OhioEPA

State of Ohio Environmental Protection Agency

Southeast District Office

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Logan, OH 43138

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Bob Taft, Governor
Jennette Bradley, Lieutenant Governor
Christopher Jones, Director

December 8, 2003

US DOE-PORTS
PIKE COUNTY

DERR CORRESPONDENCE

Melda Rafferty
Project Manager
US Department of Energy
Portsmouth Site Office
P.O. Box 700
Piketon, Ohio 45661-0700

Dear Ms. Rafferty:

RE: THE X-701B SWMU DECISION DOCUMENT

Enclosed is the X-701B Decision Document which outlines the selected remedy for groundwater and soils for the X-701B SWMU which is located in Quadrant II. Ohio EPA held a public meeting on October 7, 2003, to provide the public with the opportunity to provide comment on the remedies. Ohio EPA received one comment from the public and none from US DOE. The comment is addressed in the Responsiveness Summary of the Decision Document.

Please submit to Ohio EPA a Corrective Measures Implementation (CMI) Plan within 45 days of your receipt of this Decision Document per the requirements of the Ohio Consent Decree. The CMI must include a schedule for the implementation of the groundwater and soil remedies described in the document. We anticipate working very closely with DOE during the design and implementation of the groundwater remedy.

If you have any questions, please do not hesitate to contact me at (740) 380-5289.

Sincerely,

Maria Galanti
Site Coordinator
Division of Emergency and Remedial Response

MG/jg

cc: Kristi Wiehle, US DOE
Gene Jablonowski, US EPA-Region V
Gilbert Drexel, Bechtel-Jacobs Company LLC

O.E.P.A.
S.E.D.O.

2003 DEC -5 AM 9:11

Ohio EPA
State of Ohio Environmental Protection Agency

COVER MEMO

Subject: The Decision Document for the X-701B SWMU at the Portsmouth Gaseous Diffusion Plant in Piketon, Ohio

Prepared by: Maria Galanti, DERR-SEDO

Necessary Approvals		Approved by	Date
(X)	Chief OFFO	[signature]	12/2/03
(X)	Legal	[signature]	12/03/03
( )	Supervisor		__/__/__
(X)	Manager	[signature]	11/25/03
( )	District Chief		__/__/__
(X)	Site Coordinator (Maria Galanti)	[signature]	11/25/03
( )	Other		__/__/__

Return All Supporting Documents to:

Name: Maria Galanti, DERR-SEDO **Telephone #:** (740) 380-5289

Figure 1

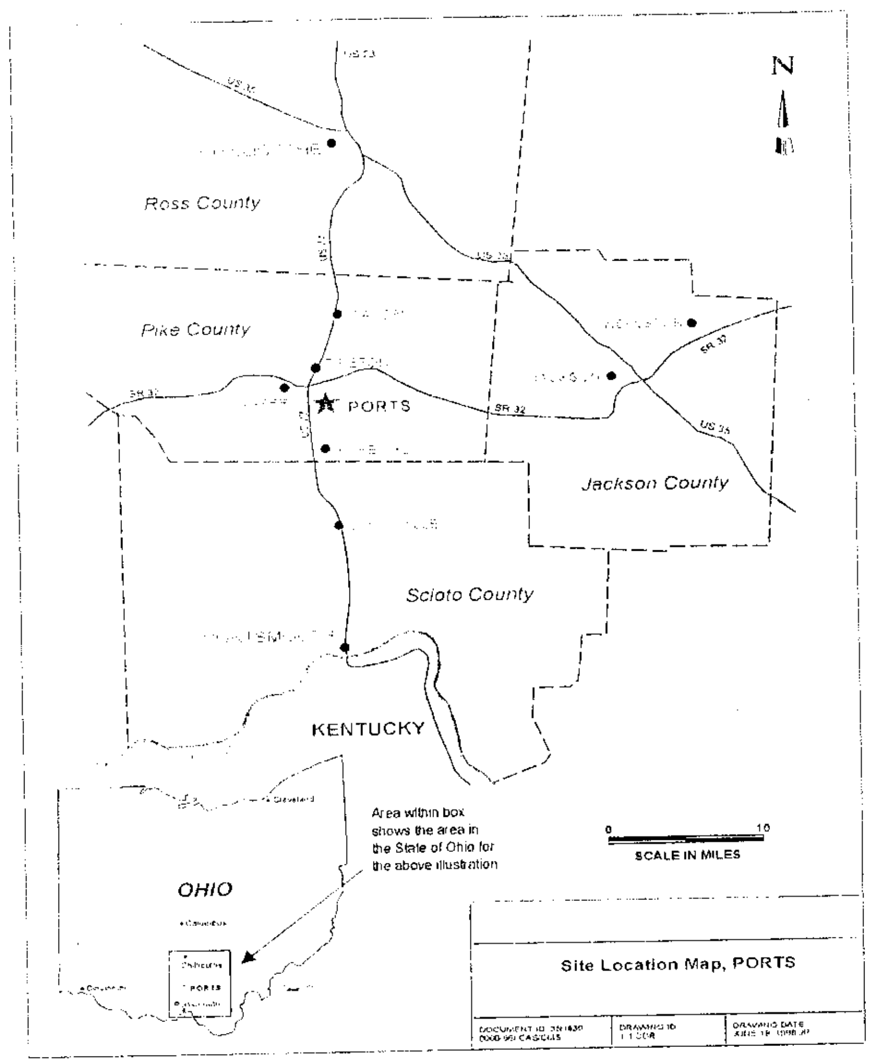

N
Ross County
Pike County
PORTS
SR 32
Jackson County
Scioto County
KENTUCKY
OHIO
Area within box shows the area in the State of Ohio for the above illustration
0
10
SCALE IN MILES
Site Location Map, PORTS

Figure 2

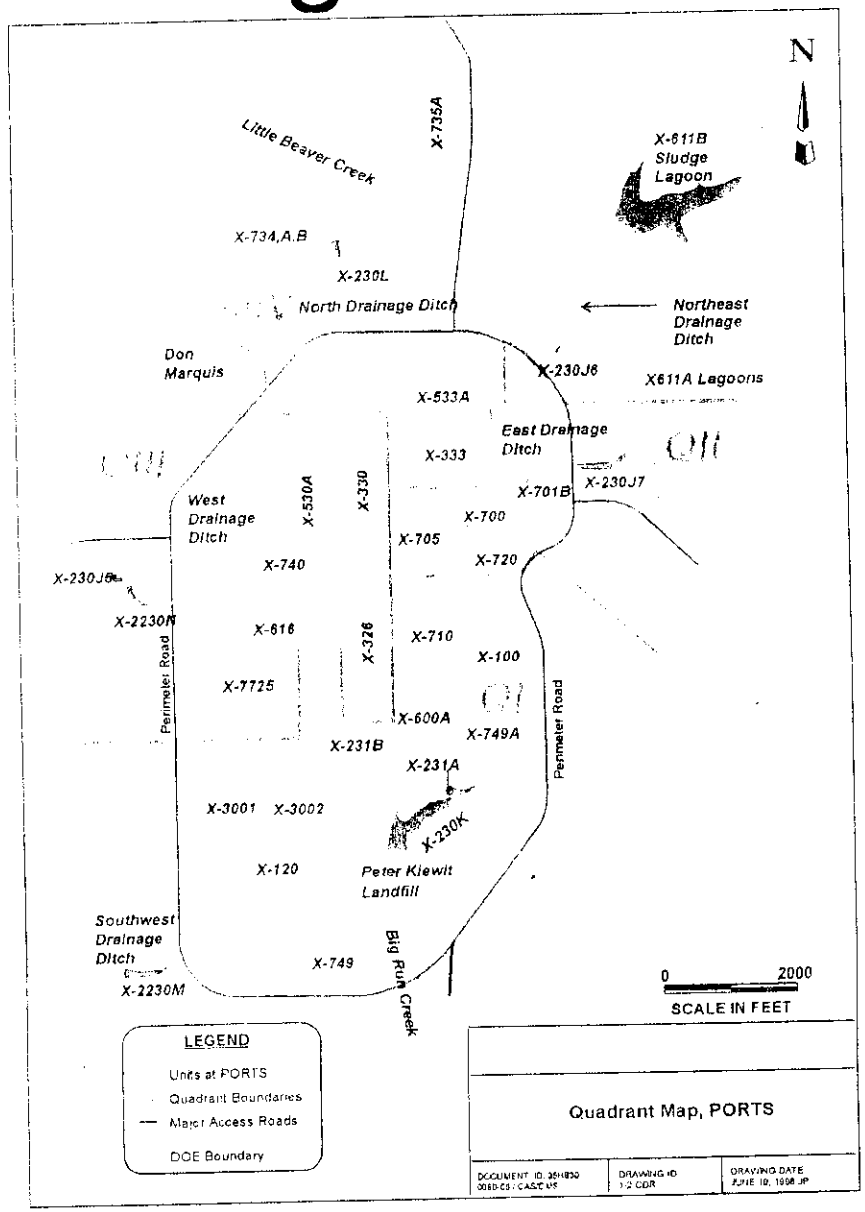

N
Little Beaver Creek
X-735A
X-611B
Sludge
Lagoon
X-734,A,B
X-230L
North Drainage Ditch
Northeast
Drainage
Ditch
Don
Marquis
X-230J6
X611A Lagoons
X-533A
East Drainage
Ditch
X-333
X-701B
X-230J7
West
Drainage
Ditch
X-530A
X-330
X-700
X-705
X-720
X-740
X-230J5
X-2230N
X-616
X-326
X-710
X-100
Perimeter Road
X-7725
X-600A
X-749A
X-231B
X-231A
X-3001
X-3002
X-230K
X-120
Peter Kiewit
Landfill
Southwest
Drainage
Ditch
X-749
Big Run Creek
X-2230M
0
2000
SCALE IN FEET
LEGEND
Units at PORTS
Quadrant Boundaries
Major Access Roads
DOE Boundary
Quadrant Map, PORTS

Figure 3

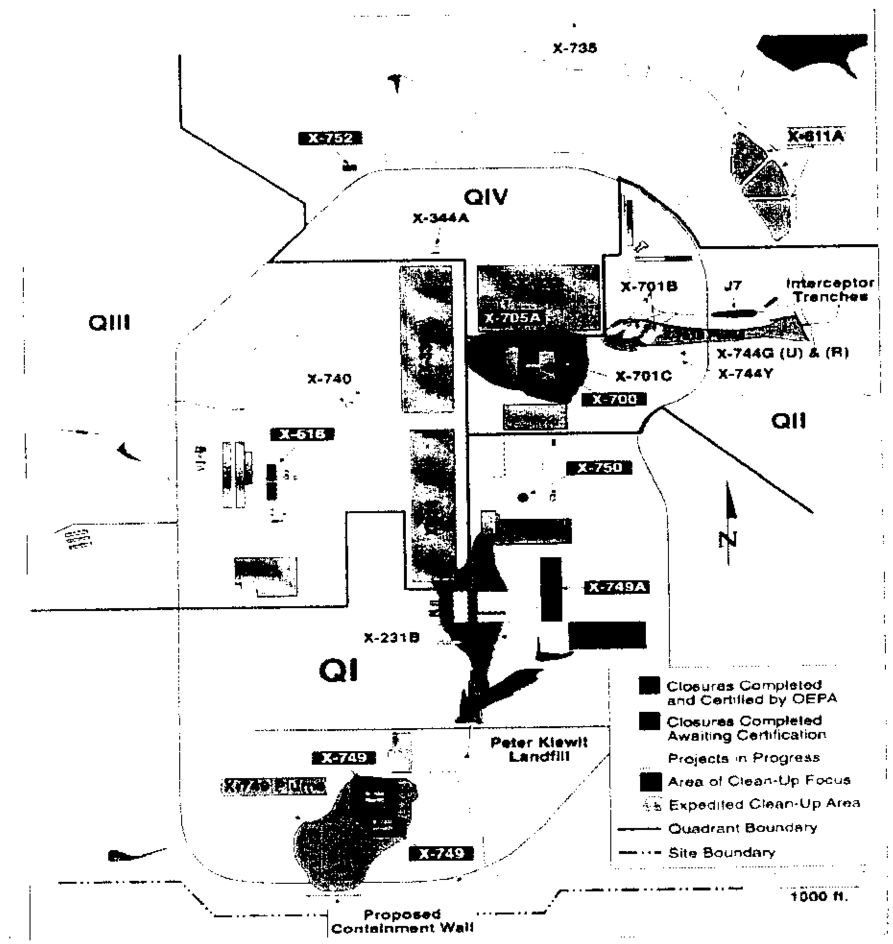
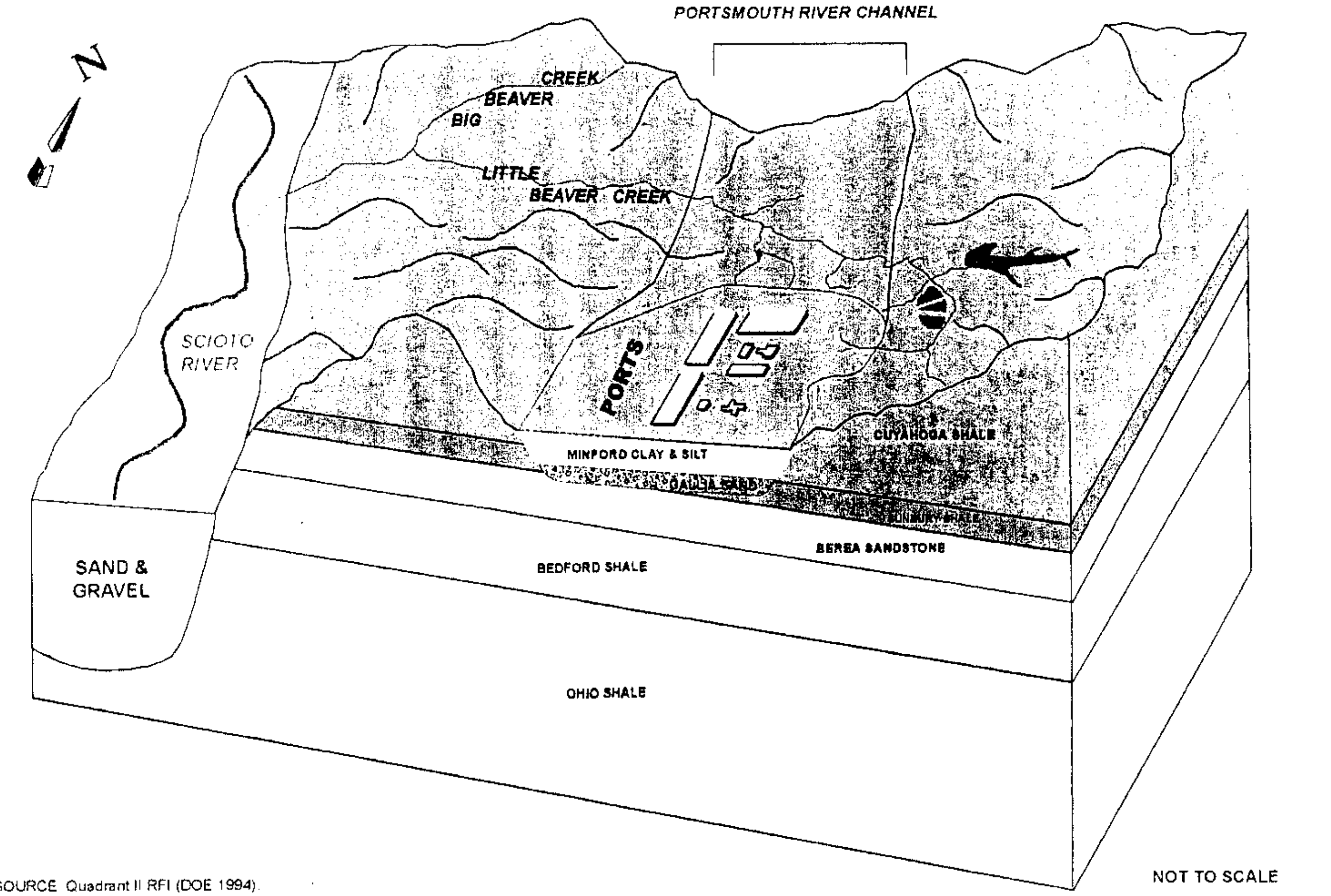

X-735
X-752
X-611A
QIV
X-344A
QIII
X-701B
J7
Interceptor Trenches
X-705A
X-744G (U) & (R)
X-744Y
X-740
X-701C
X-700
QII
X-616
X-750
X-749A
X-231B
QI
Closures Completed and Certified by OEPA
Closures Completed Awaiting Certification
Projects in Progress
Area of Clean-Up Focus
Expedited Clean-Up Area
Quadrant Boundary
Site Boundary
X-749
Peter Kiewit Landfill
X-749 Plume
1000 ft.
Proposed Containment Wall

Figure 4



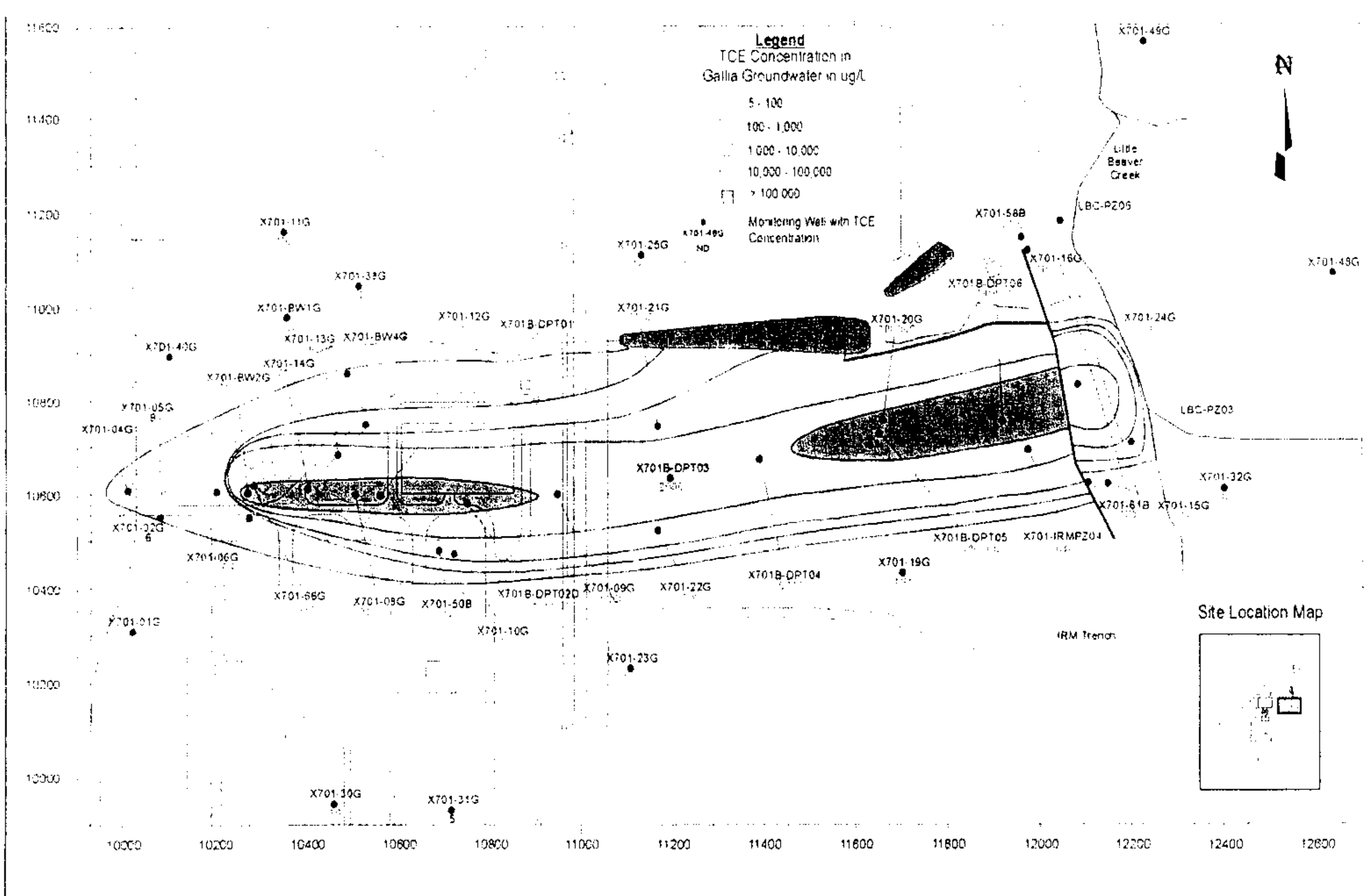
SOURCE Quadrant II RFI (DOE 1994).

Schematic Block Diagram Showing Geology at PORTS	DOCUMENT ID 35H830 0050-66 / CAS/CMS	DRAWING ID: 1-6 CDR	DRAWING DATE JUNE 19 1998 JP

Portsmouth Gaseous Diffusion Plant

Figure 5

Figure 6



X-701B Groundwater Investigative Area Plume - 1998 Map	DOCUMENT ID 35U850 0060-70/CAS/CMS	DRAWING ID 2, 8b CDR	DRAWING DATE July 28, 2000 JR

Figure 7

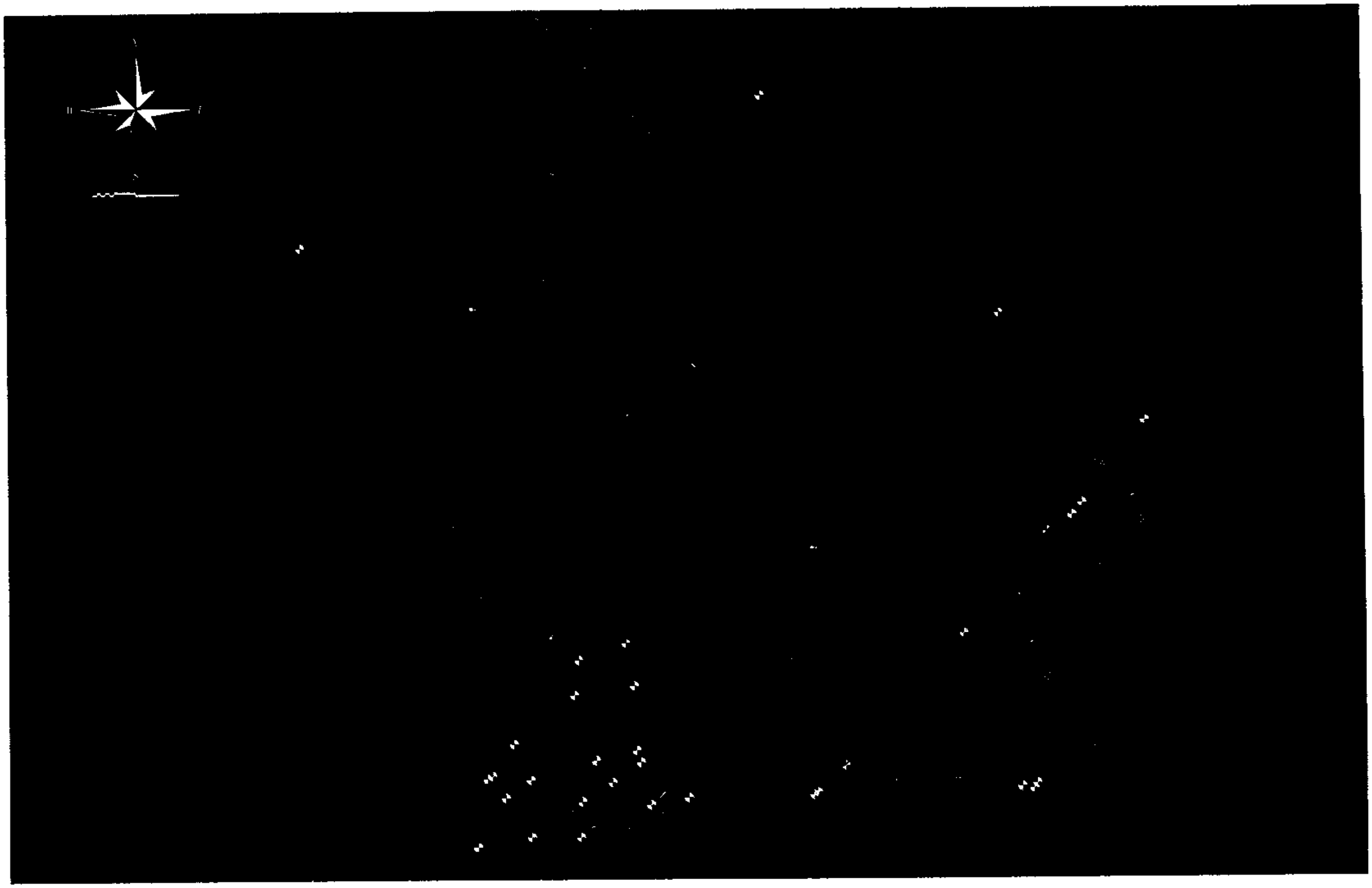
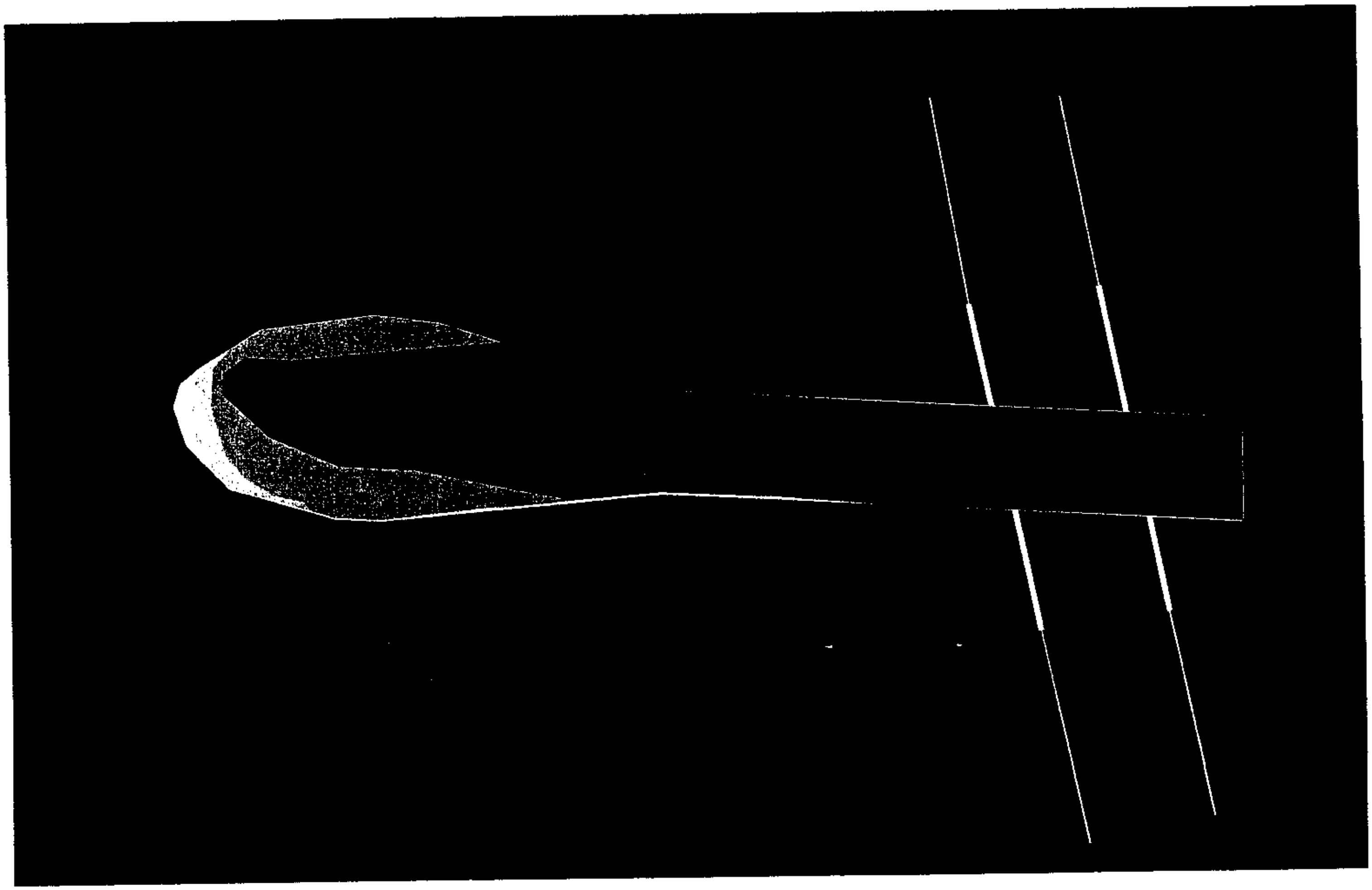


Figure 8



OHIO EPA's DECISION DOCUMENT FOR THE X-701B SWMU IN QUADRANT II OF THE US DOE PORTSMOUTH FACILITY PIKETON, OHIO

DECEMBER 2003

TABLES

APPENDICES

FIGURES

ARARs

LIST OF ACRONYMS AND ABBREVIATIONS

ALARA	As low as reasonably achievable
ARAR	Applicable or relevant and appropriate requirement
BAT	Best available technology
bgs	Below ground surface
BRA	Baseline risk assessment
BTEX	Benzene, toluene, ethylbenzene, and xylene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (Superfund Law)
CAS/CMS	Corrective action study and corrective measures study
CDI	Chronic daily intake
CFR	Code of Federal Regulations
COC	Chemical of concern
COPC	Chemical of potential concern
D&D	Decontamination and Decommissioning
ft^2	Square foot
GCEP	Gas Centrifuge Enrichment Plant
gpd	Gallon per day
HDPE	High-density polyethylene
HI	Hazard index
HQ	Hazard quotient
IGWMP	Integrated groundwater monitoring plan
MCL	Maximum contaminant level
mg/kg	Milligram per kilogram
mg/kg/day	Milligram per kilogram per day
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPDES	National Pollution Discharge Elimination System
OAC	Ohio Administrative Code
O&M	Operation and maintenance
Ohio EPA	Ohio Environmental Protection Agency
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PCE	Perchloroethene
pCi/kg	Picocurie per kilogram
PORTS	Portsmouth Gaseous Diffusion Plant
ppm	Part per million
PRG	Preliminary remediation goal
RCRA	Resource Conservation and Recovery Act
RfD	Reference dose
RFI	RCRA facility investigation
SVOC	Semivolatile organic compound
SWMU	Solid waste management unit
TCE	Trichloroethene
TPH	Total petroleum hydrocarbons

TSCA	Toxic Substances Control Act
U.S. DOE	U.S. Department of Energy
USEC	U.S. Enrichment Corporation
U.S. EPA	U.S. Environmental Protection Agency
UST	Underground storage tank
VER	Vacuum extraction recovery
VOC	Volatile organic compound
μg/kg	Microgram per kilogram
μg/L	Microgram per liter

PART 1: DECLARATION STATEMENT

DECLARATION STATEMENT

SITE NAME AND LOCATION

U.S. Department of Energy
Portsmouth Gaseous Diffusion Plant (PORTS)
X-701B SWMU in Quadrant II
Piketon, Ohio

STATEMENT OF BASIS AND PURPOSE

This Decision Document presents the selected remedial actions for the Portsmouth Gaseous Diffusion Plant (PORTS), X-701B Solid Waste Management Unit (SWMU) located in Quadrant II, on the United States Department of Energy (U.S. DOE) Reservation in Piketon, Ohio. These actions were chosen in accordance with the Resource Conservation and Recovery Act (RCRA) of 1976; the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 as amended by the Superfund Amendments and Reauthorization Act of 1986; and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and the Hazardous and Solid Waste Amendments of 1984. The remedial actions are based on the administrative record for this response action. The remaining units in Quadrant II will be addressed separately in future Preferred Plan(s) and Decision Document(s).

The PORTS X-701B SWMU is being cleaned up under (1) a Consent Decree between U.S. DOE and the State of Ohio (1989), (2) a 1997 Administrative Consent Order in which Ohio EPA maintains the oversight of the day to day activities while U.S. EPA maintains its authority under CERCLA and RCRA and (3) a 1999 Administrative Integration Order on Consent between Ohio EPA and U.S. DOE pertaining to certain SWMUs on the Reservation. Documentation for the selection of these remedial actions are available in the administrative record for the quadrant, which is maintained at both the U.S. DOE Environmental Information Center in Piketon, Ohio, iiand at the Ohio EPA Southeast District Office in Logan, Ohio. The specific documents include, but are not limited to, the Quadrant II final RCRA facility investigation (RFI) report dated 1996, the Baseline Ecological Risk Assessment, the Air RFI report, the Background Sampling Investigation Report for Soil and Groundwater, the Ohio EPA X-701B Preferred Plan, the Polycyclic Aromatic Hydrocarbon (PAH) Position Paper, the Polychlorinated Biphenyl (PCB) Position Paper, the Quadrant II CAS/CMS Report and other documents including but not limited to the Annual Groundwater Report.

SITE ASSESSMENT

Actual or threatened releases of hazardous substances from the X-701B SWMU, if not addressed by implementing the response actions proposed in this Decision Document, may pose current or future risks to public health and welfare and the environment.

DESCRIPTION OF THE SELECTED REMEDIES

Ohio EPA's selected alternative for the soils at the X-701B Holding Pond and Retention Basins is a modified version of Alternative 3. Alternative 3 consists of Institutional Controls, selective removal of soil, and containment (capping). Institutional controls include the use of deed and land use restrictions. The cap shall be engineered to meet the RCRA Subtitle C substantive requirements. U.S. DOE will consolidate contaminated soil under two caps. Ohio EPA has determined that re-consolidation of soils is preferable in this instance rather than removal. One cap will cover the X-701B Holding Pond and the Eastern Retention Basin. The second cap will cover the Western Retention Basin. Contaminated soils in this area beyond the foot print of the caps would be consolidated to fit under one or both caps.

Alternative 3 as modified by Ohio EPA will provide the best balance of trade-offs considering the criteria used to evaluate the alternatives presented in the CAS/CMS report. This alternative will be protective of human health and the environment in the short and long terms and is considered permanent as long as the integrity of the cap is maintained. U.S. DOE will periodically inspect the cap to ensure that it is performing as required. This alternative also will meet State, Federal and Local Laws and Regulations, be cost-effective, and provide long-term effectiveness. Specifics regarding the implementation of the remedy will be completed during the Corrective Measures Implementation Plan (CMI) and the design of the cap. Total cost of this proposed alternative as modified is $3,000,000.

Ohio EPA's selected alternative for the X-701B Groundwater Area is a modification of Alternative 8. Alternative 8 was submitted as an addendum to the CAS/CMS report in January 2003. Alternative 8 consists of oxidant injection, and groundwater recirculation in the western portion of the plume in the source area. The primary goal for injecting in this area is to eliminate the source of TCE. Oxidant would be injected in those areas to accomplish this task. Current pumping wells will be incorportated into the designs as needed.

U.S. DOE will also use the eastern horizontal well to inject oxidant into the plume. The purpose of injecting in this horizontal well is to remediate the portion of the plume which extends eastward from this well (near the security fence) to the interceptor trench. The interceptor trench would be operated and maintained until Preliminary Remedial Goals (PRGs) are met throughout the plume. The total cost of this remedy as selected is 43,952,000.

STATUTORY DETERMINATIONS AND REMEDY SELECTION STANDARDS

The selected remedies meet the CERCLA statutory determination because they are protective of human health and the environment, comply with federal and State of Ohio requirements that are legally applicable or relevant and appropriate to the remedial actions, and are cost effective. The selected remedies use permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. The remedy selected for the groundwater contamination at X-701B satisfies the statutory preference in CERCLA and SARA for treatment as a principal element. However the remedy selected for the soil contamination does not.

The selected remedies comply with RCRA remedial selection standards because they protect human health and the environment; control the source of releases so as to reduce or eliminate, to the extent practicable, further releases that may pose a threat to human health and the environment; and comply with applicable standards for management of wastes.

PART 2: DECISION SUMMARY

1.0 INTRODUCTION

The Ohio Environmental Protection Agency (Ohio EPA) has selected remedial alternatives to address the soil and groundwater contamination at the X-701B SWMU of the Portsmouth Gaseous Diffusion Plant (PORTS) on the U.S. Department of Energy (U.S. DOE) Reservation in Piketon, Ohio. This decision document discusses the preferred alternatives and summarizes the unit and site background and findings presented in the Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) reports, and the corrective action study and corrective measures study (CAS/CMS). The RFI and CAS/CMS reports and associated addendums present a full description of quadrant investigations and the alternatives evaluated.

This decision document consists of seven sections besides this introduction. These sections are listed below.

- Section 2.0 Opportunities for Public Involvement
- Section 3.0 Site and Quadrant Background
- Section 4.0 Risk Assessment Summary
- Section 5.0 Solid Waste Management Unit (SWMU) Descriptions and Development of Alternatives
- Section 6.0 Summary of Comparative Analysis of Alternatives
- Section 7.0 Ohio EPA's Preferred Alternatives for Quadrant II
- Section 8.0 US EPA Concurrence with Ohio EPA's Preferred Remedy

Appendix I shall provide the Applicable or Relevant and Appropriate Requirements (ARARs) for X-701B.

2.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

Ohio EPA relies on the public to ensure that the remedial alternative selected for a site meets the needs of the local community in addition to being an effective solution to the environmental problem. Ohio EPA formally presented the Preferred Plan for the X-701B SWMU soil and groundwater contamination at a public availability session and hearing held on October 7, 2003, at the Ohio State South Center in Piketon, Ohio. Ohio EPA discussed the RFI, CAS/CMS, and

Preferred Plan. In addition, Ohio EPA answered questions and received comments relevant to the preferred remedy. Ohio EPA provided public notice about the availability of the Preferred Plan and other documents related to the X-701B SWMU in order to give the public an opportunity for reviewing the Preferred Plan. Comments were solicited on all alternatives summarized in the Preferred Plan and evaluated in the CAS/CMS report. Responses to significant comments, criticisms, or new data received during the comment period and public meeting are included in the "Responsiveness Summary" which is attached to this document at Appendix IV. Public notice is necessary under the National Oil and Hazardous Substance Pollution Contingency Plan (NCP), Title 40 of the Code of Federal Regulations (CFR), Part 300; Ohio Administrative Code (OAC) Section 3745-47-12; and RCRA Regulations 124.10 and 124.24.

This decision document presents the selected remedial actions for the X-701B SWMU groundwater and soil contamination at the US DOE Portsmouth facility. These actions were chosen in accordance with RCRA, CERCLA, and SARA, and to the extent practicable, the NCP, the HWSA of 1984, and the applicable and appropriate State regulations. The decisions made in this document are based on the administrative record for this response action.

All documents regarding the X-701B SWMU are available at the following locations:

U. S. Department of Energy
Environmental Information Center
3930 U.S. Route 23
P. O. Box 693
Piketon, Ohio 45661
Telephone No: (740) 289-3317

and

Ohio Environmental Protection Agency
Southeast District Office
2195 Front Street
Logan, Ohio 43138
Telephone No: (740) 385-8501
E-mail: maria.galanti@epa.state.oh.us

The selected alternatives outlined in this document are Ohio EPA's choices for addressing the X-701B soil and groundwater contamination problems.

Technical information about the site and administrative record documents can be obtained from the following individuals:

Maria Galanti
Project Coordinator
Ohio Environmental Protection Agency
Southeast District Office
2195 Front Street
Logan, Ohio 43138
Telephone No: (740) 385-8501
E-mail: maria.galanti@epa.state.oh.us

or

Gene Jablonowski
Project Manager
U.S. Environmental Protection Agency (SR-6J)
77 W. Jackson Blvd.
Chicago, Illinois 60604-3590
Telephone No: (312) 886-4591
E-mail: jablonowski.eugene@epamail.epa.gov

3.0 SITE AND QUADRANT BACKGROUND

PORTS is located near Piketon, Ohio, in the south-central portion of the state (see Figure 1). The PORTS enrichment facility encompasses approximately 1,000 of the 3,714-acre U.S. DOE Reservation. The principal process at PORTS is the separation of uranium isotopes through gaseous diffusion. PORTS began operations in 1954, enriching uranium for use in commercial reactors and U.S. Navy power reactors. Production of enriched uranium for U.S. Navy use ceased in 1991. PORTS and all its production facilities are owned by U.S. DOE and have been leased by the U.S. Enrichment Corporation (USEC) since 1993. The enrichment operation became private in July 1998. USEC ceased all enrichment operations in May 2001 and the facility was placed in cold stand by status by U.S. DOE. Other portions of PORTS are leased to the Ohio Army National Guard and the Southern Ohio Diversification Initiative (SODI). U.S. DOE remains the property owner.

Support operations for the production of enriched uranium included the feed and withdrawal of material from the primary process, decontamination of equipment removed from the primary process, water treatment for sanitary and cooling purposes, decontamination of equipment removed from the plant for maintenance or replacement, recovery of uranium from various waste materials, and treatment of sewage wastes and cooling water blowdown. The construction, operation, and maintenance of PORTS required the use of a wide range of commercially available chemicals. Continuous operation of PORTS since 1954 has resulted in the generation of inorganic, organic, and low-level radioactive wastes.

For purposes of the RFI, PORTS was divided into quadrants (see Figure 2). Each quadrant roughly corresponds to a distinct groundwater flow cell within the primary water-bearing unit beneath PORTS and has been investigated separately. The X-701B SWMU which is located in Quadrant II is located in the western portion of the quadrant just north of the X-744G Facility (see Figure 3). The Quadrant II RFI was conducted in two phases. Phase I of the investigation was conducted from February to August 1990. Phase II was conducted from October to December 1993. All media except air were investigated during the RFI. The final version of the RFI report was submitted on September 30, 1996. The Quadrant II RFI report received final approval from Ohio EPA on September 5, 1997. U.S. DOE submitted a closure plan to the Ohio EPA Division of Hazardous Waste Management for the X-701B SWMU on November 8, 1994, which was approved by Ohio EPA on March 21, 1995. The closure plan was withdrawn in accordance with the requirement of the 1999 Integration Administrative Order on Consent. The Quadrant II CAS/CMS report which discusses the X-701B SWMU was first submitted in August 2000. The CAS/CMS Report was approved by Ohio EPA on March 26, 2001. Several addendums to the CAS/CMS report regarding the alternatives for the soils and groundwater contamination at the X-701B SWMU were prepared by U.S. DOE and submitted to Ohio EPA in February 2001, June 2002, December 2002, January 2003, and March 2003.

The X-701B SWMU characteristics as well as the geology and hydrogeology at PORTS are discussed below.

3.1 DESCRIPTION OF THE X-701B SWMU CHARACTERISTICS

The X-701B Holding Pond and Retention Basins were not investigated as part of the RFI because they were undergoing RCRA closure. However, this unit is now being addressed in the CAS/CMS report via the requirements of the 1999 Integration Administrative Order on Consent as well as the 1989 Ohio consent Decree. The groundwater contaminant plume from X-701B SWMU is being addressed as part of the CAS/CMS process. The 1999 Integration Administrative Order on Consent between Ohio EPA and U.S. DOE provided certain administrative exemptions to closure requirements in order to unify all PORTS remedial requirements in a timely and efficient manner.

3.2 GEOLOGY AND HYDROGEOLOGY

The geology (or site soil and bedrock) at PORTS has been characterized through the drilling of over 1,200 borings throughout the facility. The uppermost geologic layer (called the "unconsolidated material") consists of Minford Formation silt and clay and Gallia Formation sand and gravel. Where undisturbed, the Minford Formation consists of an upper clay layer that grades into a silt layer. Generally, the upper clay layer comprises two-thirds of the Minford Formation and consists of strong stiff clay. The silt portion of the Minford Formation is more permeable but still contains a relatively high percentage of finer clay material. The Gallia Formation is composed of poorly sorted sand and gravel with silt and clay. Below the Gallia Formation sand and gravel is the Sunbury Shale and then the Berea Sandstone. The Sunbury Shale generally thins from east to west across PORTS and is generally absent on PORTS's western side (see Figure 4). A more detailed description of the PORTS geology is provided in Section 2.0 of the Quadrant II RFI report and Section 1.3.3.3 of the Quadrant II CAS/CMS Report.

The groundwater flow system at PORTS includes two aquifers: the bedrock Berea Sandstone and the unconsolidated Gallia Formation. PORTS also has two aquitards: the Sunbury Shale and the unconsolidated Minford Formation. The basal silt portion of the Minford Formation is generally grouped with the Gallia Formation as the uppermost primary aquifer at PORTS. The hydraulic properties of these units were well defined during the RFI. Groundwater flow maps for the Gallia Formation and Berea Sandstone are provided in Appendix A of the Quadrant II RFI report.

4.0 RISK ASSESSMENT SUMMARY

The assessment of potential or current risks from wastes present at the X-701B SWMU in Quadrant II is based on guidance provided by the U.S. Environmental Protection Agency (U.S. EPA), in particular, the "Risk Assessment Guidance for Superfund" (RAGS) dated 1989 and "Guidelines for Exposure Assessment" dated 1992. These guidance documents are founded on well-established chemical risk assessment principles developed for the regulation of environmental contaminants.

The risk assessment for contaminated areas at Quadrant II consisted of a human health risk assessment and an ecological risk assessment. The ecological risk assessment was conducted separately. The initial risk assessment conducted for Quadrant II assumed that no future cleanup action would be taken and is referred to as the "baseline risk assessment" (BRA). The X-701B SWMU risks are discussed in the CAS/CMS Report. A description of the risk associated with X-701B was excluded from the approved RFI for Quadrant II since it was undergoing a RCRA closure. The methodology used to conduct each step of the risk assessment, starting from the BRA, is discussed below.

4.1 BASELINE RISK ASSESSMENT

The BRA consisted of identifying chemicals of potential concern (COPC), exposure assessment, estimation of environmental concentrations, and estimation of human intake. Each of these activities is discussed below.

4.1.1 Identification of Chemicals of Potential Concern

After data collected during the RFI were evaluated, chemicals detected during laboratory analysis were retained as COPCs. Data not appropriate for certain exposure pathways were excluded. For example, soil data for samples collected from greater than 10 feet below ground surface (bgs) are not expected to apply to the threat of possible ingestion of contaminated soil by children or adults but are expected to pose a threat to groundwater.

4.1.2 Exposure Assessment

This activity involves the evaluation of potential human exposure to site chemicals through two basic tasks: characterization of the exposure setting and identification of human exposure pathways.

4.1.2.1 Characterization of the Exposure Setting

The exposure setting was characterized by modeling or simulating exposure scenarios considered possible at Quadrant II under both current and future land-use scenarios.

Current Use Scenarios

- On-site worker
- Off-site resident
- Off-site recreational population
- On-site resident*

* This scenario was no longer considered viable after the completion of the RFI report. Stakeholders and regulators determined it is likely that the area within the security fence will remain industrial and that other areas within the reservation will be used for commercial or recreational purposes. Areas at the reservation boundary will still be evaluated as residential.

The on-site worker scenario describes potential exposures to outdoor media at PORTS of a worker engaged in normal day-to-day activities throughout Quadrant II. The future worker scenario describes potential exposures to outdoor media at PORTS and includes the ingestion of groundwater. The recreational population scenario assesses potential exposure to surface water bodies on the PORTS reservation and to fish and game eaten by local recreational anglers and hunters. To estimate exposure for both current off-site resident and recreational populations, significant direct access to media <u>within</u> the boundaries of the unit were considered unlikely. Exposures were assumed to result from contaminants that could potentially migrate off site.

Future Use Scenarios

- On-site commercial use (evaluated after approval of the RFI and BRA)
- On-site recreational population
- On-site industrial worker
- Off-site resident
- Off-site recreational population

Future use scenarios were developed consistent with reasonable maximum exposure. The area within the security fence at the Portsmouth Facility is expected to remain industrial in the future. Areas outside the security fence within the reservation were evaluated under a future recreational and commercial use scenario.

In addition to the on-site worker involved in normal day-to-day activities, another exposure scenario modeled under both current and future use conditions involves the on-site industrial worker. This worker is assumed to be in contact with contaminated media during periodic intrusive activities such as construction or landscaping. The future industrial worker scenario describes potential exposures to outdoor media at PORTS and includes ingestion of groundwater.

4.1.2.2 Identification of Human Exposure Pathways

The exposure scenarios discussed above were developed to model or simulate possible exposure situations at the site including Quadrant II and areas associated with the X-701B SWMU. It was necessary to determine the most likely exposure pathways as well. An example of an exposure pathway is the ingestion of contaminated groundwater by future on-site industrial workers. The following exposure pathways were evaluated for both the current and future on-site industrial worker as well as for the off-site recreational population:

- Exposure to groundwater through ingestion of drinking water and dermal contact and inhalation of volatiles during showering (for future on-site industrial worker only)

- Exposure to soil through incidental ingestion and dermal contact and through external gamma radiation from radionuclides present in soil
- Exposure to sediment through incidental ingestion and dermal contact
- Exposure to surface water through incidental ingestion and dermal contact
- Exposure to air through inhalation of vapors and particulates
- Exposure through ingestion of local game contaminated by grazing on land affected by site operations
- Exposure through ingestion of fish affected by site operations

4.1.3 Estimation of Environmental Concentrations

Concentrations of chemicals and radionuclides in various environmental media from which exposure may occur were estimated through the evaluation of sampling results and mathematical modeling. The Quadrant II RFI as well as the other relevant reports provides detailed discussion of this estimation.

4.1.4 Estimation of Human Intake

Estimation of human intake involves calculating the amount of each chemical and radionuclide an individual is exposed to through the various environmental media. Chemical intakes (referred to as chronic daily intakes [CDI]) are typically expressed in terms of the amount of material in contact with the body for a certain time period and are calculated as functions of (1) chemical concentration in soil or water, (2) how often the exposure occurs and for how long (exposure frequency), (3) body weight, and (4) the portion of a lifetime that exposure occurs. The generic equation for calculating a CDI (along with example units of measure) is as follows:

$$CDI = \frac{C x CR x EF x ED}{BW x AT}$$

where

CDI	=	Chronic daily intake (milligram per kilogram per day [mg/kg/day])
C	=	Chemical concentration in soil or water (mg/kg)
CR	=	Contact rate (kg/day)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (portion of lifetime over which exposure is averaged; days)

Variations of this equation are used to calculate air inhalation and radiological exposures.

4.2 TOXICOLOGICAL ASSESSMENT

The toxicological assessment involves identifying adverse health effects associated with exposure to a chemical or radionuclide and the relationship between the extent of exposure and the likelihood and severity of adverse effects. U.S. EPA has conducted such assessments of many frequently occurring environmental chemicals and radionuclides and has developed toxicity values based on these assessments for use in risk assessments. Further information regarding the toxicological assessment is presented in the Quadrant II RFI and associated report.

4.3 DETERMINATION OF CLEANUP OBJECTIVES

Cleanup goals for remediation at Quadrant II were determined through the evaluation of the following factors:

- Risk characterization
- Preliminary remediation goals (PRG)
- Use of as low as reasonably achievable (ALARA) and best available technology (BAT) principles
- Groundwater conditions

- Summary of polycyclic aromatic hydrocarbon (PAH) position paper
- Summary of polychlorinated biphenyl (PCB) position paper

Each of these factors is discussed below.

4.3.1 Risk Characterization

Risk characterization involves calculating estimates of carcinogenic (cancer causing) and non-carcinogenic risks from chemicals of concern for different exposure pathways. CERCLA requires keeping cumulative residual excess cancer risks (ECR) within the one in 1×10^{-4} to 1×10^{-6} range for all chemical carcinogenic contaminants (with 1×10^{-6} as the "point of departure") and hazard indexes (HI) of 1 or less for noncarcinogenic contaminants. Cancer risk is defined as the probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen in addition to the probability of cancer risks from all other causes. As a benchmark in developing cleanup goals at contaminated sites, an acceptable range of ECR has been established of one in one million (1×10^{-6}) to one in ten thousand (1×10^{-4}). The point of departure or program goal for risk remaining after a site is cleaned up is 1×10^{-6} (that is, a one in one million excess lifetime cancer risk above and beyond risks from other unrelated causes).

The hazard quotient (HQ) is used to determine the severity of noncarcinogenic hazards posed by a site. The HQ is determined by dividing the CDI by the reference dose (RfD). The reference dose is the amount of a chemical determined to cause a toxic effect. If the HQ is less than or equal to 1, the estimated exposure to a substance represented by the CDI is judged to be below the threshold that could result in a toxic effect. An HQ greater than 1 indicates that a toxic effect may result. To assess the cumulative effect of similar noncarcinogenic substances, the HQs for all substances being assessed at a site are added, and this result is the HI.

4.3.2 Preliminary Remediation Goals

The risks for substances at the X-701B SWMU in Quadrant II were compared to target risk levels (PRGs), and general conclusions were made regarding potential risks associated with these substances. In general, if the risks were unacceptable, remedial alternatives were developed to reduce potential exposure of human and ecological receptors to acceptable levels. This unit was undergoing closure under the requirements of RCRA. A risk assessment was not completed and therefore is not presented in this document. Based on the levels of contamination in soils and groundwater it was determined that the ELCR of 10^{-6} and an HI of 1 have been exceeded.

U.S. DOE will adhere to RCRA and CERCLA guidance and has also agreed that the initial goal for each alternative in the CAS/CMS report is to achieve PRGs when practicable. ALARA and BAT principles will also be considered during remediation.

4.3.3 Groundwater Conditions

Groundwater and surface water monitoring at PORTS began in the 1980s. Since that time, numerous investigative studies and routine monitoring programs have provided much geologic and hydrogeologic information. Groundwater monitoring has been conducted in response to regulatory requirements of the OAC, closure documents, the Consent Decree between U.S. DOE and Ohio EPA, and U.S. DOE orders.

The Integrated Groundwater Monitoring Plan (IGWMP) is designed to minimize the potential for conflicts in requirements and to maximize resources for collecting data needed for sound decision-making. Keeping the intent of the regulatory directives and objectives of various monitoring programs in mind, the IGWMP is designed to establish all groundwater monitoring requirements for PORTS. The requirements established for continued groundwater monitoring for the selected remedial alternatives at the X-701B SWMU will be incorporated into the IGWMP and will be revised as determined necessary by Ohio EPA.

4.3.4 Summary of the PAH Position Paper

PAHs, a common contaminant at PORTS, are introduced into the environment by both natural and anthropogenic combustion processes. PAHs are semivolatile organic compounds (SVOC) that consist of two or more fused aromatic rings and include chemicals such as anthracene, benzo(a)pyrene, fluoranthene, and naphthalene. PAHs are formed when hydrocarbons undergo incomplete combustion, such as when hydrogen is consumed in preference to carbon.

The purpose of the PAH position paper was to evaluate and demonstrate that the PAH contamination at PORTS was similar in concentration to areas outside of PORTS and therefore not related to site processes but rather resulting from the infrastructure of the Reservation (such as asphalt roofs, roadways, and automobile exhaust). The PAH position paper was approved by Ohio EPA on May 8, 1997. Risk goals were developed based on the most current PAH information available. The concentrations of PAH contamination were evaluated in unregulated areas (such as along roadways and community parks) as well as residential areas.

The report concluded that many of the elevated detections of PAHs appeared to result from sources such as tar-covered gravel lots, asphalt roads and parking lots, vehicle exhaust and possibly air emissions, and runoff from the coal-fired steam plant. The paper also concluded that areas containing PAHs at concentrations similar to PAH concentrations in nonregulated or residential areas should not be remediated at this time. Such an effort would not be cost-effective because these areas would likely become recontaminated. Areas such as drainage ditches, streams, and creeks will be deferred to D&D. The risk from PAHs will be evaluated at that time, and the proper remedial action will be taken.

4.3.5 Summary of the PCB Position Paper

The purpose of the PCB position paper, which was approved on September 11, 1997, was to evaluate the levels and extent of PCB contamination at Quadrant II and develop a risk goal protective of human health and the environment. At PORTS, PCBs have been used as cooling fluids in electrical transformers and capacitors; for heat transfer and hydraulic fluids; as dye carriers in carbonless copy paper; in paints, adhesives, and caulking compounds; and as sealants and road coverings to control dust. RFI and baseline ecological risk assessment sampling activities indicated that at least one PCB compound was detected at 98 of the 1,007 locations where soil was sampled at Quadrant I. PCB detections in soil appear to be distributed widely across PORTS. Of the 148 sediment samples analyzed for PCBs during the RFI and the baseline ecological risk assessment, 28 contained at least one PCB compound.

The PCB remedial goal for PORTS was based on the most probable future land use, which has been determined as industrial for Quadrant II within the perimeter road. In order to be consistent with risk goals, the cleanup goal for Quadrant II within the perimeter road is 25 parts per million (ppm). The 25-ppm goal for Quadrant II and the X-701B SWMU is consistent for an industrial site as cited in the Toxic Substances Control Act (TSCA) and CERCLA guidance as well as in the Federal Register, Proposed Rule, December 1996. Soil at the Peter Kiewit Landfill at Quadrant I is the only location where PCB concentrations exceed 25 ppm. This soil has been addressed as part of the remedial activity at the landfill.

5.0 X-701B SWMU DESCRIPTION

The X-701B SWMU is described in detail in the CAS/CMS report for Quadrant II and other associated documents including but not limited to the Description of Current Conditions for Quadrant II issued by U.S. DOE on December 7, 1990.

5.1 X-710B SWMU - DEVELOPMENT OF REMEDIAL ALTERNATIVES

The X-701B Holding Pond, Retention Basins and the X-701B Area Groundwater Plume are described in the chapters below. Based on the information provided in varying supporting documents, U.S. DOE was able to provide a wide array of alternatives for soil and groundwater for Ohio EPA to review.

5.2 X-701B HOLDING POND AND RETENTION BASINS - DETAILED DESCRIPTION

The X-701B Holding Pond was an unlined, 200 ft by 50 ft pond used for the neutralization and settling of metal-bearing wastewater, solvent-contaminated solutions and acidic wastewater. The X-701B Holding Pond was in use from 1954 until November 1988 and was regulated under RCRA and as NPDES outfall 001A between August 1983 and September 1991. Most of the waste discharged to the pond originated at the X-700 Chemical Cleaning Facility and the X-705 Decontamination Building. From 1974 until 1988, slaked lime was added to the X-701B influent at the X-701E Neutralization Facility to neutralize the low pH and induce precipitation. This precipitation caused large amounts of sludge to accumulate in the pond and necessitated periodic dredging of the sludge. The sludge recovered during dredging was stored in two retention basins located to the northwest of X-701B.

The X-701B East and West Retention Basins were unlined sludge retention basins used for the settling, dewatering and storage of sludge removed from the X-701B Holding Pond. The East Retention Basin built in 1973, was approximately 220 ft by 65 ft (narrowing to 25 ft wide in the northeast corner) and was 3.5 ft deep. The east basin was in use from 1973 until approximately 1980. The West Retention Basin was built in 1980, when the east basin reached capacity. The west basin was approximately 220 ft by 45 ft (narrowing to 35 ft wide in the northern portion) and was 3 ft deep. The west basin was in use from 1980 until 1988 (see Figure 5).

In 1989, PORTS initiated a two-phase closure of the unit. As part of the first phase, sludge was excavated from the holding pond and two retention basins. The sludge was dewatered, placed in containers and transported to on-site storage. The retention basins were backfilled, graded, and seeded. The second phase began in 1994, and included construction of a groundwater pump-and-treat system and in situ treatment of soils in the bottom of the holding pond with thermally enhanced vapor extraction (TEVE). Limestone riprap and gravel were placed on the bottom of the holding pond to support the soil treatment equipment. Several attempts were made to apply the TEVE technology which failed due to the geological conditions at the unit. However, the limestone riprap and gravel material currently remains in the holding pond, and a gravel access road remains on the southeast side of the holding pond. Two pumps in a sump located in the low point of the holding pond, which have the ability to dewater the pond, remain operational. The water removed by these two pumps is transferred, via underground piping, directly into the X-623 Groundwater Treatment Facility.

During 1997 and 1998, an investigation in the X-701B Retention Basin area revealed that the saturated fill material in the retention basins was contaminated with uranium and technetium at concentrations that exceeded PRGs. In addition, detectable concentrations of transuranics were discovered. An evaluation of surface and subsurface radionuclide data in this area indicates there is no correlation between the sporadic detections of surface contamination and contamination found in the saturated fill material. Therefore, the higher radionuclide concentrations found in the fill material are believed to be the result of incomplete removal of sludge during initial closure actions at the retention basins. Existing data does not indicate that radioactive contaminants are migrating from the retention basins to either surface water or groundwater at concentrations exceeding PRGs. However, U.S. DOE continues to sample this area and data is continuously evaluated. Only groundwater samples were collected in this area during the RFI. Therefore, no assessments were performed to evaluate the risk of exposure to contaminants in soils. The X-701B Holding Pond and Retention Basins were integrated into the CAS/CMS process in the Director's Final Findings and Orders for Integration (DFF&Os) journalized on March 24, 1999.

5.3 X-701B HOLDING POND AND RETENTION BASINS

REMEDIAL ACTION OBJECTIVES

The X-701B SWMU RAOs for soil are as follows:

- Prevent exposure of on-site personnel to COCs in soil at concentrations exceeding PRGs,
- Prevent exposure of ecological receptors to COCs exceeding PRGs; and
- Prevent migration of vadose zone contaminants from soil into groundwater.

The COPCs for the X-701B SWMU soil include any chemical detected in soil at concentrations exceeding analytical detection limits. In the Quadrant II RFI, COPCs were used to model risk. The COPCs exceeding the screening criteria described in the CAS/CMS were retained as COCs. Table 6.1in the CMS Report and Table 1 of this document presents the soil COCs and respective PRGs. TCE, technetium and uranium have been selected as the primary COCs for remediation because they have been detected in soils throughout the area, both horizontally and vertically.

Table 1 Soil COCs,
X-701B Holding Pond and Retention Basins

Contaminant of Concern	Selected soil PRG (mg/kg)
Americium-241	7.9 pCi/g
Arsenic	10
Beryllium	1.4
Nickel	34
Plutonium-239/240	9.9 pCi/g
Technetium	11,400 pCi/kg
Uranium	7.4
2-Butanone (MEK)	1.8
Benzene	0.015
Cis-1,2-Dichloroethene	0.12
Tetrachloroethene	0.27
Toluene	7.7
Trichloroethene (TCE)	0.048
Vinyl Chloride	0.012

mg/kg = milligram per kilogram

pCi/kg = picocuries per kilogram

pCi/g= picocuries per gram

5.4 AREA OF CONCERN, TYPES OF CONTAMINATION, AND VOLUME ESTIMATES

Area of Contamination

Soil samples were collected from several soil borings near this unit during both Phase I and Phase II investigations for the RFI.

Volume Estimates

For cost-estimating purposes, the volume of soil with contaminants at concentrations exceeding PRGs was estimated for the area associated with the X-701B Holding Pond and Retention Basins. In Alternative 2, the horizontal extent of contamination was assumed to be 2 ft beyond the edges of the retention basins and radiating 10 ft from each of the data points in the holding pond. The vertical extent of contaminants was assumed to be at the bottom of the retention basins and at the lowest depth of the data points in the holding pond. The estimated volume of contaminated soil for removal in Alternative 2 is 3,240 yd^3. In Alternative 3, excavation of the two northernmost points of contamination is required. The estimated volume of contaminated soil for removal in Alternative 3 is 16 yd^3, the volume of soil estimated for the soil removal activities in Alternative 5 is 31,000 yd^3. It is assumed that the majority of the contaminated soils from the holding pond and retention basin will be removed in Alternative 5. All excavated soil from this SWMU is assumed to be mixed waste.

5.5 DEVELOPMENT AND DETAILED ANALYSIS OF ALTERNATIVES

A series of Decision Team meetings involving U.S. DOE, U.S. EPA, and Ohio EPA have resulted in a site remediation strategy emphasizing soil and groundwater remediation for the X-701B SWMU as the focus for corrective measures under the Ohio Consent Decree, the 1997 3 party Order and the 1999 Integration Administrative Order on Consent. This strategy acknowledges the RCRA corrective actions that have occurred since 1989 at PORTS (through the RCRA closure process).

A range of potentially viable remedial alternatives has been assembled for the X-701B Holding Pond and Retention Basins by using the representative process options presented and selected in this section. All alternatives were selected for their abilities to meet RAOs, address all environmental problems, reduce overall risk, and protect human health and the environment. An alternative has been assembled for each of the following categories: institutional controls, removal, and capping. The remedial alternatives for soils at the X-701B Holding Pond and Retention Basins are as follows:

Alternative 1 - Institutional Controls (Soils)

Deed restrictions to limit land development and access controls to prevent exposure to contaminated soils are included in this alternative.

Alternative 2 - Institutional Controls and Removal (Soils)

Future land use at the area associated with the X-701B Holding Pond and Retention Basins will be limited to commercial/industrial activities through deed restrictions that would prevent development of the excavated area. Contaminated soil will be removed to the base of the retention basins and to depths where contaminants exceed their PRG. The horizontal extent of contamination will be addressed by excavating 2 ft beyond the edges of the retention basins and 10 ft from data points in the holding pond where contaminants exceed PRGs. Excavated soil will be evaluated to determine the proper disposal method, but is assumed to be a mixed waste for the purposes of the CMS Report and this document.

Alternative 3 - Institutional Controls, Select Removal and Capping (Soils)

Select solids excavation and backfilling in conjunction with capping is included in this alternative. For purposes of this document and the CAS/CMS, the cap will be engineered to meet RCRA Subtitles C and D and Ohio Hazardous Waste and Solid Waste requirements. For cost estimating purposes, a cap meeting Ohio Solid Waste construction specifications has been used; however, the final cap specifications will be determined as part of the CMI. There will be selected excavation of soil in outlying areas where there have been sporadic detections of contaminants. Institutional controls include deed and access restrictions. The existing storm sewer will not be re-routed around the capped area as noted in Alternative 6 below.

Alternative 4 - Institutional Controls (Soils)

This alternative includes deed restrictions to limit land development and access controls to prevent exposure to contaminated soils. Alternative #4 is very similar to Alternative #1.

Alternative 5 - Institutional Controls and Removal (Soils)

The pond and retention basins will be excavated to a maximum depth of 15 ft from the existing grade to remove contaminants exceeding preliminary remedial goals (PRGs). The horizontal limits of excavation will extend 2 ft beyond the edges of the retention basins to 10 ft beyond data points, including outlying sample locations, where contaminants exceed PRGs in soil. The excavated area will be partially backfilled, as needed, and graded to drain into the existing drainage ditch north of the holding pond. The soil excavated will be containerized and shipped off-site for disposal as low-level radioactive waste (LLW). Soil from beneath the X-701B Holding Pond will be segregated and shipped off-site as mixed (hazardous and LLW) waste. An existing storm sewer will be modified to drain through the excavation area and drainage ditch. The existing monitoring, injection, and extraction wells and X-701E Neutralization Building will be relocated. Institutional controls include deed and access restrictions.

Alternative 6 - Institutional Controls, Select Removing and Capping (Soils)

An engineered cap meeting RCRA Subtitles C and D and Ohio Hazardous Waste and Solid Waste requirements will be placed over the pond and basins. The cap will extend 25 ft beyond the limits of the pond and basins. Outside of the capped area, soils that have contamination exceeding PRGs will be excavated (maximum excavation depth of 15 ft) and placed under the cap. The existing storm sewer will be re-routed to the north of the capped area. The existing monitoring, injection, and extraction, and extraction wells and X-701E Neutralization Building will be relocated. Institutional controls include deed and access restrictions.

Alternative 7 - Institutional Controls and On-site Disposal (Soils)

Excavate the holding and retention basins to a maximum depth of 15 ft and horizontal limits of excavation extending 2 ft beyond the holding pond and retention basin. In addition, excavate surrounding areas that have been identified as exceeding the established PRGs to a maximum depth of 15 ft. The excavation resulting from the removal of the holding pond and the East Retention Basin will be converted to an engineered disposal cell, with a leachate collection system, a liner system, and engineered cap. The disposal cell will have the capacity to accept all excavated materials for the X-701B Holding Pond and Retention Basins area. The existing monitoring, injection, and extraction wells and X-701E Neutralization Building will be relocated. Institutional controls include deed and access restrictions.

Alternative 8- Institutional controls, Select removal, and Capping with Piping System Relocation (Soils)

This Alternative is essentially the same as Alternative 6 except for the additional piping to be installed for future groundwater remedial purposes - An engineered cap meeting RCRA Subtitles C and D and Ohio Hazardous Waste and Solid Waste requirements will be placed over the pond and basins. The cap will extend 25 ft beyond the limits of the pond and basins. Outside of the capped area, soils that have contamination exceeding PRGs will be excavated (maximum excavation depth of 15 ft) and placed under the cap. The existing storm sewer will be re-routed to the north of the capped area. The existing monitoring, injection, and extraction, and extraction wells and X-701E Neutralization Building will be relocated. Institutional controls include deed and access restrictions will be instituted. The existing drain pumps located in the holding pond will remain in place and additional piping will be installed for use with the existing piping system in a possible future remediation system, such as oxidant injection.

5.6 Hydrogeology of the X-701B Groundwater Area

The principal groundwater flow system for PORTS is limited to four primary geologic and hydraulic units (Minford, Gallia, Sunbury, and Berea). The uppermost unconsolidated unit is the Minford with an approximate thickness of 25 - 30 ft. The Gallia unit underlies the Minford and is relatively thick (6 - 12 ft) in the X-701B Groundwater Area. The Gallia and Minford comprise the unconsolidated aquifer at PORTS. Gallia groundwater flow in the X-701B Groundwater Area is assumed to be affected by the pumping of basement sumps in the X-705 building. The uppermost bedrock unit is the Sunbury Shale unit. The Berea Sandstone underlies the Sunbury shale and is the uppermost bedrock aquifer at PORTS. The Berea is present at approximately 35 feet below land surface in this area and groundwater flow is generally to the east.

The primary source of water in the hydrogeologic flow system in the X-701B Groundwater Area is natural recharge through precipitation. Leakage from storm sewers and other buried pipelines in the plant complex is not considered a significant source of recharge in the X-701B Groundwater Area. The rate of recharge varies across the site as a result of surface development (i.e., buildings, parking lots, or open fields) and also as a result of the thickness of the surficial

Minford clay. In general, a downward vertical gradient has been observed through each of the four major hydrogeologic units underlying the site. However, because the Sunbury Shale thins along the western portion of Quadrant II, communication between the Gallia and Berea is increased. The vertical gradient between the Gallia and Berea units is greatest where the Sunbury is thick, competent shale.

Natural groundwater flow beneath the X-701B Groundwater Area is directed to the east and northeast. The flow direction is the same for both the Gallia and Berea units. Groundwater flow direction in both the Minford and the Gallia are affected by the presence of drainage ditches and holding ponds, the most predominant areas being the X-230J7 Holding Pond and the East Drainage Ditch. Vertical hydraulic gradients in this area are generally downward except to the west in the vicinity of the X-700/X-705 buildings, where vertical gradients indicate possible upward flow from the Berea to the Gallia. This is due to thinning or absence of the Sunbury Shale in this area. Groundwater recharge to the Gallia and Berea in the X-701B Groundwater Area is reduced because of the many paved areas, buildings, and the presence of thick upper Minford Clay deposits. Pumping of groundwater from sumps located in the X-705 Decontamination Building has influenced water levels over a large portion of this area and modified the direction of groundwater flow (see Figure 6).

The area of contamination in the X-701B Groundwater Area, extends east from the vicinity of the former X-701B Holding Pond to the vicinity of Little Beaver Creek. (See Figure 5and 6). The plume width does not exceed 500 ft. TCE concentrations in the most contaminated portions of this plume exceed 100,000 μg/L.

5.6.1 X-701 B Groundwater Plume

U.S. DOE has developed and array of alternatives for the X-701B Groundwater Area plume in accordance with the requirements of the Ohio Consent Decree. Existing data are sufficient to support the development of groundwater remedial alternatives. During the Quadrant II RFI U.S. DOE sampled a number of groundwater wells in the area of the X-701B Plume. The groundwater plume at the X-744Y Waste Storage Yard will be addressed as part of the X-701B plume.

5.6.2 X-701B GROUNDWATER AREA RAOs

The RAOs for the X-701B Groundwater Area are as follows:

- Achieve PRGs for groundwater when practicable.
- Prevent migration of COCs at concentrations exceeding PRGs from groundwater into surface water.
- Prevent exposure of future off-site residents to COCs in groundwater at concentrations exceeding residential PRGs through potential exposure pathways.
- Prevent exposure of on-site personnel to COCs in groundwater at concentrations exceeding future on-site worker PRGs through potential exposure pathways.

The contaminants of potential concern (COPCs) for groundwater in the X-701B Groundwater Area include any chemical detected in groundwater during the RFI and subsequent sampling at concentrations exceeding analytical detection limits as noted in the approved CMS. The COPCs exceeding the screening criteria described in Chapter 3 were retained as COCs. Arsenic, barium, beryllium, copper, 2-butanone, bromodichloromethane, toluene, neptunium, radium, and thorium in the Gallia aquifer and all constituents listed as COCs in the Berea aquifer, except 1,1,2-trichloroethane, were each detected above PRGs at one location in a single sample. As such, these contaminants do not appear to present a risk to potential receptors due to their limited vertical and areal extent. TCE has been selected as the primary COC for groundwater in the X-701B Groundwater Area because of its widespread occurrence. Tables 4 and 5 present the COCs and their PRGs for Gallia and Berea groundwater, respectively.

Table 2 Gallia Groundwater COCs
X-701B Groundwater Area

Contaminants of Concern	Gallia Groundwater PRG (µg/L)
Arsenic *	92
Barium *	2000
Beryllium *	6.5
Cadmium	6.5
Chromium	100
Copper *	21
Lead	50
Manganese	14300
Nickel	100
Silver	50
Thallium	10.5
Bis(2-ethylhexyl)phthalate	6
1,1,1-Trichloroethane	200
1,1,2,2-Tetrachloroethane	83
1,1,2-Trichloroethane	5
1,1-Dichloroethene	7
1,2-Dichloroethane	5
1,2-Dichloroethene	900
2-Butanone *	53800
Acetone	10200
Bromodichloromethane *	100

Table 2 Gallia Groundwater COCs
X-701B Groundwater Area (Continued)

Contaminants of Concern	Gallia Groundwater PRG (μg/L)
Carbon Tetrachloride	5
Chloroform	100
Methylene Chloride	5
Tetrachloroethene	5
Toluene *	1000
Trichloroethene	5
Vinyl Chloride	2
Uranium	20
Neptunium *	0.54 pCi/L
Radium *	0.65 pCi/L
Technetium	3790 pCi/L
Thorium *	2.5-4.9 pCi/L

***Indicates a single detection**

Table 3 Berea Groundwater COCs
X-701B Groundwater Area

Contaminants of Concern	Berea Groundwater PRG (μg/L)
2,4-Dinitrotoluene *	0.397
Hexachlorobenzene *	1
Hexachlorobutadiene *	3.7
Pentachlorophenol *	1
1,1,2-Trichloroethane	5
Acrolein *	1.03
Methylene Chloride *	5
Trichloroethene *	5

***Indicates a single detection**

5.7 Remedial Alternative Evaluation

For cost estimating purposes, on-site treatment includes capital costs, permitting for air emissions discharge, and purchase of necessary supplies to perform the treatment.

The remedial alternatives for groundwater at the X-701B Groundwater Area include the following:

Alternative 1 - No Action (Groundwater)

The no action alternative is retained throughout alternative analysis and evaluation to serve as a basis for comparison with other alternatives. Under the no action alternative, no treatment, containment, removal, or monitoring of the environmental media would be performed. Unrestricted access to PORTS in its current condition would be allowed, and no present or future restrictions on access or land use would be implemented.

Alternative 2 - No Further Corrective Action (Groundwater)

Institutional controls for Alternative 2 include deed and access restrictions and groundwater monitoring. Deed restrictions would prevent residential development in the X-701B Groundwater Area. Current pumping conditions would remain. Groundwater monitoring would be initiated to aid in the assessment of contaminated groundwater migration beyond current plume boundaries. The groundwater monitoring program would use existing monitoring wells to monitor contaminant fate and transport.

Alternative 3 - Oxidant Injection/Vacuum Enhanced Recovery/Phytoremediation (Groundwater)

Alternative 3 includes implementation of three remedial technologies in the X-701B Groundwater Area. An oxidant solution would be injected in the western portion of the plume (west of Perimeter Road). VER wells would be used to extract vapor and groundwater in the central portion of the plume (east of Perimeter Road). Poplar trees would be planted in the eastern portion of the plume both east and west of the IRM trench to promote phytoextraction of groundwater. Several groundwater extraction wells would be used to control the direction of groundwater flow. Deed restrictions would prevent residential development and the use of groundwater from the area for any purpose. Groundwater monitoring would be initiated to assess the effectiveness of this alternative. The groundwater monitoring program would use existing monitoring wells to monitor contaminant fate and transport.

Alternative-specific assumptions.

(1) The Oxidant Injection system will include:

- Lance permeation to the Gallia ~ 32 ft below ground surface
- Lance placement will be on a regular grid with 10-ft spacing.
- Grid will cover approximately 90,000 ft^2 in the X-701B Holding Pond area.
- Oxidant is injected at two times, 0 years and 1 year.
- From 2 to 10 years groundwater is extracted.
- Oxidant injection will effectively remove all contaminants over a 90,000 ft^2 area.

(2) The VER system will include:

- Depth of deep extraction wells: 15 wells extending to the bottom of the Gallia (average depth 30 ft below ground surface).
- Screen length of deep extraction wells is 10 ft.
- VER system operation is from 0 to 2 years with estimated groundwater and vapor extraction rates according to rates presented in Appendix E.
- From 2 to 10 years groundwater is extracted (no vapor). From 10 to 30 years no VER system operation (monitoring only).
- VER wells will effectively remove all contamination within a 75-ft radius of the well.

(3) The Groundwater Extraction system will include:
Depth of deep extraction wells: 3 wells to 25 ft below ground surface.
Screen length of deep extraction wells is 10 ft.
System would operate from 10 to 30 years.

(4) The Phytoremediation system will include:
Planting of hybrid poplar trees in year 0.
100 trees would be planted over 2.1 acres (lower than typical tree density due to shallow groundwater table and the limited groundwater available).
Monitoring shall be conducted at 35 existing monitoring wells.

The X-705 sumps and the X-701B IRM trench continue to operate for the entire 30-year simulation.

Alternative 4 - VER and Steam Stripping (Groundwater)

Alternative 4 includes VER, steam stripping, and use of the existing groundwater monitoring wells. Steam stripping includes steam injection and groundwater extraction, which will be used to eliminate groundwater contamination in the X-701B Groundwater Area plume west of the Perimeter Road. Deed restrictions would prevent residential development and the use of groundwater from the area for any purpose. Groundwater monitoring would be initiated to assess the effectiveness of this alternative. The groundwater monitoring program would use existing wells to assess contaminant fate and transport.

Alternative-specific assumptions.

(A) Twenty-four VER wells will be installed.

(B) All VER wells will operate for two years and will effectively remove all contamination within a radius of 75 ft of the well.

(C) Steam stripping will operate for two years and eliminate groundwater contamination in the portion of the X-701B Groundwater Area plume west of Perimeter Road. The mass of injected steam is approximately equal to the mass of extracted groundwater in the area west of Perimeter Road.

(D) Groundwater will be treated at existing facilities.

(E) The X-705 sumps and the X-701B IRM trench continue to operate for the entire 30-year simulation.

Alternative 5 - VER (Groundwater)

Alternative 5 includes institutional controls, use of the existing groundwater monitoring wells and the installation of 39 VER wells. Deed restrictions would prevent residential development and the use of groundwater from the area for potable water supplies. Groundwater monitoring would be continued to assess the effectiveness of this alternative.

Alternative-specific assumptions.

(A) Thirty-nine VER wells will be installed.

(B) All VER wells will operate for two years and will effectively remove all contamination within a radius of influence of 75 ft.

(C) Twenty-five VER wells will operate as conventional extraction wells for an additional 28 years.

(D) The X-705 sumps and the X-701B IRM trench continue to operate for the entire 30-year simulation.

(E) Groundwater will be treated at existing facilities.

Alternative 6 - Groundwater Extraction and Bioremediation (Groundwater)

Alternative 6 includes installation of nine conventional extraction wells and use of enhanced bioremediation. Deed restrictions would prevent residential development and the use of groundwater from the area for any purpose. Groundwater monitoring would be initiated to assess the effectiveness of this alternative. The groundwater monitoring program would use existing monitoring wells to monitor contaminant fate and transport.

Alternative-specific assumptions.

Use of enhanced bioremedial techniques in the eastern area of the X-701B Groundwater Area plume completely eliminates contamination in a 160,000 ft^2 area within 2 years.

(A) The X-705 sumps and the X-701B IRM trench continue to operate for the entire 30-year simulation.

(B) Nine conventional wells operate for the entire 30-year simulation.

(C) Groundwater will be treated at existing facilities.

Alternative 7 - Oxidant Recirculation (Groundwater)

Alternative 7 includes installation of 30 extraction wells and 17 injection wells and utilization of an aboveground oxidant injection system. Contamination reduction would be achieved in the first six months of this simulation. Reduction would be accomplished by extracting groundwater, circulating it through the aboveground oxidant injection system, and reinjecting the treated groundwater into the injection wells where the oxidant would reduce residual soil contamination as well as groundwater contamination. Deed restrictions would prevent residential development and the use of groundwater from the area for any purpose. Groundwater monitoring would be initiated to assess the effectiveness of this alternative. The groundwater monitoring program would use existing monitoring wells to monitor contaminant fate and transport.

Alternative -specific assumptions

(A) Introduction of oxidants throughout the X-701B groundwater area plume eliminates contamination in a 430,000 ft^2 area within 2 years.

(B) The oxidant injection system would operate for six months.

(C) The X-705 sumps and the X-701B IRM trench would continue to operate for the entire 30-year simulation.

All model assumptions used to evaluate the alternatives listed above are in Appendix E of the Quadrant II CAS/CMS.

Alternative 8- Oxidant Injection/Extraction/Recirculation and Phytoremediation (Groundwater)

Alternative 8 consists of oxidant injection through vertical and possibly horizontal wells into the Gallia and Sunbury formations in the western portion of the plume. The oxidant will be recirculated through wells in the western portion of the groundwater plume extending from the security fence to the east and to Brown Avenue to the west. The injection would be phased over a period of time concentrating on the upgradient contamination first. The injection process would take place over at least a two year period during and after which additional sampling would occur to determine if continuation oxidant injection will be necessary.

The oxidant would also be injected through the existing horizontal wells to attempt to remediate the dissolved phase of the TCE plume extending throughout the area between the eastern horizontal well and the existing collection trench. The collection trench will continue to operate until PRGs are met in the groundwater throughout the plume.

The alternative also includes a phytoremediation component at the eastern most portion of the plume which exists between the existing recovery trench and Little Beaver Creek. Currently, there are numerous trees in the area and phytoremediation may be ongoing. If additional trees are needed, hybrid Poplar trees may be planted in a row(s) perpendicular to the plume such that the roots systems would capture and extract the contaminated groundwater. The additional trees would be planted to enhance the phytoremediation which may already be ongoing.

Alternative 8 was developed in order to address the most recent data regarding TCE concentrations in the groundwater plume.

6.0 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

Under CERCLA, remedial alternatives are required to be evaluated against eight criteria. To select remedial alternatives for the X-701B SWMU, Ohio EPA considered these eight criteria, which are described below.

1. **Overall protection of human health and the environment** addresses whether a remedy provides adequate protection through the elimination, reduction, or control of risks by treatment, engineering controls, or institutional controls.

2. **Compliance with state, federal, and local laws and regulations** addresses whether a remedy will meet all applicable state, federal, and local environmental statutes (ARARs). ARARs include chemical-, action-, and location-specific ARARs.

3. **Long-term effectiveness and permanence** refers to a remedial alternative's ability to protect human health and the environment over time once cleanup goals have been met.

4. **Reduction of toxicity, mobility, or volume of contaminants** through treatment is the anticipated performance of the treatment technologies to either (1) reduce the toxic characteristics of the COCs, (2) remove quantities of COCs to acceptable risk concentrations or regulatory limits, or (3) decrease the ability of contaminants to migrate through the environment.

5. **Short-term effectiveness** involves the period of time needed to achieve protection and considers adverse impacts on human health and the environment that may be posed during the construction and implementation period until cleanup goals are achieved.

6. **Implementability** is the technical and administrative feasibility of an alternative, including the availability of goods and services needed to implement the chosen remedial alternative.

7. **<u>Cost</u>** includes consideration of the capital and O&M costs.

8. **<u>State and local community acceptance</u>** will be assessed in the decision document after review of the public comments received on the RFI report, the CAS/CMS report, and this Preferred Plan.

Alternatives selected reflect the scope and purpose of the actions being undertaken at the X-701B SWMU and how the remedies relate to long-term comprehensive response. The following discussion summarizes how the alternatives address these criteria.

6.1 EVALUATION OF THE EIGHT CRITERIA FOR THE X-701B SWMU

<u>SOILS</u> -

The X-701B Holding Ponds and Retention Basins

1. <u>Overall Protection of Human Health and the Environment</u>

Alternatives 1 and 4 (Soils) - Institutional Controls would not be protective of human health and the environment because it remains unclear if long-term land-use restrictions could be implemented at the SWMU to address all potential exposure pathways including workers. In addition, contaminants are not prevented from leaching into groundwater, creating an exposure pathway for potential future users and potentially lending to migration of contaminated groundwater to Little Beaver Creek.

Alternative 2 (Soils)- Institutional Controls and Removal would be protective of human health and the environment because soil removal is an effective and reliable method to prevent direct contact with affected soil and eliminates infiltration and contaminant transport. This alternative may not meet all remedial action objectives (RAOs) because of the limited amount of soil removed (approximately 3,240 yd^3) and it is unclear if long-term land use restrictions could address all potential exposure pathways including on-site workers.

Alternatives 3 & 6 (Soils) - Institutional Controls, Select Removal and Capping would be protective of human health and the environment. Capping is an effective and reliable method to prevent direct contact with affected soil and eliminate infiltration and contaminant transport into the groundwater. The removal of soil is an effective and reliable method to prevent direct contact with contaminated soils. Alternative 6 would require the re-routing of the drainage lines around the capped area. Both the cap and soil removal will greatly reduce potential exposure of human and ecological receptors. Alternative 3 would not meet the substantive requirements of RCRA becuase the drainage lines would be left beneath the capped area. These Alternatives would meet RAO's.

Alternative 5 (Soils)- Removal and excavation of 31,000 yd^3 of soil would not directly impact ecological receptors or habitat. Control measures such as silt fences, erosion control, and dust prevention would be implemented to ensure that human and ecological receptors and habitat surrounding PORTS would not be adversely impacted. Soil removal is an effective and reliable method to prevent direct contact with affected soil and eliminates infiltration and contaminant transport into the groundwater. Deed and land use restrictions would limit exposure to current and future workers as well as the general public.

Alternative 7 (Soils)- Institutional controls and on-site disposal would eliminate the migration of and surface exposure to contaminants. The constructions of a waste cell and cap would reduce infiltration of surface water and contaminants leaching into the groundwater. Access restrictions (i.e. signs and fences) will control access to selected areas. Institutional controls such as deed and land use restrictions will restrict this area to industrial development only and prohibit development or modification of the capped area.

Alternative 8 (Soils)- Institutional controls, Select Removal and Capping with Piping System relocation would be protective of human health and the environment Alternative 8 would relocate contamination and cap the contaminated soil area. Alternative 8 also includes installation of a piping system to address remediation of groundwater should it be needed. Capping is an effective and reliable method to prevent direct contact with affected soil and eliminate infiltration and contaminant transport. The piping system relocation would prevent surface water from discharing from under the capped area and flow directly into the East Drainage Ditch. The relocation would prevent potential damage to the on site disposal cell and cap should anything happen to the discharge pipe. Access restrictions (signs and fences) will control access to selected areas. Institutional controls such as deed restrictions will restrict this area to industrial development only and prohibit development or modification of the capped area.

2. Compliance with State, Federal, and Local Laws and Regulations

Chemical-Specific ARARs (Soil): Alternatives 1,2 and 4 would not comply with chemical specific ARARs or RCRA ARARs. Alternative 2 would leave some areas of contamination exposed therefore allowing contaminants to continue to migrate into the groundwater. Alternative 3 would comply with the chemical specific ARARs but not the substantive requirements of RCRA (i.e. minimize maintenance) because the surface water drainage will remain beneath the capped area. Alternatives 5, 6, 7,and 8 would comply with all chemical specific ARARs as well as the substantive requirements of RCRA.

Action-Specific ARARs (Soil): Alternatives 2 & 3 would require that all contaminated soils removed be properly disposed of a hazardous waste facility. Alternatives 5, 6 , 7 and 8 would require that all contaminated soil be disposed of properly either on site or at an off site disposal facility. The waste would need to be properly stored on site if no facility is available to take the waste (i.e. LLW).

Location-Specific ARARs: None of the alternatives evaluated would trigger location specific ARARs. Therefore these ARARs are not applicable for this SWMU.

3. Long-Term Effectiveness and Permanence (Soils)

Alternatives 1 and 4 may be effective in reducing exposure of future on-site workers if institutional controls can be maintained in perpetuity. Alternative 4 also relies on deed and land use restrictions to prevent exposure and direct contact with the contaminants. The long term enforceability and resulting reliability of deed and land use restrictions can not be assured. Maintaining this level of institutional controls in perpetuity is problematic. Alternatives 1 and 4 would not prevent potential exposure of ecological receptors or continuing contamination of groundwater.

Alternatives 2 and 5 would be reliable alternatives due removal of contaminants. These alternatives would require operation and maintenance (O&M) efforts to maintain and uphold the integrity of the backfilled area. Alternative 2 leaves contaminants in place outside the capped area therefore the long-term effectiveness and permanence is not assured. Alternative 5 would be more effective in meeting the requirement for long-term effectiveness and permanence due to the amount of contaminated soil removed from the area. This alternative would also require limited

O&M to maintain the regraded area.

Alternative 3 is also expected to meet the long term effectiveness and permanence criteria. This Alternative would require O&M efforts to maintain and uphold the integrity of the backfilled and capped area as well as the drainage pipe below the cap.

Alternatives 6, 7 and 8 are also expected to meet the long term effectiveness and permanence criteria although Alternative 5 does this to a greater degree because the contaminants would be removed from the area. Alternatives 6 & 8 require the re-routing of the surface drainage lines around the capped area. Alternative 8 would require O&M for the installed piping that could be used to address the groundwater contamination should it become necessary. These alternatives would require O&M efforts to maintain the cap. Alternatives 3, 6, 7 and 8 will require the long term O&M of a disposal cell as well as a cap. The alternatives described above would not reduce the contaminant mass but would prevent infiltration of surface water as long as the caps are properly maintained. These alternatives will prevent direct contact with contaminated soil and will reduce contaminant transport.

4. **Reduction of Toxicity, Mobility, or Volume Through Treatment (Soils)**

Alternatives 1 and 4 would not reduce the toxicity, mobility or volume of the soil contaminants because there is not treatment or removal of contaminants. Alternative 2 does not include treatment to reduce toxicity, mobility or volume of contaminated media. A limited amount of contaminants would be removed from the area and no further action would be implemented. Alternative 3 would not include treatment to reduce the toxicity, mobility or volume of contaminated media. Alternative 3 is considered a containment option. Alternative 5 would be considered the most effective in reducing toxicity, mobility and volume since the alternative calls for the excavation and removal of contaminated soil assuming off site treatment occurs. Alternatives 6, 7 and 8 are considered containment options since the contaminants remain on site below an engineered cap. The mobility of contaminants would be reduced via containment due to the lack of contact with precipitation limiting the amount of downward movement of contaminants. Alternative 6 does implement some removal therefore slightly reducing the toxicity, mobility and volume of contaminants in the area if treatment is included.

5. Short-Term Effectiveness (Soils)

Minimal short-term risks to neighboring populations are associated with any of the selected alternatives. Alternatives 1 would pose no short term human exposure risks other than continued risks to on-site workers. Alternatives 2 & 3 would prevent some short term exposure risks to remediation works and current on site workers during construction activities. Exposure could be controlled and greatly reduced by implementation of a site-specific health and safety plan. ALARA principals would be observed to limit and prevents exposure of workers to contaminants.

Alternatives 6 and 8 include site-specific hazards and those commonly associated with general construction projects and use of construction equipment. Alternatives 5 and 7 would present an increased short-term potential hazards to on-site workers, due to significant health physics concerns raised by the necessity of dust control to contain wind-blown radioactive dust from contaminated soil during excavation activities. Alternative 5 presents the greatest short-term potential hazards, since wetting the soil for dust control will need to be minimized for all excavated soil, which will be shipped off-site for disposal. Exposure could be controlled and greatly reduced by implementation of a site-specific health and safety plan. As low as reasonably achievable (ALARA) principals would be observed to limit and prevent exposure of workers to contaminants.

6. Implementability (Soils)

Alternatives 1 and 4 require minimal remedial activities. Alternatives 1and 4 would be the most easily implemented alternatives and would require the least amount of time to implement.

Alternatives 2 and 5 would require removal of the debris and associated soil, and backfilling of the area with clay. The O&M would be minimal and would involve monitoring the integrity of the backfill. The time required to implement Alternative 2 is approximately 9 - 12 months. Alternative 5 will present difficulty in implementation. Extensive planning will be required for the containment of wind blown radioactive dust from excavated soil. Planning will also be required for evaluating off site disposal locations as well as shipment requirements. Alternative 5 would also take 9 to 12 months to implement.

Alternative 3 would require the selective removal of contaminated soil and backfilling of the area with clay. The O&M would require monitoring the integrity of the cap and the backfill. The time required to implement Alternative 3 is approximately 11-15 months.

Alternative 6 and 8 would require the selective removal of soil and capping of the remaining contaminated area. These alternatives are readily implementable. Several caps have been installed on the site and the requirements have been well established. Alternative 8 would require the installation of a piping system in addition to the cap. These alternatives would take between 11 and 15 months to implement. Alternative 8 would take the longest of the two.

Alternative 7 requires the construction of an on site disposal cell and the re-routing of the existing storm sewer. Implementation of alternative 7 would require containment of wind-blown radioactive dust from contaminated soil excavated from this area. A cap is also required for this alternative. The time to implement this remedy would be longer due to these factors. Alternative 7 would take approximately 18 to 24 months to implement.

7. Cost (Soils)

The cost for each alternative is broken down below. Costs are presented in descending order.

Alternative 5 -	Present worth capital Cost	$ 28,267,000
	Present worth O&M Cost	$98,000
	Total Cost	$28,365,000
Alternative 7-	Present worth capital Cost	$ 9,581,000
	Present worth O&M Cost	$98,000
	Total Cost	$9,679,000
Alternative 8-	Present worth capital Cost	$4,391,000
	Present worth O&M Cost	$98,000
	Total Cost	$4,489,000
Alternative 6	Present worth capital Cost	$ 4,343,0000
	Present worth O&M Cost	$98,000
	Total Cost	$4,441,000

Alternative 2:	Present worth capital cost	$4,012,000
	Present worth O&M cost	$ 103,000
	Total Cost	$4,115,000
Alternative 3:	Present worth capital cost	$3,401,000
	Present worth O&M cost	$103,000
	Total Cost	$3,504,000
Alternative 4-	Present worth capital Cost	$229,000
	Present worth O&M Cost	$98,000
	Total Cost	$327,000
Alternative 1:	Present worth capital cost	$ 68,000
	Present worth O&M cost	$ 103,000
		$171,000

8. COMMUNITY ACCEPTANCE

Ohio EPA and U.S. EPA evaluated state and local community acceptance during the public comment period. All comments pertinent to the preferred alternatives were addressed during the public meeting and in the responsiveness summary of this decision document in Appendix IV.

6.2 EVALUATION OF THE EIGHT CRITERIA FOR THE X-701B SWMU (GROUNDWATER)

X-701B Groundwater Plume

The remedial action objectives for the **X-701B Groundwater Plume** are as follows:

(A) Achieve PRGs for groundwater whenever practicable;

(B) Prevent migration of COCs at concentrations exceeding PRGs (human health and ecological) from groundwater to surface water;

(C) Prevent exposure of future off-site residents to COCs in groundwater at concentrations exceeding residential PRGs;

(D) Prevent exposure of on-site workers to COCs in groundwater at concentrations exceeding future on-site worker PRGs.

1. Overall Protection of Human Health and the Environment (Groundwater)

Alternative 1 (Groundwater)- No action--would not be protective of human health and the environment and would not meet any of the clean up objectives for the area.

Alternative 2 (Groundwater)- No further action--includes deed and land use restrictions, in combination with groundwater capture and treatment. This alternative may reduce the likelihood of exposure of current and future on site workers and the general public to contaminated groundwater. This alternative is dependent on the ability to operate and maintain existing remedial measures and to maintain deed and land use restrictions. This alternative would not meet the clean up objectives (PRGs) in this area.

Alternative 3 (Groundwater)- Oxidant Injection, Vacuum Enhanced Recovery/Phytoremediation–deed and land use restriction would greatly reduce the area of groundwater contamination. This alternative would reduce the likelihood of exposure of current and future on-site workers and the general public to contaminated ground water, through the use of active remediation, institutional controls and deed restriction to limit property use. Groundwater monitoring would continue while the remedy is ongoing. However, at the end of a 30 year period, a small area will exceed the PRG for TCE based on the information that was used to develop the groundwater alternatives for the purposes of the development of the Quadrant II CMS report.

Alternative 4 (Groundwater)- VER and Steam Stripping would significantly reduce the levels and area of groundwater contamination. Deed and land use restrictions in combination with VER and Steam Stripping would reduce the potential of exposure of current and future on-site workers and the general public to contaminated groundwater. However, at the end of a 30 year period, a small area will exceed the PRG for TCE based on the information that was used to develop the groundwater alternatives for the purposes of the development of the Quadrant II CMS report. Groundwater monitoring will continue until RAO's are met.

Alternative 5 (Groundwater)- VER would reduce the mass of groundwater contamination in this area. The use of deed and land use restrictions would limit exposure to current and future workers as well as the general public. Groundwater monitoring would continue throughout the entire lifespan of the remedy to ensure that the mass of contaminants continues to decrease. However, at the end of a 30 year period, a small area will exceed the PRG for TCE based on the information that was used to develop the groundwater alternatives for the purposes of the development of the Quadrant II CMS report.

Alternative 6 (Groundwater)- Groundwater Extraction and Bioremediation would decrease the volume of the contaminants in the groundwater. The use of deed and land use restrictions would prevent residential development in this area. Institutional controls would prevent exposure to current and future workers. The PRG for TCE in the Gallia ground water is not expected to be achieved with this technology based on the information that was used to prepare the groundwater model for the purposes of developing the Quadrant II CMS Report.

Alternative 7 (Groundwater) - Oxidant Recirculation through out the entire plume would reduce the total volume of contaminants in the ground water. However, at the end of a 30 year period, a small area will exceed the PRG for TCE based on the information that was used to develop the groundwater alternatives for the purposes of the development of the Quadrant II CMS report. Institutional controls should prevent exposure to on-site workers, and deed restrictions would prevent residential development. The groundwater monitoring program would use existing monitoring wells to monitor flow and transport.

Alternative 8 (Groundwater)- Oxidant Injection/Recirculation in the western portion focusing on the source areas and potentially utilizing the horizontal wells to inject and collect groundwater would reduce the total volume of contaminants in the groundwater. The use of the collection trench may be necessary for several years beyond the 30 year time line discussed in the CAS/CMS report in order to meet the PRGs outlined above. Phytoremediation to the west of the trench will help remediate and remove contaminants in the groundwater especially volatiles, greatly reducing the potential for contaminants to enter Little Beaver Creek. Institutional controls should prevent exposure to on-site workers, and deed restrictions would prevent residential development. The groundwater monitoring program would use existing monitoring wells to monitor flow and transport. This alternative was developed based on the most recent date developed by U.S. DOE.

2. **Compliance with State, Federal, and Local Laws and Regulations (Groundwater)**

Chemical-Specific ARARs: One such ARAR would be for the groundwater to meet PRGs throughout the plume, with the point of compliance being the unit boundary. All of the alternatives evaluated (except the no action) are expected to reduce contaminant levels in the groundwater to some degree. Groundwater Alternatives 3, 4, 5, 6, 7, and 8 are expected to achieve the groundwater remedial goals throughout some of the plume area. Alternatives 7 And 8 are expected to do a better job on minimizing the area of the gorundwater plume that remains above the PRGs.

Action-Specific ARARs: Under alternatives 3, 4, 5, 6, 7 and 8, an action specific ARAR for X-701B is the requirement that VOC - contaminated drill cuttings from installation of extraction or injection wells be disposed of in a solid waste landfill, or if necessary, to a hazardous waste facility. Also, for any alternative which may bring ground waters to the surface for treatment prior to discharge, NPDES permit requirements would apply. Air permits must be obtained for alternatives that utilize VER wells to treat soil and groundwater COCs. Reinjection of contaminated groundwater would require Agency approval. For Alternatives 3-8, such ARARs can be met with proper design.

Location-Specific ARARs: Location-specific ARARs do not apply to the alternatives evaluated for this SWMU. None of the alternatives would have adverse effects on archaeological resources, cultural resources, flood elevations, or critical habitats. No socioeconomic effects are anticipated from implementation of any of the alternatives.

3. **Long-Term Effectiveness and Permanence (Groundwater)**

Alternative 1 would not provide long-term effectiveness and permanence. Alternative 2 depends on institutional controls to prevent exposure of on-site and off-site residents as well as future on-site workers and would not meet PRGs. This alternative is, therefore, less protective in long term compared to Alternatives 3 through 7. Alternatives 3, 4, 5, 6, and 7 would effectively reduce contaminant levels to slightly above PRGs. Alternative 8 would significantly reduce contaminant levels but if groundwater exceeds PRGs after 30 years the collection trench will continue to be operated and maintained. These alternatives also rely on institutional controls to prevent exposure of current on-site workers. In addition, deed restrictions must be maintained to prevent future residential use of this area.

4. **Reduction of Toxicity, Mobility, and Volume through treatment (Groundwater)**

Alternative 1 would not meet remedial action objectives. Alternative 2 would continue the operation of the X-701B IRM Trench, and the existing X-701B extraction system. This alternative would reduce the contaminant toxicity, mobility, and total volume through removal but would fail to meet clean up objectives. Alternatives 3-8 are more active in reducing the toxicity, mobility, and volume of contaminants in the ground water. Although PRGs for TCE in the groundwater may not be fully met within 30 years, these alternatives attempt to eliminate the source of the contamination, therefore limiting the amount of residual contamination.

5. **Short-Term Effectiveness (Groundwater)**

Alternatives that minimize the amount of contaminants in the soil and water that on-site workers could be exposed to through installation of wells and other remedial activities would provide the greatest degree of short term effectiveness. Alternatives 1 and 2 pose fewer risks in the short term because no construction activities are associated with these alternatives. Alternatives 3 through 8 would pose greater risks in the short term because of construction activities. These risks can be minimized through proper work safety procedures.

6. **Implementability (Groundwater)**

All the alternatives evaluated are readily implementable. Alternatives 1 and 2 require no additional remedial activities, would be the most easily implemented and would require the least amount of time to implement.

Alternative 3 uses oxidant injection, VER, and phytoremediation to remove and treat contaminated groundwater. All three technologies are proven and have been implemented in a wide variety of hydrogeologic settings. Time required to implement Alternative 3 is approximately 9-12 months.

Alternative 4 uses VER and Steam Striping to eliminate contamination in selected areas of the X-701B Area Plume during the first two years after implementation. This is followed by groundwater extraction. These technologies have been proven effective at the PORTS site as well as other facilities. This alternative can be implemented in 11-15 months.

Alternative 5 uses VER to eliminate contamination in selected areas of the groundwater plume during the first two years after implementation. This alternative is followed by groundwater extraction. This alternative has been proven effective and can be implemented in 10-12 months.

Alternative 6 uses groundwater extraction and bioremediation to eliminate contamination in the groundwater at the X-701B Area Plume. Bioremediation must still be evaluated to determine if it is a feasible technology to use in this area of the facility. This alternative (if found feasible) could be implemented in 6-12 months.

Alternative 7, Oxidant Recirculation, This alternative uses off the shelf components. Standard drilling and construction equipment will be used and is readily available. Fugitive dust emissions must be considered for all construction activities, and air monitoring would be part of any such activities. This alternative if found feasible could be implemented in 12-18 months.

Alternative 8, Oxidant Injection/ Extraction/Recirculation and Phytoremediation, could be implemented in 12 to 18 months. Standard drilling and construction equipment will be used and is readily available. Fugitive dust emissions must be considered for all construction activities, and air monitoring would be part of any such activities.

7. Cost (Groundwater)

The cost for each alternative is broken down below. Costs are presented in descending order.

Alternative 8	Present worth capital cost	$42,096, 000
	Presents worth O&M costs	$24,547,000
	*Total Cost	$66,643,000
Alternative 4	Present worth capital costs	$10,516,000
	Present worth O&M costs	$16,003,000
	Total Cost	$26,519,000

Alternative 5	Present worth capital costs	$2,348,000
	Present worth O&M costs	$17,665,000
	Total Cost	$20,013,000
Alterative 7	Present worth capital costs	$1,560,000
	Present worth O&M costs	$17,315,000
	Total Cost	$18,875,000
Alternative 6	Present worth capital costs	$2,781,000
	Present worth O&M costs	$15,503,000
	Total Cost	$18,284,000
Alternative 3	Present worth capital costs	$9,167,000
	Present worth O&M costs	$7,218,000
	Total Cost	$16,385,000
Alternative 2	Present worth capital costs	$ 0
	Present worth O&M costs	$10,971,000
	Total Cost	$10,971,000
Alternative 1	No costs are associated with this alternative.	

*The costs for Alternatives 3-7 would be substantially higher had they taken into account the amount of DNAPL contamination as outlined in Alternative 8. Alternative 8 presents a more realistic accounting for the purposes of remedy selection and cost. Requiring U.S. DOE to make revisions to the CAS/CMS for Quadrant II would be expensive, and consume limited U.S. DOE budget dollars that are best used for remediation. Additionally, revisions to the CAS/CMS estimates would take time, and may delay the implementation of a remedy for an additional fiscal year. Please refer to the CMS Report and to Appendix III for an explanation of how the costs for the alternatives were derived.

8. Community Acceptance

Ohio EPA and U.S. EPA evaluated state and local community acceptance during the public comment period. All comments pertinent to the preferred alternatives were addressed during the public meeting and in the responsiveness summary of this decision document.

7.0 OHIO EPA'S SELECTED ALTERNATIVES FOR X-701B SOIL AND GROUNDWATER

Ohio EPA has selected a modified version of Alternative 3 for soils and Alternative 8 for groundwater. Each of these alternatives is briefly discussed below. U.S. EPA has provided Ohio EPA with concurrence for the alternatives presented in this section.

7.1 X-701B Holding Pond and Retention Basins (Soils Only)

Ohio EPA's selected alternative for the X-701B Holding Pond and Retention Basins is a modified version Alternative 3 (Please refer to Figure 7). Alternative 3 consists of Institutional Controls, selective removal of soil, and containment (capping). Institutional controls include the use of deed and land use restrictions. The cap shall be engineered to meet the RCRA Subtitle C substantive requirements as noted in Ohio Administrative Code (OAC) 3745-56-28. Ohio EPA has determined that re-consolidation of soils is preferable in this instance rather than removal. U.S. DOE will consolidate contaminated soil under two caps. One cap will cover the X-701B Holding Pond and the eastern retention basin. The second cap will cover the western retention basin. Contaminated soils in this area beyond the foot print of the caps will be consolidated to fit under one or both caps. Prior to placement of the reconsolidated soil, the bottom of the holding pond will be filled with 8 feet of clean fill and a two-foot recompacted clay barrier, overlain by a flexible membrane liner. The purpose of the barrier layer and liner is to significantly reduce infiltration of contaminants to the ground water. This action will eliminate the need for the U.S. DOE to relocate the storm water drainage pipe located between the eastern and western retention basins as per soil Alternatives 6 & 8. Storm water or discharge pipes are not desirable beneath caps because they may require repair causing significant damage to the cap. Completion of all remedial activities associated with this unit will meet the substantive requirements of RCRA as noted in the Ohio EPA's Directors Findings and Orders for integration Section VI, Paragraph 2. All surface water drainage shall be directed around the caps. Culverts, drainage ditches or process lines shall not be placed under the cap in areas in which waste has come to be placed. Control measures such as silt fences, erosion control, and dust prevention will be implemented to ensure that environmental receptors and habitats surrounding PORTS are not affected by construction activities. All activities required to treat the groundwater and DNAPL beneath the holding pond area and retention basins will be completed prior to installation of the cap.

Alternative 3 as modified by Ohio EPA will provide the best balance of trade-offs considering the criteria used to evaluate the alternatives presented in the CAS/CMS report. This alternative will be protective of human health and the environment in the short and long terms and is considered permanent as long as the integrity of the cap is maintained. U.S. DOE will periodically inspect the cap to ensure that it is performing as required. This alternative also will meet ARARs, be cost-effective, and provide long-term effectiveness. This alternative may be further modified as needed to ensure that the cleanup objectives for the X-701B SWMU are met. Specifics regarding the implementation of the remedy will be completed during the CMI and the design of the cap. Total cost of this alternative as modified is $3,000,000 based on discussion with U.S. DOE. The cost is more than anticipated in the CMS report for Alternative 3, but less than Alternative 8. This is due to the modification of the alternative.

7.2 X-701B GROUNDWATER AREA

Ohio EPA's selected alternative for the X-701B Groundwater Area is a modification of Alternative 8. Alternative 8 was submitted as an addendum to the CAS/CMS report in January 2003. Alternative 8 consists of oxidant injection, and groundwater recirculation in the western portion of the plume where the source area is believed to be located. This area is bounded by the security fence in the east and approximately Brown Avenue to the west (see Figure 8). The primary goal for injecting in this area is to eliminate the source of TCE where recent data suggests that a substantial DNAPL is present within the Gallia and Sunbury formations. Oxidant will be injected in those areas to accomplish that task. Sampling will be performed periodically to determine if the injection of oxidant has been effective and continues to be effective. Current pumping wells will be incorportated into the designs as needed.

The oxidant injection area will focus on the source area for the plume. The oxidant injection shall be performed for the entire thickness of the Gallia, and potentially into the upper Sunbury. Where necessary the oxidant injection may include areas within the Minford in the south west area of the X-701B holding pond. The frequency and number of oxidant applications shall be dependent on the residual COCs in the Minford, Gallia and Sunbury formations. The specific injection locations, number of injection points and the preferred oxidant(s) will be evaluated and determined during the design. Should the sampling results of wells within the source area and the plume indicate the oxidant injection is no longer effective, modifications to the design may be necessary. The criteria for determining when oxidant injection is no longer effective shall be developed in the remedial design. It is expected that the remedy will be operated until PRGs are attained or sooner if Ohio EPA determines that the remedy is no longer effective in removing contaminant mass, and that the selected remedial technology cannot be improved to achieve mass removal.

U.S. DOE will also use the eastern horizontal well to inject oxidant into the plume. The purpose of injecting in this horizontal well is to remediate the portion of the plume which extends eastward from this well (near the security fence) to the interceptor trench. The interceptor trench will be operated and maintained until PRGs are met throughout the plume.

Additional phytoremediation willl be implemented throughout the area between the interceptor trench and Little Beaver Creek if necessary to enhance the phytoremediation that is ongoing. Hybrid Poplar trees will be planted east of the existing groundwater trench, if needed, to enhance the phytoremediation of groundwater. Phytoremediation will remediate any TCE in groundwater which exists beyond the trench and protect Little Beaver Creek from contamination. Deed restriction(s) will be implemented to prevent the use of groundwater for any purpose until remedial action goals are met.

The phytoremediation area will cover approximately 2.1 acres and will include additional planting if needed while U.S. DOE is actively remediating groundwater. Specific details regarding the implementation, schedule and certain aspects of the design of the remedy outlined above shall be evaluated during the Corrective Measures Implementation Plan (CMI) process.

U.S. DOE will continue to operate the collection trench until such time as the remedial goal for TCE in groundwater is met. The active remedy (oxidant injection) will be terminated when PRGs are attained or sooner if Ohio EPA determines that the remedy is no longer effective in removing contaminant mass, and that the selected remedial technology cannot be improved to achieve mass removal. After a minimum of 5 years of operation of oxidation injection, U.S. DOE may petition Ohio EPA for a determination whether the technology is no longer effective, and whether alternative measures or discontinuance of oxidant treatment is warranted. Modifications to this remedy in order to achieve the PRGS may include but are not limited to alternatives discussed in the CAS/CMS report for Quadrant II.

Institutional controls, when enforced, are expected to effectively prevent exposure to people during the time this alternative is in operation. Deed and land-use restrictions will limit future land use, place limitations on excavation depths, and prohibit development of groundwater for use as a potable water supply. The groundwater monitoring program will use monitoring wells to monitor contaminant fate and transport. Groundwater will be monitored at least semi-annually or as needed during the start of the remedial process. The frequency of groundwater monitoring will be evaluated in the approved corrective measures implementation plan, and the monitoring results will be reported in the integrated groundwater monitoring annual report for the X-701B SWMU. The IGWMP will include sampling parameters and frequency. The parameters and frequency of monitoring may change as remediation progresses.

Alternative 8 will provide the best balance of trade-offs considering the criteria used to evaluate the alternatives presented in the CAS/CMS report. Ohio EPA believes that this remedy will be protective of human health and the environment both in the short term and over the long term. This alternative will meet ARARs, be cost-effective, and provide long-term effectiveness. The cost for this remedy as modified is $19,405,000 for the oxidant injection and recirculation and $24, 547,000 for the operation and maintenance of this alternative for 30 years. The total cost of this alternative is $43, 952,000. Please refer to Appendix III for an explanation of the costs. This alternative will meet the required RCRA substantive requirements noted in the Director's Findings and Orders for Integration, Section VI, Paragraph 2, when the RAO's are met for groundwater. The alternative will be evaluated in five years from the date of remedy implementation to determine its effectiveness. For this remedy to be effective, groundwater data in the western portion of the plume must indicate that the source (nonaqueous/nondisolved contaminants) have been removed in a reasonable time frame. This alternative may be modified as needed to ensure that the cleanup objectives for the SWMU will be met.

8. CONCURRENCE

U.S. EPA has provided Ohio EPA with concurrence for all of the selected alternatives for the X-701B SWMU outlined above.