beryllium	1.30E-01	2.36E-02	6.74E-02			2.21E-01	0.00%
Cadmium	3.36E-02	6.10E-03	1.20E-02			5.17E-02	0.00%
Chromium	7.08E-01	6.43E-02	3.66E-01			1.14E+00	0.01%
Cobalt	2.14E-02	4.86E-05	1.18E-02			3.32E-02	0.00%
Iron	1.93E+01	0.234	9.97E+00			2.95E+01	0.29%
Lead	6.63E+03	2.34E-01	3.43E+03			1.01E+04	98.82%
Manganese	1.42E+00	8.02E+01	2.86E-01			8.19E+01	0.80%
Mercury	1.13E-02	2.94E-04	1.07E-02			2.23E-02	0.00%
Nickel	1.19E-01	8.00E-04	6.99E-02			1.90E-01	0.00%
Sulfate						0.00E+00	0.00%
Uranium	1.51E-01	3.23E-04	7.83E-02			2.30E-01	0.00%
Vanadium	1.32E+00	2.40E-01	6.84E-01			2.24E+00	0.02%
Zinc	3.28E-02	2.98E-04	2.93E-02			6.24E-02	0.00%
1,1-Dichloroethene	7.15E-03	1.16E-04	1.08E-02	1.95E-03	2.12E-02	4.12E-02	0.00%
TCE	2.59E-02	5.01E-03	2.49E-02	7.06E-03	7.67E-02	1.40E-01	0.00%
Am-241						0.00E+00	0.00%
Cs-137						0.00E+00	0.00%
Tc-99						0.00E+00	0.00%
U-235						0.00E+00	0.00%
U-238						0.00E+00	0.00%
Total	6.66E+03	8.11E+01	3.44E+03	9.01E-03	9.79E-02	1.02E+04	
Percent	65.38%	0.80%	33.82%	0.00%	0.00%		100.00%

Table G.2.13 WAG 27 Hazard Estimates for the Child Rural Resident User McNairy Ground Water C-720

Chemical of Potential Concern	Direct Ingestion	Dermal contact	Ingestion of Vegetables	Inhalation while showering	Inhalation of Particulates and Vapors	Total
Aluminum	5.84E+00	8.41E-02	3.94E+00			9.86E+00
Arsenic	2.53E-01	8.89E-04	1.75E-01			4.29E-01
Barium	2.92E-01	6.00E-03	1.98E-01			4.96E-01
Beryllium	3.13E-01	4.51E-02	2.12E-01			5.70E-01
Bromide						0.00E+00
Cadmium	8.11E-02	1.17E-02	3.76E-02			1.30E-01
Chromium	1.71E+00	1.23E-01	1.15E+00			2.98E+00
Cobalt	5.18E-02	9.32E-05	3.72E-02			8.91E-02
Iron	4.66E+01	4.47E-01	3.14E+01			7.84E+01
Lead	1.60E+04	1.54E+02	1.08E+04			2.70E+04
Manganese	3.42E+00	1.23E-01	9.00E-01			4.44E+00
Mercury	2.73E-02	5.63E-04	3.36E-02			6.15E-02
Nickel	2.87E-01	1.53E-03	2.20E-01			5.09E-01
Sulfate						0.00E+00
Uranium	3.66E-01	6.19E-04	2.45E-01			6.12E-01
Vanadium	3.19E+00	4.59E-01	2.15E+00			5.80E+00
Zinc	7.92E-02	5.70E-04	9.21E-02			1.72E-01
1,1-DCE	1.73E-02	2.21E-04	3.39E-02	9.43E-03	1.02E-01	1.63E-01
TCE	6.24E-02	9.59E-03	7.82E-02	3.41E-02	3.70E-01	5.54E-01
VC						0.00E+00
Am-241						0.00E+00
Cs-137						0.00E+00
Np-237						0.00E+00
Tc-99						0.00E+00
U-235						0.00E+00
U-238						
Total	1.61E+04	1.55E+02	1.08E+04	4.35E-02	4.72E-01	2.70E+04
Percent	59.38%	0.57%	40.08%	0.00%	0.00%	

Table G.2.14 WAG 27 Hazard Estimates for the Future Excavation Worker C-720

Chemical of Potential Concern	Direct Ingestion	Dermal contact	Inhalation of Particulates and Vapors	Total	Percent
Antimony	2.27E-03	5.08E-02		5.31E-02	13.66%
Arsenic	2.55E-02	2.78E-02		5.33E-02	13.72%
Barium	2.60E-03	1.66E-02	5.51E-07	1.92E-02	4.94%
Beryllium	4.60E-04	2.06E-02	6.96E-11	2.11E-02	5.42%
Chromium	1.02E-02	2.28E-01	4.62E-07	2.38E-01	61.31%
Cobalt	2.32E-04	1.30E-04	1.06E-06	3.63E-04	0.09%
Bis(2-ethylhexyl)phthalate	1.39E-05	6.55E-05	8.49E-10	7.94E-05	0.02%
TCE	1.62E-04	2.41E-03	6.51E-04	3.22E-03	0.83%
VC					
U					
U-238					
Total	4.14E-02	3.46E-01	6.53E-04	3.88E-01	
Percent	10.67%	89.17%	0.17%		100.00%

Table G.2.15 WAG 27 Excess Cancer Risk for the Rural Resident NcNairy Ground Water C-720

Chemical of Potential Concern	Ingestion[c]	Dermal Contact while Showering[c]	Inhalation of Vapors while Showering	Inhalation of Vapors During Household Use[c]	Ingestion of Vegetables	External Exposure	Total	Percent
Aluminum								
Arsenic	3.30E-05	1.40E-07			1.90E-05		5.21E-05	1.31%
Barium								
Beryllium					4.40E-04		4.40E-04	11.03%
Bromide								
Cadmium								
Chromium								
Cobalt								
Iron								
Manganese								
Mercury								
Nickel								
Sulfate								
Uranium								
Vanadium								
Zinc								
1,1-DCE	2.70E-05	4.10E-07	1.90E-05	2.10E-04	4.40E-05		3.00E-04	7.53%
TCE	1.20E-06	2.10E-07	2.30E-07	2.50E-06	1.20E-06		5.34E-06	0.13%
VC	1.80E-05	2.20E-07	1.00E-06	1.10E-05	4.30E-05		7.32E-05	1.83%
Am-241	5.10E-04				2.70E-04		7.80E-04	19.55%
Cs-137	1.60E-05				7.30E-06		2.33E-05	0.58%
Np-237	3.10E-04				1.70E-04		4.80E-04	12.03%
Tc-99	1.00E-06				3.20E-04		3.21E-04	8.04%
U-235	1.20E-04				6.50E-05		1.85E-04	4.64%
U-238	8.70E-04				4.60E-04		1.33E-03	33.33%
Totals	1.91E-03	9.80E-07	2.02E-05	2.24E-04	1.84E-03	0.00E+00	3.99E-03	100.00%
Percent	4.78E-01	2.46E-04	5.07E-03	5.60E-02	46.10%			

Table G.2.16 WAG 27 ELCR for the Future Excavation Worker C-720

Chemical of Potential Concern	Direct Ingestion	Dermal contact	Inhalation of Particulates and Vapors	Total	Percent
Antimony					0.00%
Arsenic	4.10E-06	4.50E-06	1.80E-11	8.60E-06	61.78%
Barium					0.00%
Beryllium					0.00%
Chromium			2.00E-10	2.00E-10	0.00%
Cobalt					0.00%
Bis(2-ethylhexyl)phthalate	1.40E-09	6.60E-09			0.00%
TCE	3.80E-09	5.70E-08	8.30E-09	6.91E-08	0.50%
VC	9.40E-07	2.10E-06	1.80E-06	4.84E-06	34.77%
U	2.60E-07		6.70E-11	2.60E-07	1.87%
U-238	1.50E-07		3.80E-11	1.50E-07	1.08%
Total	5.46E-06	6.66E-06	1.81E-06	1.39E-05	
Percent	39.19%	47.87%	12.99%		100.00%